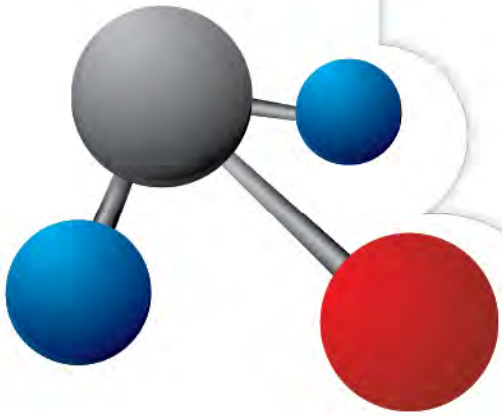
SPRING HARBOR WATERSHED STUDY

CITY OF MADISON, WI



July 2nd, 2025 - THIS REPORT HAS BEEN AMENDED SINCE ITS DATE OF PUBLISH
The Spring Harbor Watershed Study - Amendment 1 (02/26/2025) can be found in Appendix O. Amendment 1 functions to update and supplement this Spring Harbor Watershed Study - Final Report (06/09/2022). Recommendations and updated flood maps presented in Amendment 1 report take precedence over those presented in this original report. For areas that Amendment 1 does not cover (e.g. model development), it can be assumed that those specific details of the Watershed Study were not changed, except where noted.

The City makes no representation about the accuracy of these records and shall not be liable for any damages

Prepared For

June, 2022

AE2S Project #: P13937-2018-001

SPRING HARBOR WATERSHED STUDY

For

Madison, WI

June 2022

Professional Certification

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Wisconsin

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*New Appendices added July 2nd, 2025

List of Abbreviations

1D: One-Dimensional

2D: Two-Dimensional

AC: Acres

AC-FT: Acre-Foot

CAD: Computer Aided Drawing

CFS: Cubic Feet per Second

DEM: Digital Elevation Model

DOT: Wisconsin Department of Transportation

EPA: Environmental Protection Agency

FT: Feet

GPM: Gallons Per Minute

HGL: Hydraulic Grade Line

HSG: Hydrologic Soil Group

LVL: Level

LiDAR: Light Detection and Ranging

NAVD88: National Adjusted Vertical Datum of 1988

NO.: Number

NRCS: Natural Resources Conservation Service

RCB: Reinforced Concrete Box

RCP: Reinforced Concrete Pipe

SQRT: Square Root

SS: Storm Sewer

SWMM: Stormwater Management Model

USACE: United States Army Corps of Engineers

USGS: United States Geological Survey

WDNR: Wisconsin Department of Natural Resources

WWI: Wisconsin Wetland Inventory

1. Executive Summary

1.1 Background

Recognizing the changing rain patterns, and likelihood of more frequent future large rain events, the City of Madison (City) is conducting a multi-faceted approach to address stormwater flooding. As one component of that approach, the City is developing comprehensive stormwater management studies for each watershed within the City. The studies are conducted in two phases. Throughout both phases, the City incorporates multiple opportunities for public involvement and interaction.

Phase 1: Development of a hydrologic/hydraulic stormwater runoff model representing the physical and drainage properties of the watershed under existing conditions. The model is then calibrated to measured runoff events and used to identify the areas of the watershed most likely to flood under various rain conditions.

Phase 2: Using the model, evaluate alternative methods and/or infrastructure improvements to eliminate, or reduce flooding impacts from large rain events.

This document reports the methods, procedures, and results of the Spring Harbor Watershed Project. The project area covers approximately 2,390 acres (3.7 square miles) on the west side of the City.

Figure 1 shows the extent of the project area**.**

1.2 City's Flood Mitigation Targets

The analyses conducted for the watershed studies referred back to the City's flood mitigation targets to understand where targets were being met and where there is room for improvement. The City has the following flood mitigation targets. Please note, these targets may change in the future as more information becomes available.

A. No surcharging onto the street for up to the 10-year (10% chance event) design storm
B. Centerline of street to remain passable during 25-year (4% chance event) design storm with no more than 0.2 feet of water at the centerline
C. No home or business will be flooded during the 100-year (1% chance event) design storm.
D. Enclosed depressions to be served to the 100-year (1% chance event) design storm.
E. Greenway crossings at streets to be served to the 100-year (1% chance event) design storm.
F. Safely convey stormwater during the 500-year (0.2% chance event) design storm event.
G. Provide flooding solutions that do not negatively impact downstream properties.

1.3 Existing Conditions Results

The existing conditions analysis found the following when compared to the City's flood mitigation targets:

A. Of the 21.9 miles of storm sewer evaluated during the study, approximately 18% of them surcharge during the 10% chance event, thus not meeting the target. Of the 1123 storm inlets evaluated during the study, 40% of them do not have adequate capacity during the 10% chance event.
B. Of the 68 miles of streets evaluated in the study, approximately 35% (23.5 miles) of them have more than 0.2 feet of water at the centerline during the 4% chance event, thus not meeting the target.
C. Of the 3,294 structures included in the watershed, approximately 334, or 10% are at risk of flooding during the 1% chance event, thus not meeting the target.
D. Of the 0 enclosed depression evaluated during the study, 0% are not served to the 1% chance event, thus meeting the target.
E. Of the 10 greenway crossings evaluated during the study, 100% are not served to the 1% chance event, thus not meeting the target.
F. The 0.2% chance event was not explicitly evaluated during this study, however, the results of Section 12 (where the 0.2% chance event was evaluated) indicate there are areas within the watershed that do not meet this target.

1.4 Proposed Solutions and Costs

Following the existing conditions analysis, an extensive process was conducted to brainstorm, evaluate, and ultimately identify solutions to meet the City's flood mitigation targets. The following table lists the solutions that were selected, along with estimated design and construction cost for each. Figures depicting each solution can be found later in this report.

Table 1.1 Proposed Improvements: Opinions of Probable Cost

Solution	Cost
West Towne Pond Expansion	$3,652,100
Kenosha Greenway	$1,652,700
Masthead Greenway Ponds	$2,641,600
Gettle Avenue Box Storm Sewer	$9,112,000
Glen Oak Hills Park Greenway	$1,789,900

Owen Park Channel and Floodwall (along Forsythia Cunnette)	$4,868,200
Nautilus Drive Box Culvert Greenway Crossing	$1,151,900
Inner Drive Box Culvert Greenway Crossing	$773,600
Jetty Drive Box Culvert Greenway Crossing	$530,600
Masthead Drive Box Culvert Greenway Crossing	$896,300
Yellowstone Drive Box Culvert Greenway Crossing	$727,300
Quarterdeck Drive Box Culvert Greenway Crossing	$661,400
Regent Street Box Culvert Greenway Crossing	$886,900
Local Storm Sewer Improvements	To Be Determined with Street Improvement Projects

1.5 Proposed Solutions Results

As the proposed solutions were being evaluated, they were compared to the flood mitigation targets. The proposed conditions analysis found the following when compared to the City's flood mitigation targets:

A. Of the 27.1 miles of storm sewer evaluated during the study, approximately 0% of them surcharge during the 10% chance event, thus meeting the target. Inlet capacity was not analyzed in the proposed solutions. It is assumed that sufficient inlet capacity will be determined during the design phase of the project. (Note: the proposed solutions pipe length exceeds the existing pipe length due to pipe added for the solutions)
B. Of the 68 miles of streets evaluated in the study, approximately 0.4% (.24 miles) of them have more than 0.2 feet of water at the centerline during the 4% chance event, resulting in 99.6% meeting the target.
C. Of the 3,294 structures included in the watershed, approximately 10 primary structures, or 0.3% are at risk of flooding during the 1% chance event, resulting in 99.7% meeting the target.
D. Of the 0 enclosed depression evaluated during the study, 0% are not served to the 1% chance event, thus meeting the target.
E. Of the 10 greenway crossings evaluated during the study, 0% are not served to the 1% chance event, thus meeting the target.
F. The 0.2% chance event was not explicitly evaluated during this study, however, the results of section 12 (where the 0.2% chance event was evaluated) indicate there are areas within the watershed that still would not meet this target.

There are still locations where the flood mitigation targets are not met. The targets cannot be met for various reasons including lack of physical space, topographic relief limitations, and land use change concerns. Detailed information can be found in Section 11 of this report.

Figure ES- 2 depicts the flood control summary within the watershed with the selected solutions implemented. It shows surface flooding locations under the 4% change storm event and how the performance of the improved stormwater conveyance system compares to City's flood mitigation targets with the selected solutions in place.

2. Introduction

2.1 Project Background and Purpose

In response to the 2018 summer floods, the City of Madison initiated a City-wide focus on identifying and addressing issues within the urban drainage system. This includes creating comprehensive watershed plans for watersheds throughout the City, including the Spring Harbor watershed.

This report documents the analysis and results for existing conditions for the Spring Harbor watershed.

2.2 Scope of Study

The scope of work includes:

- Review of existing data;
- Support to a data collection plan;
- Public engagement;
- Development and calibration of an existing conditions XP-STORM model;
- Execution of the existing conditions model;
- Evaluation of flood mitigation alternatives;
- QA/QC of other watershed models; and
- Documentation.

This report documents the development and calibration of the existing conditions Spring Harbor watershed model and proposed solutions for the watershed. Volume control infrastructure is being analyzed separately.

2.3 Historic Flooding in Watershed

There are several locations that have a documented history of flooding within the Spring Harbor watershed. These locations have been grouped in three categories that are a qualitative assessment of how frequently flooding occurs at the locations:

- Frequent – Assigned to locations where there have been several documented instances of flooding in the past.
- Rare – Assigned to locations that have had at least one or two documented instances of flooding in addition to the August 2018 flood storm.

- August 2018 Flood – Assigned to locations that flooded in the August 2018 flood, but there are no other documented instances of flooding at the location.

Figure 8 illustrates where these locations are within the Spring Harbor watershed. It should be noted that these locations are not an exhaustive list of where flooding has or could occur; only the ones that have been documented by the City or reported through the City's Flood Reporting tool. A summary of these locations along with the qualitative flooding frequency assessments is listed below:

- Frequent
    - Overtopping of Quarterdeck Drive from City greenway
    - Oakwood Village drainage issues
    - Overtopping at Jetty Drive and grate clogging
    - Flooding along Crestwood Place
    - Flooding along Burnett Drive
    - Bordner Park channel flooding and inlet clogging
    - Street flooding on Gettle Avenue
- Rare
    - Overtopping of South Yellowstone Drive from City greenway
    - Owen Park discharge channel washouts
- August 2018 Flood
    - Flooding of properties adjacent to Garner Park
    - Flooding south of West Towne Ponds along Odana Road
    - Flooding north of West Towne Ponds along Mineral Point Road Between S. Gammon Road and Grand Canyon Drive
    - Flooding at the intersection of Odana Road and Grand Canyon Drive
    - Swale failure behind Dogwood Place resulting in street conveyance
    - Swale failure behind Elder Place resulting in street conveyance
    - Swale failure behind Forsythia Place resulting in street conveyance
    - Flooding at Memorial High School
    - Walking path flooding behind Knoche's Market and Butcher Shop
    - Flume failure, erosion, and culvert overtopping south of Bordner Drive
    - Culverts and channel washout at Regent Street greenway crossing

The August 2018 flood caused significant damage throughout the Spring Harbor watershed. Reported flood damage locations and amounts (in dollars) are also shown in ***Figure 8***.

Finally, residents provided information in the Focus Groups (***Appendix F***).

2.4 Flood Mitigation Goals

The following flood mitigation goals have been established by the City of Madison:

1. No home or business will be flooded during the 1% Chance Storm.
2. Eliminate flooding from the storm sewer system for up to the 10% Chance Storm; all water shall be contained within the pipes and structures (exception: low points).
3. Allow no more than 0.5 feet of water above storm sewer inlet rim at inlet-restricted low points for up to the 10% Chance Storm.
4. Centerline of street to remain passable during 4% Chance Storm with no more than 0.2 ft of water at the centerline.
5. Enclosed depressions to be served to the 1% Chance Storm (which can include safe overland flow within street, easements, greenways or other public lands).
6. Greenway crossings at streets to be served to the 1% Chance Storm.
7. Provide flooding solutions that do not negatively impact downstream properties.

It should be noted that the focus of the Watershed Study is on the capacity / deficiencies with City-owned infrastructure and rights of way and that the Watershed Study should be considered a "planning-level" analysis. Therefore, there are several limitations to the study that are documented further in ***Section 7.2***.

2.5 Summary of Past Studies

While there have been numerous site-specific stormwater management plans and design analyses associated with street reconstruction projects, there are no large-scale past drainage studies within the Spring Harbor watershed.

The site-specific stormwater management plans were incorporated into the Watershed Study, as appropriate. Design information for street storm sewer was input to the model based either on the City's GIS database, design plans obtained from the City, or survey data.

3. Water Resources Inventory

3.1 Study Setting

The Spring Harbor watershed is located on the west / near west side of the City of Madison as shown in ***Figure 1***. Generally, the watershed extends from west of High Point Road south of the Beltline to Spring Harbor along Lake Mendota east of University Drive. Prominent features within the watershed include:

- West Towne Mall
- Memorial High School
- Market Square Shopping Center
- Oakwood Village Retirement Community
- Portions of Research Park
- Owen Park
- University Row Development

3.2 Watershed

The Spring Harbor study area is just shy of 2,400 acres (3.75 square miles). The study area includes the 2,260-acre Spring Harbor watershed which drains to the northeast before ultimately discharging into Lake Mendota and an additional 130 acres of the McKenna / Greentree watershed that partially drains the West Towne Ponds to the south during high-stage events (***Figure 1***).

The Spring Harbor watershed is bounded by the major watersheds listed below. All of these watersheds have ongoing Watershed Studies at various stages, which are also noted relative to the Spring Harbor Watershed Study).

- Strickers/Mendota and Pheasant Branch to the North / Northwest (same / similar timeline as Spring Harbor Watershed Study);
- Willow Creek to the west (Begins early 2020 lagging Spring Harbor Watershed Study by about a year);
- Wingra West to the southeast (same / similar timeline as Spring Harbor Watershed Study); and
- McKenna / Greentree to the south (Began mid-2019, lagging Spring Harbor Watershed Study by about 6 months).

Because Strickers/Mendota, Wingra West, and Pheasant Branch are on similar timelines as Spring Harbor Watershed Study, effort was made between the four studies to create a consistent boundary between these. Willow Creek will likely use the eastern boundary of the Spring Harbor watershed to create a consistent boundary on that side. Because there is overlap between Spring Harbor and McKenna / Greentree (discussed further below), there are minor discrepancies in the boundaries, but these discrepancies do not have an impact on the overall conclusions of either study.

As noted above, the Spring Harbor Watershed Study includes the portion of the McKenna / Greentree watershed that contributes to Watts Road, which totals about 130 acres. The reason this adjacent watershed was included in the Spring Harbor watershed is that there is a 48 to 66" storm sewer that interconnects the West Towne Ponds with the McKenna Watershed under the Beltline, and an accurate (and dynamic) boundary condition was needed for the West Towne ponds. Further, during extreme flooding, the bike path underpass at the Beltline can also provide a supplementary interconnect with the McKenna / Greentree watershed.

Because the timing of the Spring Harbor Watershed Study preceded the McKenna / Greentree Watershed Study, the Spring Harbor existing conditions analysis was completed well ahead of the McKenna / Greentree existing conditions analysis. Therefore, there are likely differences between the McKenna / Greentree analysis included in the Spring Harbor Watershed Study and the McKenna / Greentree analysis included in the yet-to-be-completed McKenna / Greentree Watershed Study. If results within the McKenna / Greentree watershed differ between the Spring Harbor Watershed Study and the McKenna / Greentree Watershed Study, the McKenna / Greentree Watershed Study should be used.

3.3 Topography

The following data sources were used for topography within the watershed. Topographic data was needed for both delineating subwatersheds and defining overland flow paths / channels).

- 2017 City of Madison Light Detection and Ranging (LiDAR) Digital Elevation Model (DEM) and 1-foot contours generated from that DEM;
- Construction drawings provided by the City;
- Nautilus ponds and the future Gammon Road corridor design surfaces;
- Survey collected by the City April-June 2019 and Fall 2021; and
- Site observations performed by AE2S Staff.

3.4 Drainage Systems

Because the Spring Harbor watershed is fully developed, the entire drainage system has been built or altered. The major drainage system is comprised of regional stormwater ponds (namely

West Town ponds), large storm sewer / culverts, and greenways. Greenways are open water channels in the City design for stormwater conveyance. The major system is supplemented by the minor drainage system, which consists of street storm sewer, street surface flow, and smaller open channels.

The overall drainage system is shown schematically in ***Figure 1***.

3.5 Runoff Conditions

3.5.1 Land Use

Figure 2 shows the existing land use for the watershed.

Existing land use consists mainly of commercial, institutional, and high-density residential in the southwest and northeast corners of the watershed corresponding to major transportation corridors. Single-family residential land use, parks, and greenways are located throughout the central portion of the watershed.

3.5.2 Impervious Area

Figure 3 shows the total impervious area by land use. Total impervious area for this study was obtained from two different sources:

- Streets and non-single-family residential impervious area: City of Madison impervious approximation coverage layer.
- Single-family residential land use: City's stormwater utility database containing impervious area by lot.

3.5.3 Soils

Figure 5 shows the Hydrologic Soil Group (HSG) classifications throughout the watershed. Most soils in this study area are HSG C, with areas of HSG C/D along the drainageways and depressions and a small portion of HSG B on the northeast and southwest edges of the watershed. For this study, any split HSG soils were assumed to be in their higher runoff condition.

3.5.4 Wetlands

Figure 5 shows the Wisconsin Wetland Inventory (WWI) information within the Spring Harbor watershed, which shows wetlands likely exist within Kettle Park pond, Garner Park, West Towne ponds, and a few private developments. While a WWI wetland classification does not require a unique modeling approach, it is important to understand the presence of wetlands when reviewing the feasibility of potential improvements.

It should be noted that the WWI is not an exhaustive inventory of wetlands within the system, and that any construction project will need to do a desktop and/or field delineation of wetlands meeting both WDNR and USACE standards to determine whether wetlands do indeed exist.

4. Guidance and Data Sources

4.1 Model Guidance Documentation

The latest available Modeling Guidance Document that was available during model development was in draft form, which was the modeling guidance used to develop the existing conditions calibrated model (***Appendix A***). Differences between the existing conditions modeling approach and the Modeling Guidance are noted in this report.

All elevations listed in this report are relative to National Adjusted Vertical Datum of 1988 (NAVD88) unless otherwise noted.

4.2 Data Sources

The following is a list of data used in this analysis:

- City of Madison 2017 LiDAR DEM;
    - The DEM was used to create the two-dimensional (2D) surface within the model. The DEM therefore includes channels that exist within the watershed by defining their geometry as part of the surface within the model.
- City of Madison 2018 Aerial imagery;
- NRCS Soils Data for Web Soil Survey (Published 09-11-2018);
- Existing 2019 impervious surface approximation from City;
- Existing impervious disconnection approximated using WinSLAMM Land use designation based on 2015 Dane County Landuse cross-linked to 2016 WinSLAMM Standard Landuse Files;
- Existing storm sewer, Inlet, and structure data from City GIS database;
- Parcel Data from the City;
- Various construction drawings provided by the City;
- Nautilus ponds and Gammon Road corridor design surfaces provided by the City of Madison on 5/28/19;
- Survey collected by the City April-June 2019 and fall 2021;
- Impervious characterization per land use provided by Brown and Caldwell in an excel table corresponding to WinSLAMM standard land use files;
- Site observations performed by AE2S Staff;

- Input obtained through the Focus Groups (***Figure 9*** and ***Appendix F***);
- Improvement constraints provided as a GIS shapefile by the City;
- Unit rates for cost estimates provided by the City;
- Monitoring data collected by City and USGS including:
    - USGS Gage No. 05427965 at Spring Harbor box storm sewer
        - Realtime data downloaded from USGS website
        - Site visit to gaging site on August 8, 2019
        - Various correspondence with USGS staff on information used to develop rating curve.
    - USGS Gage No. 430356089293601 at South Yellowstone Drive storm sewer
        - Realtime data downloaded from USGS website or provided by USGS via email correspondence
    - USGS Gage No. 430338089295701 at detention pond outlet at Memorial High School
        - Realtime data for calibration events provided by USGS via email correspondence
    - Trimble Sites
        - Bordner Park Channel LVL
        - Hill Drive SS FLOW
        - Memorial Pond South LVL
    - Rainfall data
        - USGS Gage No. 05427965 at Spring Harbor box culvert
        - USGS Gage No. 430356089293601 at South Yellowstone Drive storm sewer
        - USGS Gage No. 430338089295701 at detention pond outlet at Memorial High School
        - USGS Gage No. 430358089281901 at South Kenosha

5. Model Development

5.1 Modeling Software

The hydrologic and hydraulic routing analysis was carried out using XP-STORM, which is a proprietary version of EPA-SWMM. The only difference between XP-SWMM and XP-STORM is that XP-STORM does not include the sanitary sewer portion of XP / EPA SWMM. Since the focus of this study is purely stormwater flows, XP-STORM and XP-SWMM are the same model framework, and one model can be run in either platform.

The version of XP-STORM that was used was XP-STORM 2019.1.2. Both the 1D node-link and 2D surface terrain features of XP were used for this study.

5.1.1 Modeling Approach

The one-dimensional (1D) portion of the model only includes subsurface drainage systems (storm sewer and culverts) and their connection to the surface drainage system, which was modeled entirely in two dimensions (2D). Additional detail on the 2D portion of the hydraulic model development is included in ***Section 5.4***.

5.2 Rainfall Files

Two different rainfall data sources were needed for this study:

- Design rainfall distributions, and
- Measured rainfall data for model calibration.

5.2.1 Design Rainfall % Chance Storm

The MSE 24-hour rainfall distribution with NOAA Atlas 14 rainfall depths was used for event-based modeling. ***Table 5.1*** lists the design depths used in the analysis. In addition to the % Chance Storms listed below, a back-to-back 1% Chance Storm was also run (13.2 inches in 48 hours), which would be more severe than a 0.1% Chance Storm (1 in 1,000 chance probability) for that duration.

Table 5.1 NOAA Atlas 14 Design Storm Rainfall Depths

Rainfall Duration	50% Chance Storm (inches)	20% Chance Storm (inches)	10% Chance Storm (inches)	4% Chance Storm (inches)	2% Chance Storm (inches)	1% Chance Storm (inches)	0.2% Chance Storm (inches)
24-Hours	2.8	3.5	4.1	5.0	5.7	6.6	8.8

5.2.2 Measured Rainfall Storms

Rainfall and monitoring data were collected across the west side of Madison between June and October 2019 to support the west side watershed studies. Using Theissen polygons, the Spring Harbor watershed was divided into four separate regions corresponding to four separate rain gages (***Table 5.2***). Although the City installed a rain gage at Owen Park, data collected from this location was not successful and, therefore, excluded from the analysis.

Appendix H summarizes the respective rain gage assigned to each subcatchment.

Table 5.2 Rain Gage Location for the Spring Harbor Watershed

Gage Location	Operated By
Spring Harbor	USGS
East Kenosha	USGS
Yellowstone	USGS
Memorial	USGS

Calibration storms were selected in coordination with City staff and the other Watershed Study project teams that were scheduled on a similar timeline. The storm selection criteria focused on largest storms with the most complete rainfall station records during the monitoring period. The approximate "average" duration and depth were compared to % Chance Storm -recurrence interval based on NOAA Atlas 14 Volume 8 Version 2 data. The total depth, total duration, and approximate recurrence interval for the three selected calibration storms are summarized in ***Table 5.3.***

Table 5.3 2019 Calibration Storm Rainfall Summary

Storm	Spring Harbor Raingage (inches)	Kenosha Raingage (inches)	Yellowstone Raingage (inches)	Memorial High School Raingage (inches	Approximate Average Duration (hours)	Approximate Recurrence Interval (NOAA Atlas 14)
July 18-20	2.55	2.73	2.35	2.50	58.7	100% Chance Storm
August 11	0.91	1.03	1.53	1.58	4.8	100% Chance Storm
October 1-2	3.27	Error in Gage	3.12	3.00	46.9	Between 50%-100% Chance Storm

In addition to the three calibration storms, the August 2018 flood was evaluated based on Weather Underground data, which are summarized in ***Table 5.4*** below.

Table 5.4 August 2018 Validation Storm Rainfall Summary

Storm	KMMADIS50 Raingage (inches)	KMMADIS87 Raingage (inches)	KMMADIS202 (inches)	KMMADIS138 (inches)	Approximate Average Duration (hours)	Approximate Recurrence Interval (NOAA Atlas 14)
August, 2018	11.98	6.8	10.28	10.08	15.5	0.05%-0.033% Chance Storm

5.3 Hydrologic Model Development

5.3.1 Methodology

Subcatchment runoff was computed using EPA SWMM runoff routing methodology with Horton infiltration parameters. While there are numerous other modeling approaches that would also produce reasonable results, this approach was selected in coordination with the City and other watershed study project teams.

It should be noted that the City's stormwater regulatory framework is based on NRCS runoff methodology (Curve Number and Time of Concentration). While the EPA SWMM method and NRCS method produce somewhat different results, the focus of these watershed studies at this time is in already-developed portions of the City, so the overlap between the City's stormwater regulatory program and this watershed study will be minimal.

5.3.2 Subwatershed Input Data

5.3.2.1 Level of Detail

Subwatersheds (or subcatchments) were delineated to a level of detail such that subwatersheds:

- Contributed to each group of inlets along a street or at an intersection;
- Corresponded to level of detail for the modeled storm sewer system (discussed later in ***Section 5.3***);
- Contributed to points along long stretches of streets with no existing storm sewer, such that the model could demonstrate whether new storm sewer would need to be extended further up the street.

This approach is consistent with the Modeling Guidance referenced in ***Section 4.1***.

5.3.2.2 Input Data

Appendix B contains input data for each subwatershed. The list below provides a summary overview of the input parameters and how they were calculated for use in the "pre-calibrated"

model recognizing that parameters would potentially need to be adjusted as part of the calibration process.

- Subwatershed Area – calculated using GIS. A total of 471 subwatersheds were delineated for this watershed with areas ranging from 0.1 to 28.7 acres, with a median size of 3.9 acres.
- Impervious / Pervious Area
    - Total Impervious Area – Calculated as described in ***Section 3.5.2***.
    - Directly-connected impervious area, often associated with streets, driveways, parking lots, and rooftops for high-density land uses – fraction of total impervious area calculated from WinSLAMM Standard Land Use files.
    - Indirectly-connected impervious area, often associated with single-family residential rooftops – fraction of total impervious area calculated from WinSLAMM Standard Land Use files.
    - Pervious area, corresponding to lawns, terraces, parks, and greenways.

  The split between directly and indirectly connected impervious area was made using the City WinSLAMM standard land use files provided by the City. ***Figure 4*** shows percentage of indirectly-connected impervious area by land use.

  Internal subwatershed routing was used as follows:

    - Directly-connected impervious area assigned as subcatchment 1 and routed to subwatershed outlet.
    - Indirectly-connected impervious area assigned as subcatchment 2 and routed to pervious area.
    - Pervious area assigned as Subcatchment 3 and runoff (including run-on from Subcatchment 2) routed to subwatershed outlet.
- Subwatershed width was generally calculated using equation below, which provided a reasonable estimate of a manually calculated subcatchment width based on spot checks throughout the Spring Harbor watershed.
    - Width = 0.7 * SQRT(Area)

      Width was assigned the same for each of the three subcatchments described above (directly connected impervious area, indirectly connected impervious area, and pervious area).

- Slope for the subwatershed was computed using the LiDAR DEM and computed as the average percent slope within the subwatershed. The same slope was assigned to all three subcatchments. Subwatershed slopes range from 1.7% to 20.1%, with a median of 7.7%.
- Infiltration parameters were assigned as an area-weighted average of the different HSG soils within a subwatershed. Horton infiltration parameters for each soil HSG were taken from the Modeling Guidance Document referenced previously.
- Antecedent runoff conditions were assumed to be average, consistent with standard engineering practice. The initial Horton infiltration rate was set accordingly.
- Depression storages for impervious and pervious areas were set consistent with the Modeling Guidance referenced previously.
- Runoff routing destination / receiving node – All subwatersheds were routed to surface nodes to begin inundation on the surface. Receiving nodes fall into three categories:
    - "Orphan" nodes are nodes where no storm sewer currently exists, but runoff to the 2D surface is needed to accurately reflect the potential inundation / flooding risk.
    - Surface nodes connected to a group of aggregated inlets (modeled as a weir – discussed in more detail in ***Section 5.4.3***.
    - Surface node that is the upstream end of a culvert or storm sewer system.
- Internally-drained areas were modeled with a corresponding subcatchment with the storage modeled in the 2D hydraulic portion of the model.

5.4 1D Hydraulic Model Development

5.4.1 Level of Detail

The Modeling Guidance referenced previously requires that the level of detail for the 1D hydraulic model include:

- Public system
    - Standard: 18" pipes (or equivalent) and larger
    - Process for exceptions: Provide justification for reason that the pipe does not need to be modeled in order to evaluate the system relative to the City's Flood Mitigation Goals that are outlined in Modeling Guidance.
    - Process for requiring inclusion of smaller pipes: Necessary when they are the only pipes draining a part of the public system.

- Private system
    - Standard: Not included.
    - Process for requiring inclusion of private pipes: Necessary for modeling stormwater detention facilities or when they are a major part of the system (e.g., West Towne Mall parking lot drainage).

Appendix D illustrates the system that is included in the model relative to the standards outlined above.

Recognizing that the storm sewer level of detail does not require modeling every pipe, every inlet was not modeled individually. Rather, inlets were aggregated into groups as described further in ***Section 5.4.3***.

5.4.2 Hydraulic Conveyance System Analysis

All storm sewer and culverts were modeled with inputs consistent with the Modeling Guidance referenced previously. Inverts, pipe sizes, pipe types, and pipe shape were input from a variety of sources as outlined in ***Section 4.2***. Where conflicts in data sources existed, the most reliable data source was used.

While existing conditions reflects the condition of the system as it exists at the time of the study, there are two improvements that are either currently under construction or in the design phase that are reflected in the existing conditions analysis, which are as follows:

- Gammon Road improvements from the Beltline to Mineral Point Road – This is a DOT project that is currently under design. Input information for the surface was obtained from the DOT via a CAD terrain surface. Storm sewer data was extracted from CAD and preliminary design sheets.
- Nautilus Pond project – This is a City project that is currently under construction. Input information for the surface was obtained via a CAD terrain surface. Pond inlet and outlet structures were obtained from final design sheets.

Because XP-SWMM/STORM does not allow a surcharge pressure prior to popping a solid manhole lid off its base, all nodes representing either manhole lids or blind storm sewer tees were set as sealed. Surcharging of the storm sewer system onto the 2D surface if the storm sewer hydraulic grade line exceeds the ground surface is allowed through the simplified inlets described ***Section 5.4.3*** below.

5.4.3 Inlet Capacity Analysis (Existing Conditions Only)

5.4.3.1 Approach

Because surface flooding can be controlled either by storm sewer capacity, inlet capacity, or a combination of the two, the modeling approach must include inlet capacity in some manner.

To provide a similar level of detail for the inlet modeling approach as the storm sewer level of detail, inlets were simplified and aggregated into a single combined inlet on a one-per-subwatershed basis. The inlet capacity analysis was only completed for existing conditions, as the overall proposed conditions approach assumes that sufficient inlet capacity is added such that the storm sewer is the controlling factor for surface flooding, recognizing that continuous grade inlets can never be 100 percent efficient at capturing surface runoff.

The simplified inlets were modeled as weirs that connect a surface node whose invert is connected to the 2D surface and a storm sewer node. Weirs were selected as the modeling approach for the following reasons:

- Allows both positive and negative flow through the weir to allow flow from the 2D surface into the storm sewer system and vice versa.
- Simplified approach that is a reasonable representation of capacity at modest depths recognizing that at deeper depths, the weir equation would overpredict capacity. However, in the design condition, the City's Flood Mitigation Goals described in the previously referenced Modeling Guidance require that street flooding depths be relatively modest.
- While XP-SWMM/STORM allows negative flow through a rating curve, other SWMM platforms do not. Since the study began with a different SWMM modeling platform (InfoSWMM), rating curves were not used.

The weir length for the combined inlet was set based on the sum of the weir length that would correspond to the inlet type as noted in the GIS database. For example, a Neenah R-3067 inlet (2 x 3) would have a length of 7 feet (2 feet along each side and 3 feet along the street). The weir length was then reduced based on the factors outlined in the Modeling Guidance. For continuous slope inlets, the slope was estimated from the LiDAR DEM.

Appendix E contains an extensive table noting which physical inlet was assigned to each aggregated inlet.

From a performance standpoint, inlet capacity limitations that cause the system to not meet the 10% Chance Storm flood mitigation goals were evaluated using the following approach:

- Flooding along the curb line was reviewed to determine where the flooding depth at the curb line exceeded 0.5 feet.
- In areas where the curb flooding depth exceeded 0.5 feet, the storm sewer hydraulic grade line (HGL) at manholes was compared to the rim elevation at the same manholes.
- If the storm sewer HGL exceeded the rim elevation, flooding that exceeds the flood mitigation goal is controlled by storm sewer capacity; however, if the storm sewer HGL is below the rim elevation, flooding that exceeds the flood mitigation goal is controlled by inlet capacity.

- Conversely, if flooding along the curb line is less than 6 inches, that portion of the storm sewer system meets the flood mitigation goal.

5.4.3.2 Public System

Inlets that are part of the public system (i.e., street right-of-way) were grouped such that the combined inlet represented a particular location in the street. For example, inlets at a single intersection were modeled as a single, simplified inlet that reflects the combined capacity of the inlets at the intersection. Similarly, inlets on opposite sides of the street were modeled as a single, simplified inlet that reflects the combined capacity of both inlets.

Naming convention for public / street right-of-way inlets are "#-CTY-Subcatchment ID". For example, 1-CTY-ME02-A-0045-A-012 represents the first grouping of City inlets in subcatchement "ME02-A-0054-A-012". If a second grouping of inlets were to be modeled within the same subcatchment, the first digit in the ID would change from "1" to "2".

Within the Spring Harbor watershed, there are 1,196 street inlets in the GIS database, which were then modeled with 304 aggregated inlet weirs.

5.4.3.3 Private System

While much of the private storm sewer system was ignored in this study, ignoring the inlet capacity of the private system would underestimate the overall system's ability to direct runoff into the storm sewer system. Therefore, whenever a subcatchment had more than 5 or more private storm sewer inlets, these inlets were modeled as a separate weir into the storm sewer system. Since the GIS data lacked dimensions for the private inlets, each inlet was modeled with a nominal (assumed) weir length of 4 feet.

The naming convention for these inlets are the same as the street right-of-way inlets, except that "CTY" is replaced with "PVT".

5.4.4 Detention Pond Analysis

All public and private stormwater detention ponds were included in the analysis. To simplify the flood inundation mapping process, storage for all stormwater detention facilities were modeled using the 2D terrain. Outlet structures were input based on information from City-provided drawings, GIS database, survey, and field visits.

5.4.5 1D Tailwater Conditions

Outfalls to Lake Mendota were set per the Modeling Guidance (851.1 NAVD88). The outfall going south to the McKenna/Greentree greenway was modeled in 2D, so no 1D outfall was needed at this location.

5.5 2D Hydraulic Model Development

5.5.1 2D Modeling Area

As described previously, the entire surface drainage system was modeled in 2D.

5.5.2 2D Terrain Data

The LiDAR DEM was used for the 2D terrain with the following changes:

- Gammon Road design surface from Beltline to Mineral Point Road
- Nautilus pond and drainage channel design surface

It should be noted that the LiDAR DEM for wet detention ponds (such as West Towne ponds) reflect the pond water level and not the true ground surface. However, the LiDAR DEM did not need to be edited to accurately model these systems.

Further, as part of the City's survey data collection effort, the City collected some channel cross sections along the greenways. However, given the complexity of the drainage channels through the greenways, "burning" these cross sections through the entire greenway was not feasible. Therefore, the original LiDAR DEM was used to generate the greenway terrain unless noted above.

5.5.3 2D Grid

For most results reported in this study, a grid cell size of 15 feet (with 3-second base timestep) produces a good balance of model accuracy and run times. However, for large-scale inundation maps, a smaller grid cell size and shorter timestep was used noting that the difference in hydrograph flows, etc. between the two model grid sizes is minimal.

Grid orientation affects model stability. For the Spring Harbor watershed, a grid orientation of negative 45 degrees was used, which creates cells that are generally perpendicular to the main greenway.

5.5.4 2D Land Use and Roughness Values

Figure 6 shows the Manning's n roughness value that was assigned to the 2D terrain. The Modeling Guidance lists roughness values to use for a 2D terrain, which appear to be generally taken from Table 7-1 USACE publication EM 1110-2-1417 (August 31, 1994 publication date). These roughness values, however, correspond to "sheet flow" or "overland flow" conditions that are representative of conditions that might occur at the inception of runoff.

Because the model is not a "rain on grid" model where modeling the conditions at the inception of runoff occurs, using these roughness values would significantly overestimate the roughness that is simulated in the watershed study model. In other words, lower roughness values are

necessary because most of the flow conditions that are modeled in this study are either shallow concentrated or open channel flow conditions. This approach is supported by the same USACE reference that states:

> *"Typical roughness coefficients for overland flow are about an order of magnitude greater than for channel flow. The overland flow roughness coefficients (Table 7-1) will range between 0.1 and 0.5 depending on the surface cover; whereas the roughness coefficients for channel flow are normally in the range of 0.012 to 0.10."* – Excerpt from USACE publication EM 1110-2-1417, page 7-15.

Further, Manning's n roughness values were originally developed for an equation based on estimating flow capacity for a river using a 1D (cross section) approach. As Ven Te Chow's classic "Open Channel Hydraulics" book that is widely recited alludes to, Manning's n roughness values are intended to also account for energy losses associated with eddies created from pools and shoals, stream meandering, etc. These types of losses are better accounted for explicitly in a 2D terrain, which also suggests Manning's n roughness values should be lower.

Table 5.5 summarizes the 2D roughness values used in this model. Street rights of way were assigned a roughness via the model's default roughness, so no separate roughness polygon was necessary for this land use. The City's greenways have varying vegetation which can be separated into two main categories – wooded or grassed. For the greenways, the Manning's n values were assigned based on their vegetation type.

Table 5.5 Manning's n Roughness Values

Landuse	Streets and West Town Mall	Concrete channel downstream of Owen Park	Commercial areas and grassed parks	Open space	Residential development	Forested greenway and parks
Roughness	0.016	0.02	.03	.05	.06	0.1

5.5.5 Inactive Areas

Per the Modeling Guidance, all buildings were modeled as inactive areas. It should be noted that this approach requires some engineering judgment for whether a building is at risk for flooding, since it would be unclear whether a building is dry due to the ground around it slightly above the surrounding area or whether it's because of the inactive area. Further, this approach ignores the minor storage that flooded buildings cause. For example, several of the businesses around West Towne ponds were filled with water.

Building footprints were obtained from the following data sources:

- GIS shapefile "Building_Footprint_County.shp" obtained from Dane County GIS data
- GIS shapefile "Building_Footprints_MadMaps.shp" provided by the City of Madison

Additional areas that were modeled as inactive were:

- The development bounded to the south by Mineral Point Road and the east by S Gammon Road. Recent development is not reflected in the current LiDAR and therefore this area was modeled in ID.
- The private parking lot located south of the Beltline off Exact Lane (McKenna/Greentree watershed). Multiple depressed inlets were modeled in 1D as a storage area to eliminate the need to model numerous private laterals.

5.5.6 1D-2D Interface Lines

Because all surface systems were modeled in 2D, no 1D-2D interface lines were needed.

5.5.7 2D Boundary Conditions

5.5.7.1 Internal Boundaries

Wet detention basins were assigned starting water surface elevation boundary conditions, as summarized in ***Table 5.6*** below.

5.5.7.2 External Boundaries

An external boundary condition was set for the model corresponding to an elevation 1' above the target maximum summer water surface elevation on Lake Mendota (***Table 5.6***). This is a conservative backwater elevation—it is uncommon for Lake Mendota to reach this water surface elevation.

Table 5.6 Boundary Conditions Summary

	External Boundary	Lake Mendota	West Towne Pond South	West Towne Pond North	Nautilus Pond South	Nautilus Bioretention
Elevation (ft)	851.1	851.1	1028.75	1025.49	998.5	997.5

5.6 Existing Conditions Pre-Calibrated Model Results

The "pre-calibrated model" was run, and the results fit the monitoring data and August 2018 high water marks fairly well. The figures described in the calibration section generally represent the "pre-calibrated" conditions, except for some minor adjustments in invert elevations at some of the gage locations to better match the dry period prior to a storm.

6. Model Calibration

6.1 Baseflow Conditions

In the Spring Harbor watershed, there is little to no baseflow at the Spring Harbor USGS gage, therefore, no baseflow calibration is necessary.

6.2 Recorded Rainfall and Flow Data

6.2.1 Calibration Storms

As described previously in ***Section 5.2.2***, three rainfall storms were used to calibrate the model using rainfall, water level, and flow monitoring data collected by the USGS under a separate contract with the City.

Section 4.2 lists the rainfall, water level, and flow monitoring sites used in this study. Due to equipment malfunction or other reasons, it was not possible to use all gages for every storm.

6.2.2 August 2018 Model Validation

In addition, high water marks and information gained from the Focus Groups (***Appendix F***) and photographs provided by the City for the historic August 2018 storm were used to validate the model for larger storms than what were recorded during the 2019 monitoring data collection effort. Specific photographs from the Focus Groups were provided to the City in a separate electronic transmittal. Rainfall data for the August 2018 storm was obtained from Weather Underground stations.

6.2.3 Spring Harbor USGS Gage Issues

The Spring Harbor watershed has a long-term USGS gage (Gage No. 05427965) that has been active since 1976. Based on the annual peak flow data, it appears that the peak discharge possible is about 750 cfs, which occurs a few times in its past, including the historic August 2018 storm that dropped almost a foot of rain on the watershed.

Based on the total hydrograph volume recorded from that storm, the Spring Harbor USGS gage recorded about 2 inches of total runoff over the watershed. Based on the amount of rainfall that fell, this low runoff volume recorded at the gage could mean one of only two things:

1. There is a major surface overflow bypass such that the gage does not record nearly all of the runoff that occurs; or
2. The gage data is incorrect.

Based on extensive discussions with the USGS, additional monitoring equipment installed by the USGS, detailed supplemental modeling by AE2S outside of SWMM, and a field tour that involved

walking much of the large box storm sewer, these additional data sources revealed the following key findings:

- When the USGS installed the gage in the mid 1970s, they constructed a small concrete weir in the box storm sewer with the intent of creating a reliable rating curve.
- While typically the USGS will collect in-field flow measurements at high discharges, given the confined space entry and flow conditions, the highest recorded field measurement was at about 200 cfs. Most annual peaks are above that 200 cfs measurement, and the gage will often see multiple peaks in a year that are above 200 cfs.
- The USGS has both a real-time depth / pressure sensor, as well as a peak stage recorder. The peak stage recorded by the real-time depth / pressure sensor and the peak stage recorder produced similar results, indicating that the depth measurements were mostly accurate.
- Based on the detailed supplemental modeling completed by AE2S, at a discharge of 200 cfs and below, the weir creates subcritical flow conditions upstream of the weir. However, the normal depth condition in the box storm sewer is supercritical flow at most or all flows. Because the shallow weir is less of an obstruction at higher flows, supercritical flow conditions push closer and closer to the weir until the depth that is measured at the gage is now in supercritical flow instead of subcritical flow, which is what the entire rating curve is based on.
- During the October 1 storm, a hydraulic jump (or at least a very large standing wave) was confirmed just upstream of the gage with the webcams the USGS had mounted to the roof of the box storm sewer. Photographs from the webcam are included in ***Appendix D.***
- The USGS now has a disclaimer on this gage that all flows above 200 cfs should be considered suspect, although flows above 200 cfs may still be accurate to some point. The USGS also has a velocity meter installed at the gage site now, and based on a few velocity measurements, the October 1 peak flow somewhat similar to the flow computed from the original rating curve suggesting that the rating curve may be at least somewhat reasonable to about 600 cfs.
- The USGS is continuing to work on an approach to improve the accuracy of the gage across the full flow regime.

6.3 Selected Runoff Storms

The three storms for use in the calibration were selected in collaboration with City staff and the consultant for the Strickers/Mendota and West Wingra watershed studies (Brown and Caldwell). Storms were selected with the following considerations (generally in order of importance):

- Total rainfall / recurrence interval estimate;

- Functioning monitoring equipment;
- Differences with the two other selected storms (i.e., attempting to avoid two similar storms);
- Consistency with the storms selected for the Strickers/Mendota and West Wingra watershed.

Based on these factors, the storms summarized in ***Section 5.2.2*** were selected for use in the calibration.

6.4 Calibration Performance

6.4.1 Calibration Criteria

The criteria for calibration are as follows:

- Overall average model bias for water surface elevations (or flow) is within +/- 5% with reasonable effort made to minimize the largest absolute error while at the same time balancing that effort with the relative importance of the model results at each monitoring site location.
- The largest absolute error at each monitored location is defined as +/- 25 percent.
- These calibration criteria are set recognizing that there may be some circumstances where calibration at a specific location cannot be accomplished. For example, in order to calibrate a larger portion of the model and/or produce results that are more accurate for the larger storms, a particular gage may have an error that exceeds the 25 percent threshold.

6.4.2 Calibration Results

Table 6.1 on the following page summarizes the model bias for each gage site and each storm. Model bias was weighted to computed runoff volume to give more weight to both larger storms and gages that were larger portions of the watershed.

Figures illustrating the modeled versus gaged data are shown in ***Appendix H***.

Table 6.1 Model Bias Summary

Storm		Gage Location / Name	Gage vs. Model Peak Flow Error	Computed Volume (ac-ft)	Weighted Error
July 18-20		Spring Harbor USGS Gage	+40%	179.5	+70.92
July 18-20		Yellowstone USGS	+42%	87.2	+36.45
July 18-20		West Towne Pond North Discharge USGS Gage	-7%	78.0	-5.15
August 11-12		Spring Harbor USGS Gage	+46%	80.2	+36.54
August 11-12		Bordner Park	+41%	65.8	+27.24
August 11-12		Yellowstone USGS	+27%	49.8	+13.24
August 11-12		West Towne Pond	+2%	46.0	+1.05
August 11-12		Hill Drive	+21%	3.3	+0.69
August 11-12		West Towne Pond North Discharge USGS Gage	-31%	45.1	-14.18
October 1-2		Spring Harbor USGS Gage	-9%	192.6	-18.20
October 1-2		Bordner Park	-23%	133.8	-30.39
October 1-2		Yellowstone USGS	-42%	80.2	-33.59
October 1-2		West Towne Pond	+4%	78.80	+3.29
October 1-2		West Towne Pond North Discharge USGS Gage	-20%	68.4	-13.49
	Average Model Bias			1188.7	+6.6%

Individual locations exceed the goal of a maximum absolute error of 25 percent. Given that the largest of the three calibration storms (October) in general underpredicted runoff and the smaller storms overpredicted, it was not possible to both reduce the model's predicted runoff for the July and August storms while at the same time increasing the model's predicted runoff

for the October storm. Therefore, the focus of the model calibration was on overall average model bias.

While the model appears to be biased slightly high for the three storms and just outside the +/- 5 percent goal for average model bias, this was deemed acceptable for four reasons:

1. USGS rates their permanent flow gages using four categories based on how accurate their true readings are most of the time:

    a. "Excellent" which is plus or minus 5 percent;

    b. "Good" which is plus or minus 10 percent;

    c. "Fair" which is plus or minus 15 percent; and

    d. "Poor" which is a record that is worse than that.

    The Spring Harbor gage is rated as "poor" for any flows over 100 cfs. It also stands to reason that temporary flow gages, if they were subjected to the same quality review, may also fit into the fair or poor category. Therefore, it is not possible to say with certainty whether the model is truly biased high or whether the readings are simply within the tolerance that USGS qualifies their own gage readings.

2. To provide consistency with the other ongoing watershed studies, the other ongoing watershed studies are all using the runoff parameters contained in the Modeling Guidance, so reducing the runoff parameters slightly to fit within the +/- 5 percent model bias was deemed a larger drawback than maintaining consistency with the other watershed studies.

3. More importantly, ***Figure H1*** in ***Appendix H*** illustrates how the model performs with respect to the observed high water marks and observations from the August 2018 storm, which illustrates the model matches the observed flooding quite well. Therefore, while there appears to be a slight bias high for smaller storms, the model matches the flood extents for larger storms quite well.

4. Finally, the goal of the SWMM model is to be a reasonable tool to make engineering decisions on the location and scale of improvements. As with any engineering tool, it is useful, even recommended, to have some factor of safety in any design. Having a model potentially biased slightly high provides some modest factor of safety for the hydraulic sizing of improvements.

7. Results Evaluation

Figure 10 through ***Figure 17*** illustrate the calibrated model results for the % Chance Storms. ***Appendix D*** contains the depth for each design storm for the 25 locations shown on ***Figure 10***.

7.1 Model Results Compared to Flood Mitigation Goals

Figure 20 and ***Figure 21*** show areas within the watershed that do not currently meet the City's Flood Mitigation goals. These two figures show that there are numerous locations where the system does not meet the identified flood mitigation goals:

1. All ten greenway crossings overtop in the 1% Chance Storm. This criterion was evaluated based on the 1% Chance Storm inundation showing continuous inundation from the upstream to downstream ends of the greenway crossings.
2. About 334 structures are potentially flooded in the 1% Chance Storm, which is about 10 percent of the total structures in the watershed. The criteria for potentially flooded was that the 1% Chance Storm inundation extents greater than 6 inches within 5 horizontal feet of the structure;
3. For the 4% Chance Storm,
    a. About 14 percent of the streets have more than 0.2 feet of flooding at the centerline of the street,
    b. About 6 percent of the streets have some water at the centerline, but less than 0.2 feet, and
    c. About 80 percent of the streets have either zero flooding at the centerline or were not explicitly included in the model.

   This criterion was evaluated based on the road centerline polyline database and sampling the 4% Chance Storm inundation raster along that polyline and assigning the maximum depth that occurred along segments of the road centerline.
4. About 18 percent of the storm sewer is storm sewer capacity limited (surcharging above ground surface) in the 10% Chance Storm. This criterion was evaluated by comparing the storm sewer HGL to the rim elevation of each storm sewer manhole. At any location where the HGL exceeded the rim elevation, that junction is assumed to be storm sewer capacity limited.
5. Within public streets in the 10% Chance Storm:
    a. About 37 percent of the storm sewer system has adequate capacity such that the curb flow line has less than 0.5 feet of flooding;

b. About 40 percent of the storm sewer system is inlet capacity limited with curb flow line flooding depths greater than 0.5 feet; and

c. About 23 percent of the storm sewer system is storm sewer capacity limited with curb flow line flooding depths greater than 0.5 feet.

This criterion was evaluated by creating a street right-of-way polygon and determining if there was any location within each segment that exceeded a 0.5-foot depth. If the maximum depth is less than 6 inches, the system has adequate capacity. If the depth is greater than 6 inches, then the storm sewer HGL is compared to the rim elevation. If the HGL is less than the rim elevation, the system was assumed to be inlet capacity limited. If the HGL is greater than the rim elevation, the system was assumed to be storm sewer capacity limited.

7.2 Limitations of Study

The Spring Harbor Watershed Study is a planning-level study. The model developed for this study is a tool built on planning level information. In general, all models are approximations, and as such, there is a certain amount of uncertainty in the results. This uncertainty is due to approximations in the input data, simplification of the methods used to calculate hydrologic and hydraulic parameters, the level of detail and accuracy of input parameters, and resolution of the topographic data.

This model was built following the City's Modeling Guidance document and was calibrated to limited monitored storm events that do not encompass all rainfall and antecedent hydrologic conditions that may be observed within the watershed.

The model was constructed at the watershed-level and is intended to identify flooding problems at that scale. It can be used to determine if the City's flood control goals are met within the watershed. Caution should be exercised when evaluating flooding problems at finer scales, additional refinement of model input parameters may be required.

While not an exhaustive list, several limitations for using the model and results beyond the scope of this study are listed below

- Flooding on private property due to localized drainage issues (such as backyards that do not drain well) are outside the scope of this study. Flooding on private property is generally only shown when it is the result of flooding conditions that originate from inadequate street or greenway flow capacity.
- Because this study covers over 3.5 square miles, it is not possible to review and confirm flood inundation (or a lack thereof) at every location throughout the watershed. Further, model calibration has its limitations as well, as described in ***Section 6***. Finally, flooding along every part of every street is not shown. Therefore, if the flood inundation maps

do not show flooding on a particular property, it is not a guarantee that the property does not flood. Correspondingly, while care was taken to confirm flooding conditions throughout the watershed, there may be flooded locations shown on the inundation maps that have less flood risk than shown.

- While SWMM can simulate supercritical flow conditions, links within the model would have to be split into very small slices, which is beyond the scope of the project and would make run times excessively long for the model to be a practical tool. As noted in ***Section 6***, the main box storm sewer from Bordner Park to Spring Harbor can flow under supercritical flow under a wide range of flow conditions. Therefore, the hydraulic grade line through the box storm sewer is less reliable than in other parts of the model. In addition, using the entrance and exit losses and standard roughness values listed in the modeling guidance resulted in the model over-predicting flood extents compared to focus group observations from the August 2018 flood event. When entrance and exit losses were removed and Manning's roughness values were lowered to 0.011, the modeled 2018 flood extents matched observations much more closely. Therefore, these changes were made to both the existing conditions and PFCI models.
- Inlets were modeled as simplified combined inlets into the system in existing conditions, and inlet capacity limitations were not included in proposed conditions (per City guidance). Further, storm sewer laterals were, in general, not included in the analysis. Therefore, additional site-specific evaluations that more accurately look at each individual inlet will be needed, particularly for local storm sewer improvements. Finally, proposed conditions inundation mapping for local streets does not reflect the fact that continuous grade inlets can never intercept 100 percent of street flow, so street flooding following local storm sewer improvements will be greater than what is represented on the proposed conditions inundation maps.
- Because every inlet was not modeled, there may be locations where there is more or less bypass flow or flooding depth on one side of the road than the other than what is shown in the model results.
- As noted in the calibration discussion, the model may be biased high (predicts higher flood elevations than what occurs), particularly for smaller storm storms.
- This study is not intended to be used for FEMA floodplain mapping purposes.

7.3 Model Results Compared to City Observations

The model reasonably replicates City observations outlined in ***Section 2.3***, which are summarized here for reference.

- Frequent
    - Street flooding on Gettle Avenue: Model shows flooding depths exceeding 2 feet beginning in the 10% Chance Storm.

- Overtopping of Quarterdeck Drive from City greenway: Model shows overtopping beginning in the 50% Chance Storm.
- Oakwood Village drainage issues: Model shows the underground parking garage beginning to flood in the 10% Chance Storm.
- Overtopping at Jetty Drive and grate clogging: Model shows overtopping beginning in the 50% Chance Storm.
- Flooding along Crestwood Place: Flooding away from the street right of way begins to occur in the 50% Chance Storm.
- Flooding along Burnett Drive: Model shows flooding into residents' garages in the 10% Chance Storm.
- Bordner Park channel flooding and inlet clogging: Not applicable to flood inundation mapping.

- Rare
  - Overtopping of South Yellowstone Drive from City greenway: Model shows overtopping beginning in the 2% Chance Storm.
  - Owen Park discharge channel washouts: Not applicable to flood inundation mapping
- August 2018 Flood
  - Flooding of properties adjacent to Garner Park: Modeled August 2018 storm shows flooding along South Hill Drive north of Garner Park.
  - Flooding south of West Towne ponds along Odana Road: Modeled August 2018 storm shows extensive flooding south of West Towne Ponds.
  - Flooding north of West Towne Ponds along Mineral Point Road Between S. Gammon Road and Grand Canyon Drive:
  - Flooding at the intersection of Odana Road and Grand Canyon Drive: Modeled August 2018 storm shows extensive flooding at this intersection.
  - Swale failure behind Dogwood Place resulting in street conveyance: Not applicable to inundation mapping.
  - Swale failure behind Elder Place resulting in street conveyance: Not applicable to inundation mapping.
  - Swale failure behind Forsythia Place resulting in street conveyance: Not applicable to inundation mapping.
  - Flooding at Memorial High School: Modeled August 2018 storm shows flooding against the Memorial High School building.

- Walking path flooding behind Knoche's Market and Butcher Shop: Modeled August 2018 storm shows flooding in this area.
- Flume failure, erosion, and culvert overtopping south of Bordner Drive: Modeled August 2018 storm shows flooding through this area.
- Culverts and channel washout at Regent Street greenway crossing. Modeled August 2018 storm shows Regent Street overtopping.

8. Public Engagement

As part of the Spring Harbor Watershed Study, the City carried out an extensive public information effort with assistance from AE2S. In addition, various social media and web-based communication methods and public meetings were held as summarized below.

8.1 Public Information Meetings

An initial public meeting was held on April 25, 2019 at Madison Memorial High School. According to the sign-in sheet, nearly 100 residents attended the meeting. The purpose of the meeting was to inform the public that the study was ongoing, provide an overview of what will be accomplished by the study, and collect feedback from residents on experienced flooding. At that meeting, residents also had the opportunity to request neighborhood "focus group" meetings with City and AE2S staff. Based on resident requests, focus groups were held with smaller groups in specific geographic areas that had experienced flooding.

A second public meeting was held on February 24, 2020 at John Muir Elementary School. According to the sign-in sheet, almost 60 residents attended the meeting. This meeting was held following the existing conditions model draft calibration to present model results and gather feedback from the public regarding the model validity.

A third public meeting was held on June 30, 2021 using the Zoom virtual platform. Based on the attendance count, approximately 40 people attended the meeting. The purpose of the meeting was to present stormwater solutions for the watershed and collect feedback from attendees. Small focus groups were held in breakout rooms.

Additional information on the PIMs and the watershed is provided on the City's project website: https://www.cityofmadison.com/engineering/projects/spring-harbor-watershed-study

8.2 Focus Groups

8.2.1 Public Engagement (Round 1)

During the initial phase of the Spring Harbor Watershed Study, 8 focus groups were held. The meetings discussed flooding issues residents had experienced and allowed for additional information to be collected. The location of each of these meetings is listed below with locations show in ***Figure 9***, with additional information listed in ***Appendix F*** that includes a brief written description of the focus group along with a map of key observations made during the Focus Group.

- Mineral Point Park to Owen Park (August 28, 2019)
- Owen Park Concrete Cunnette (August 29, 2019)
- Regent Street, Burnett Drive and Calumet Circle (August 29, 2019)

- Marbella Condo Association (August 30,2019)
- Oakwood Village Association (September 18, 2019)
- Bordner Park (September 19, 2019)
- West Towne Pond (September 16, 2019)
- Spring Harbor Neighborhood Association (October 3, 2019)

8.2.2 Public Engagement (Round 2)

The second round of focus group meetings were held at the end of PIM #2 as small break-out groups. In general, resident feedback showed the model reasonably represented past flood observations.

8.2.3 Public Engagement (Round 3)

A third round of focus group meetings were held at the end of PIM #3 as virtual break out rooms. Resident feedback was gathered and is included in ***Appendix F.***

8.3 Public Comment Period

Following the finalization of the draft report, the City held a Public Comment Period from January 28, 2022 through March 4, 2022. The City collected comments and questions and will respond to the comments and questions following the finalization of this report. The information will be posted to the City's project website and will be sent to those that submitted comments and questions.

Additionally, the comments, questions, and City responses from the Watershed Study Report Comment Period can be found in Appendix N* of this report.

*New Appendix added July 2nd, 2025

9. Proposed Solutions Development

9.1 Overall Process

This report covers the peak flow control analysis for the watershed. Volume control infrastructure is being analyzed separately.

9.1.1 Consultant and City Data Review

The results of the existing conditions flooding maps were reviewed with City staff to determine 10 different major constriction points and a qualitative evaluation of the causes of flooding for these constriction points. Constriction points were selected based on severity of flooding where specific causes could be identified, which were generally either insufficient storm sewer capacity or storage deficiencies.

9.1.2 Consultant and City Brainstorming

Following the initial data review, a meeting was held in early 2020 between AE2S and the City of Madison Engineering Staff to discuss constriction locations and opportunities for potential solutions. During that meeting, areas where solutions would be prohibited were also discussed. These prohibited areas included areas, such as railroads, major utility corridors, cemeteries / historic sites, and landfills.

9.1.3 Consultant Modeling

Following the brainstorming session, AE2S developed preliminary solutions that met the City's flood mitigation goals at the identified major constriction points. Due to the complexity of the watershed and the interdependence of the solutions, a "stepped solution" approach was performed. The stepped solution approach involved adding proposed improvements, one at a time, into the model, determining the resulting flood inundation, and comparing it to the previous stepped solution to determine the relative benefit of each solution and aid the project team in the selection of final solutions.

9.1.4 Meetings with City Engineering Staff

Through the stepped solution process, multiple meetings were held between City Staff and AE2S to discuss benefits and drawbacks of the preliminary solutions to determine which solutions would be incorporated into subsequent models.

9.1.5 Convergence of Solution to Share with City Agencies

Selected stepped solutions based on discussions with City staff were incorporated into a comprehensive model that reflected all the initially proposed solutions, which were then

discussed internally between City engineering staff and various City agencies. Meeting notes from those discussions are included in ***Appendix L***.

9.1.6 Finalization of Solutions

Following feedback from City agencies, solutions were refined. Refinements included the following:

- Scaling back the Glen Oak Hills Park Greenway project to reduce impact to existing oak trees and park use
- Refining the grading at West Towne Pond Expansion Project to reflect the 400′ well head boundary (to be done in final design)

A final peer review followed model refinement. Peer review comments and responses are included in ***Appendix J***.

9.2 Reviewed Solutions

9.2.1 Solutions Considered, but Eliminated from Consideration

As part of developing the solutions presented in this watershed study report, numerous solutions were evaluated that were ultimately eliminated from consideration. This section of the report documents those solutions that were ultimately eliminated along with the rationale for removing that solution from further consideration.

9.2.1.1 West Towne Pond Expansion

- **Maintaining the existing stage-storage relationship and increasing the outlet capacity**: This alternative was analyzed, but eliminated due to the high cost required to install the required 12′(span) x 4′ (rise) RCB, as well as the downstream impact that would result from the increased flow.
- **Increasing outlet capacity going south**: This alternative was not analyzed due to the existing flooding issues in the McKenna/Greentree Watershed, and the significant investment the City recently made with the McKenna Boulevard crossing and greenway improvements.

9.2.1.2 Glen Oak Hills Park Greenway

- **Excavating most of the park greenway and constructing larger / taller berms to maximize storage**: This solution was scaled back based on City Parks Department input to reduce the impacts to the existing oak trees and public recreational area.

- **Adding more outlet capacity from the greenway to the Gettle Avenue box culvert**: This solution was analyzed and eliminated due to lack of benefit due to timing differences of the peak at Gettle Drive and the greenway.

9.2.1.3 Owen Park

- **Increasing the box culvert capacity from the existing box storm sewer inlet south of Forsythia Place and west of Bordner Drive**: This alternative was eliminated from consideration due to lack of flood elevation change from Bordner Park upstream to the Owen Park Cunnette.
- **Increasing the channel capacity (depth and/or width) from Owen Park to the box storm sewer inlet located southwest of Bordner Drive**: This alternative was eliminated from consideration due to the impacts to the forested area south of the concrete channel (cunnette), the relatively recent investment the City made on the concrete channel, and the need to reconfigure the two sanitary sewer lines that cross the channel with minimal cover.

9.2.1.4 Masthead Greenway

- **Adding a third regional detention basin just north of Masthead Drive**: This alternative was eliminated from further consideration due to the narrow corridor and existing steep grades, making it difficult to create substantial storage without large retaining walls. Preliminary modeling also indicated that the modest detention that could be provided in this location did not reduce downstream 1% chance flows.
- **Reducing the street width of Island Drive to provide a wider greenway / regional detention facility corridor**: This alternative was eliminated from consideration due to the substantial street reconstruction that would be needed, although if Island Drive were to be constructed in the future, reducing the street width and expanding the greenway width could be considered.

9.2.1.5 Garner Park Pond

- **Increasing the storage of Garner Pond**: Given the impacts to the oak trees surrounding the pond and the lack of regional benefit (i.e., limited flow reduction at Regent Street) and the Water Utility's future well that is planned south of the existing pond, this alternative was eliminated from further consideration.

9.2.1.6 Bordner Park to Railroad

- **Adding a levee or flood wall around Bordner Park**: This alternative was not analyzed, but while homes along the west side of the park sit higher by 4 to 6

feet, homes to the south of Bordner Park are quite low, making the ability to back water up not feasible without buying out additional property.

- **Expanding the storage in Bordner Park by creating a larger footprint**: Preliminary modeling of this alternative indicated that an area double the size of the entire current park would be needed to avoid downstream conveyance improvements. This alternative was eliminated from further consideration because of the impacts to the park and the property buyouts that would need to occur to obtain the necessary footprint.
- **Expanding the storage in Bordner Park by excavating below the existing box storm sewer invert and installing a lift station to drain the pond down between storms**: Preliminary modeling of this alternative indicated that with a 3H:1V side slope, the pond bottom would have to be about 20 feet below the existing box storm sewer invert to provide sufficient storage within the existing park footprint. This alternative was eliminated from further consideration because of the impacts to the park, the likely aesthetic issues associated with a pond this deep, and the engineering challenges associated with excavating a pond this deep.

9.2.1.7 Railroad to Spring Harbor

- **Increasing the capacity of the RCB storm sewer from the railroad to Spring Harbor**: This alternative was analyzed but eliminated due to the lack of benefit achieved from increasing the capacity. This section of storm sewer has a steeper slope than the section from Bordner Park to the railroad and currently has sufficient capacity to carry existing and future flows.

9.2.2 Solutions Considered and Selected

This section provides a summary of the selected solutions and key components that were developed to meet the City's flood mitigation goals. Additional detail on each solution is included in ***Section 10***.

9.2.2.1 West Towne Pond Expansion (*Figure 23*)

- Excavating existing soccer fields to increase storage;
- Combining current three "ponds" into a single large pond; and
- Lowering normal pool using a small lift station to lower water level below current gravity outlet. The lift station would discharge to the existing gravity storm outfall going north under Mineral Point Road.

9.2.2.2 Kenosha Greenway and Regent Street Greenway Crossing (*Figure 31*)

- Excavating the Kenosha Greenway to increase storage capacity. This solution works in conjunction with increasing the capacity of the Regent Street culvert.

9.2.2.3 Glen Oak Hills Park Greenway (*Figure 28*)

- Adding three berms across the existing greenway to create additional storage; and
- Adding the equivalent of an additional 42" storm sewer from the greenway to the existing box storm sewer at Gettle Avenue.

9.2.2.4 Owen Park Channel and Floodwall (along Forsythia Cunnette) (*Figure 27*)

- Excavating and deepening the existing channel running north-south in the Owen Conservation Park along the west side of Forsythia Place and Elder Place; and
- Adding a flood wall within the Owen Conservation Park along the back lots of the residents located on the south side of Forsythia place.

9.2.2.5 Masthead Greenway Ponds (*Figure 26*)

- Adding two regional detention facilities in the greenway from Masthead Drive to Nautilus Drive; and
- Adding a box culvert from the northern pond to the greenway downstream of Inner Drive.

9.2.2.6 Gettle Avenue Box Storm Sewer (*Figure 29*)

- Increasing the capacity of the box storm sewer from the Bordner Park to the railroad.

9.2.2.7 Greenway Crossings (*Figure 24, Figure 25, Figure 26, Figure 30* and *Figure 31*)

- Increasing the capacity of several greenway crossings to eliminate roadway overtopping in the 1% Chance Storms.

9.2.2.8 Local Storm Sewer Improvements (*Figure 32*)

- Increasing the capacity of the storm sewer within street right of ways throughout the watershed in conjunction with street reconstruction projects to meet the City's flood reduction goals. Inlet capacity was not analyzed in the proposed solutions. It is assumed that sufficient inlet capacity will be determined during the design phase of the project.

10. Selected Alternative

10.1 West Towne Pond Expansion

10.1.1 Improvement Description

The West Towne pond is located east of South Gammon Road between Mineral Point Road and Odana Road. The pond detains runoff from the southwest portion of the watershed. The current pond configuration lacks sufficient capacity to meet the City's flood mitigation goals causing adjacent buildings to the southeast of the pond to flood in the 1% Chance Storm.

As described previously, increasing downstream flows significantly would cause impacts to existing property, so in order to eliminate adjacent building flooding without increasing downstream flows, additional storage is required. To achieve the necessary storage, this improvement will expand the pond across the existing soccer fields and lower the normal pool an additional two feet below the existing outlet. The anticipated excavation volume is approximately 180,000 cubic yards.

To maintain the existing gravity outlet across Mineral Point Road, a pump is proposed to drain the volume below the outlet and discharge water into the existing 36" RCP downstream of the pond. If the pond would be drawn down the full depth in one day, a 10,000-gpm pump would be needed. Project details are displayed in ***Figure 23***.

10.1.2 Flood Reduction

Both City staff and businesses along the south side of the West Towne Pond observed structure flooding and closure of both Odana Road and Mineral Point Road during the August 2018 flood event. The proposed project eliminates adjacent building flooding in the 1% Chance Storm without increasing flows downstream; however, events exceeding the 1% Chance Storm could still flood these structures. Road flooding depths are reduced considerably in the 1% Chance Storm with a maximum inundation on Odana Road and Mineral Point Road between 0.5-1.0 feet.

10.1.3 Land Ownership

The City of Madison, Stormwater Utility owns the property where improvements would be needed.

10.1.4 Utility Conflicts

There are no known major utility conflicts for this project. Costs associated with minor utility conflicts that are likely as part of any construction project within developed areas are included in the contingency allowance.

10.1.5 Other Known Concerns

There are several known or potential issues that could impact costs or the ability to construct the improvement:

- Proximity to City well: The northeast portion of the pond is located within 400' of a well. During the final design phase of the project, the pond grading would be refined to avoid encroachment of this area.
- High Groundwater: The site has a potential for high groundwater although based on recollections by City engineering staff, high groundwater is not anticipated.
- Parkland: Areas adjacent to the pond are currently leased by the Stormwater Utility for soccer fields, which would need to be coordinated with the Parks Division and the leasee.
- Allowance for forebays and access roads during final design which may reduce the pond footprint.

10.1.6 Anticipated Permits

Based on the planning-level design, the following environmental permits would be needed:

- City of Madison Erosion Control
- Wisconsin DNR Construction Site Disturbance (WRAPP)
- Wisconsin DNR/USACE Permit for Wetland Disturbance
- Artificial Wetland Permit

10.1.7 Water Quality Information

The existing West Towne pond is designed for flood storage and not water quality improvement. This project would maintain the primary function of the pond as a flood storage pond and is not intended for water quality treatment as a primary benefit, however it is anticipated that the project would increase the existing treatment potential.

10.2 Kenosha Greenway

10.2.1 Improvement Description

The Kenosha greenway is located between South Hill Drive and Regent Street adjacent to Burnett Drive. Flooding has been observed adjacent to the greenway even during small storms.

Improvements are required to eliminate adjacent structure flooding, including local storm sewer upgrades and increased storage in the greenway. The project includes excavating approximately 13,000 cubic feet from the greenway. In addition to the greenway grading, the Regent Street culvert would need to be improved, as summarized in Section 10.7. Project details for the greenway are displayed in ***Figure 31***.

10.2.2 Flood Reduction

The existing Kenosha Greenway floods and overtops Regent Street in large events. In addition, the undersized culvert capacity under Regent Street creates backwater along Burnett Drive, causing several of the homes on the west end of Burnett Drive to flood, which were observed by residents and City staff both in the August 2018 flood and in less severe flooding events as well. Residents had provided photo documentation of the 2018 flood depths on structures during the focus group meeting.

The proposed projects eliminate Regent Street road overtopping and adjacent building flooding in the 1% Chance Storm. Note that local storm sewer upgrades are also required to meet the flood mitigation goals, such as eliminating structure flooding on Burnette Drive.

10.2.3 Land Ownership

The City of Madison, Stormwater Utility owns the property where improvements would be needed.

10.2.4 Utility Conflicts

There are no known major utility conflicts for this project. Costs associated with minor utility conflicts that are likely as part of any construction project within developed areas are included in the contingency allowance.

10.2.5 Other Known Concerns

There are no known or potential issues that could impact costs or the ability to construct the improvement, however this area (at the time of the report) is managed jointly by the Stormwater Utility and volunteer groups for invasive and vegetation management. Coordination with the volunteer groups is anticipated during the design process.

10.2.6 Anticipated Permits

Based on the planning-level design, the following environmental permits would be needed:

- City of Madison Erosion Control
- Wisconsin DNR Construction Site Disturbance (WRAPP)

- If the drainage is considered navigable by the WDNR, a Wisconsin DNR Chapter 30 permit would be needed for a culvert along with water quality certification from the USACE (Section 401/404).

10.2.7 Water Quality Information

This project is designed for flood storage and conveyance and is not intended for water quality treatment.

10.3 Glen Oak Hills Park Greenway

10.3.1 Improvement Description

The Glen Oak Hills Park greenway is located between Glen Highway and Park Way. The greenway is currently drained by a 48" RCP that connects to the existing box storm sewer under Gettle Avenue. Flood waters currently overtop the road at the northern edge of the greenway and run down Glen Highway contributing to the flooding at Gettle Avenue.

The proposed project consists of installing three berms across the greenway to increase storage. The southern two storage cells will drain via culverts installed through the berms. The northern storage cell will drain by installing a 42" reinforced concrete pipe under the berm and Glen Highway, ultimately tying into the box culvert under Gettle Avenue.

Project details are displayed in ***Figure 28***.

10.3.2 Flood Reduction

Glen Oak Hills Park Greenway currently overtops in large events with water flowing down the Glen Highway, which has been observed by City staff on multiple occasions. Water then flows west to the Gettle Ave sag. Residents on Gettle Avenue also provided observations of flood depths and damage during the 2018 flood event; however, neither residents nor City staff were aware that Glen Oak Hills Park greenway overtopping could contribute to flooding at the Gettle Avenue sag.

The proposed project reduces greenway overtopping but does not eliminate it. In order to preserve the existing oak trees and recreational areas, the project was scaled back from the original concept. The northern berm will overtop in the 1% Chance Storm.

10.3.3 Land Ownership

The City of Madison, Parks Department and Street Right of Way own the property where improvements would be needed. Coordination with the Parks Division and approval by the Board of Parks Commissioners will be required.

10.3.4 Utility Conflicts

There are no known major utility conflicts for this project. Costs associated with minor utility conflicts that are likely as part of any construction project within developed areas are included in the contingency allowance.

10.3.5 Other Known Concerns

There are known or potential issues that could impact costs or the ability to construct the improvement:

- Glen Oak Hills Park exists within the greenway and consideration for park usage should be taken during design and construction of the project. Legal documents should be reviewed to determine if any land use limitations exist.
- Dam Classification

Note that per Wisconsin Administration Code NR 333 a dam is defined as an artificial barrier across a watercourse (stream with bed and banks) constructed with the primary intention of impounding water. Wisconsin Administrative Code NR 333 applies to dams that:

a) Have a structural height of more than 6 feet and a maximum impoundment of 50 ac-ft or more of water (large dam)
b) Have a structural height of 25 feet or more and a maximum impoundment of 15 ac-ft or more of water (large dam)
c) Have a structural height of 6 feet or less or a maximum storage of less than 50 ac-ft, if the WDNR determines that a dam failure would likely endanger life, health, or property if not designed and constructed according to standards in NR 333 (small dam)

The Glen Oak Hills Park Greenway berms do not meet the criteria to be considered a large dam and therefore would not automatically require a hazard rating. However, because the ponds could be classified as small dams, WDNR may require design and construction in accordance with NR 333.

10.3.6 Anticipated Permits

Based on the planning-level design, the following environmental permits would be needed:

- City of Madison Erosion Control
- Wisconsin DNR Construction Site Disturbance (WRAPP)
- If the drainage is considered navigable by the WDNR, a Wisconsin DNR Chapter 30 permit would be needed for a culvert along with water quality certification from the USACE (Section 401/404).
- If the WDNR takes jurisdiction over the embankment as a small dam, a dam construction permit through NR 333 would be needed.

10.3.7 Water Quality Information

This project is designed for flood storage and conveyance and is not intended for water quality treatment. However, where possible, water quality improvements may be added with the find project design.

10.4 Owen Park Channel and Floodwall (Along Forsythia Cunnette)

10.4.1 Improvement Description

Homes along Forsythia Place and Bordner Drive currently flood in the 1% Chance Storm. Flooding sources are a combination of:

- Surface drainage from the west from Owen Conservation Park: There is currently a channel running north to south along the eastern edge of the Owen Conservation Park which drains to the concrete flume/cunnette in the greenway south of Forsythia Place. The existing channel is filled with sediment or has been damaged over time and no longer functions to prevent overtopping to the east. (A cunnette is a concrete lining of the bottom of a stormwater conveyance channel, often referred to as a greenway. Historically cunnettes were used to stabilize channels, and help stormwater move quicker through the greenway.
- Owen Park Greenway Flooding: The existing greenway includes a concrete cunnette that drains to a box storm sewer under Bordner Drive. Flood elevations in the channel inundate homes along Forsythia Place and overtop the Bordner Drive crossing.

The solution consists of re-grading / expanding a 5-foot-deep channel in Owen Conservation Park to intercept flow prior to draining to the east out of the park. The channel will discharge into the greenway upstream of Forsythia Place. In addition, a flood wall is proposed along the property line of the residents located south of Forsythia Place extending up the slope at the culvert entrance. The average height of the flood wall is approximately 7 feet with a maximum height of 11 feet near the east end.

Project details are displayed in ***Figure 27.***

10.4.2 Flood Reduction

Both City staff and residents observed flood waters flowing through lots south of Forsythia Place and west of Bordner Drive during the August 2018 flood event, likely caused by flow exceeding the cunnette / box storm sewer capacity. One home at the west end of Forsysthia Place also had floodwaters enter their basement window, likely caused by overtopping of the small earthen channel running along the eastern edge of Owen Park Conservancy.

The proposed project eliminates flooding along Forsythia Place and overtopping of Bordner Drive in the 1% Chance Storm.

10.4.3 Land Ownership

The City of Madison Parks Department and Wis Cooperative Housing Association own the property where improvements would be needed. The City has an easement where the existing cunnette is for storm sewer purposes. Approval from the Board of Park Commissioners will be required. In addition, potential access easements, construction easements or permanent limited easements may be needed to accommodate the work.

10.4.4 Utility Conflicts

There are no known major utility conflicts for this project. Costs associated with minor utility conflicts that are likely as part of any construction project within developed areas are included in the contingency allowance. However, it should be noted that the concrete cunnette cannot be lowered as it sits on top of a shallow sanitary sewer main.

10.4.5 Other Known Concerns

There are several known or potential issues that could impact costs or the ability to construct the improvement:

- Property ownership south of existing Owen Park Cunnette;
- Access / removable floodwall sections needed for access for channel / box storm sewer entrance and sanitary sewer maintenance;
- Floodwall height and potential overturning stability;
- Coordination needed on impacts of existing walking paths within the Owen Park Conservation park on Crestwood Neighborhood land; and
- Design to consider drainage on north side of wall, which may include piping downspouts through the wall with backflow preventers or a drainage pipe to Bordner Park via Bordner Drive

10.4.6 Anticipated Permit

Based on the planning-level design, the following environmental permits would be needed:

- City of Madison Erosion Control
- Wisconsin DNR/USACE Permit for Wetland Disturbance
- Wisconsin DNR/ USACE Permit for Streambank Stabilization

10.4.7 Water Quality Information

This project is designed for flood storage and conveyance and is not intended for water quality treatment.

10.5 Masthead Greenway Ponds

10.5.1 Improvement Description

The Masthead Greenway is located west of Island Drive and south of South Hill Drive. The existing greenway overtops South Hill Drive in the 1% Chance Storm. In addition, the existing culvert under South Hill Drive discharges upstream of Inner Drive which contributes to road overtopping at Inner Drive.

The proposed solution consists of excavating two dry detention basins within the greenway to increase storage and replace the existing outlet with a 10′ x 4′ box culvert that will discharge downstream of Inner Drive.

Project details are displayed in ***Figure 26.***

10.5.2 Flood Reduction

There are no firsthand observations of flooding along the Masthead greenway system; however, given the home downstream of Nautilus Drive and west of Inner Drive was flooded during the August 2018 flood event, in all likelihood, Nautilus Drive overtopped during that event as well. The proposed project eliminates road overtopping in the 1% Chance Storm and provides additional storage in the watershed to reduce downstream structure flooding.

10.5.3 Land Ownership

The City of Madison, Stormwater Utility and adjacent private property owners own the properties where improvements would be needed. Permissions or land acquisitions (easements or purchase) may be required to construct to the full improvements described.

10.5.4 Utility Conflicts

There are no known major utility conflicts for this project. Costs associated with minor utility conflicts that are likely as part of any construction project within developed areas are included in the contingency allowance.

10.5.5 Other Known Concerns

There are known or potential issues that could impact costs or the ability to construct the improvement:

- Depth to water table
- Extensive tree removals
- Dam Classification

The Masthead Greenway ponds do not meet the criteria to be considered a large dam and therefore would not automatically require a hazard rating. However, because the ponds could be classified as small dams, WDNR may require design and construction in accordance with NR 333.

10.5.6 Anticipated Permits

Based on the planning-level design, the following environmental permits would be needed:

- City of Madison Erosion Control
- Wisconsin DNR Construction Site Disturbance (WRAPP)
- If the drainage is considered navigable by the WDNR, a Wisconsin DNR Chapter 30 permit would be needed for a culvert along with water quality certification from the USACE (Section 401/404).
- If the WDNR takes jurisdiction over the embankment as a small dam, a dam construction permit through NR 333 would be needed.

10.5.7 Water Quality Information

This project is designed for flood storage and conveyance and is not intended for water quality treatment.

10.6 Gettle Avenue Box Storm Sewer

10.6.1 Improvement Description

The existing storm sewer under Gettle Drive varies in size from 14′ x 6′ to 17′ x 6′ upstream of the railroad. There is significant flooding along Gettle Avenue due to insufficient capacity in the existing box storm sewer. During large storms, drainage in Bordner Park overtops North Rosa Road and flows east to the sag located approximately 500 feet east of the park. Homes adjacent to the sag flood in modest-sized storms.

This solution was designed to reduce the depth of flooding along Gettle Avenue and create downstream conveyance for upstream improvements.

The flood inundation maps, and cost estimates shown in this report are based on the original project extents which consisted of replacing the box storm sewer between Bordner Park and the railroad to an equivalent of a 22′ x 6′ reinforced concrete box storm sewer while maintaining the existing entrance in Bordner Park (which is much larger than a 22′ x 6′ opening). Original project details are displayed in ***Figure 29.***

As part of the ongoing design for the Old Middleton Road reconstruction project, the City of Madison recently collected survey data on invert elevations for various portions of the box storm sewer between Bordner Park to Spring Harbor. A comparison of the survey data

against the 1961 and 1963 record drawings indicates steeper sections of pipe, mainly between Border Park and the railroad resulting in increased capacity. Additional analysis will be conducted for this area, contact City Engineering for data relating to it.

Both residents and City Staff observed flooding to structures along Bordner Park and Gettle Avenue in the August 2018 flood event. Flood waters in Bordner Park overtopped Rosa Road and contributed to significant flooding at the Gettle Avenue sag. Further, City staff have observed the Glen Oak Hills Park greenway overtopping at Glen Highway several times, and modeling shows that the overtopping flow also contributes to flooding at the Gettle Avenue sag.

The proposed project eliminates overtopping at Rosa Road and reduces the depth of flooding at the Gettle Avenue sag. In addition, this project creates downstream conveyance for upstream improvements. The project prevents some but not all structures from flooding in the 1% Chance Storm.

10.6.2 Land Ownership

The City of Madison owns the Street Right of Way.

10.6.3 Utility Conflicts

There are multiple utility conflicts within the street ROW that need to be addressed during design. The proposed box storm sewer maintains the same depth and profile to avoid as many critical utility conflicts as possible. Known utility conflicts consist of sanitary sewer, water main, gas main and other private utilities.

10.6.4 Other Known Concerns

There are known or potential issues that could impact costs or the ability to construct the improvement:

Depending on the construction and size of the trenches needed it is reasonable to expect that temporary limited easements or construction easements will be required. Due to the size and depth of the box culvert and the limited width of the roadway, water and sanitary sewer may need to be double-mained and that could require permanent easements along Gettle Avenue.

10.6.5 Anticipated Permits

Based on the planning-level design, the following environmental permits would be needed:

- Wisconsin DNR Permit for Culvert
- City of Madison Erosion Control
- Determination by WDOT on Bridge or Culvert Identification/Number

10.6.6 Water Quality Information

This project is designed for flood conveyance and is not intended for water quality treatment.

10.7 Greenway Crossings

10.7.1 Improvement Description

There are seven greenway road crossings within this watershed. All crossings currently overtop in the 1% Chance Storm. This solution increases the capacity of the crossings to meet the City of Madison Flood Mitigation goals.

Table 10.1 lists the geometry of the existing and proposed culvert crossings. Additional details are shown in ***Figure 24, Figure 25, Figure 26,*** and ***Figure*** 30**.**

It is known that flow leaving a channel modeled fully in 2D, going into a culvert modeled in 1D, and back to a channel modeled fully in 2D involves complex 1D and 2D calculations. It can be highly sensitive to the grid cell size and 1D/2D flow connections around the 1D culvert. As such, AE2S checked all of our culverts with HY8 and XP results and found that for our culverts, the results were very similar especially between hy8 and inspection points, and that any differences were due to tuflow averaging a few grid cells around it. AE2S generally based our sizing on hy8 / inspection point results relative to the overflow elevation.

Table 10.1 Existing and Proposed Culvert Crossings

Crossings	Existing Geometry	Proposed Geometry
Yellowstone Drive	48″ RCP: 1 Barrel	8′ x 4′ RCB: 1 Cell
Quarterdeck Drive	30″ RCP: 2 Barrels	12′ x 5′ RCB: 1 Cell
Jetty Drive	38″ x 57″ Arch: 1 Barrel	4′ x 4′ RCB: 1 Cell
Masthead Drive	48″ RCP: 1 Barrel	6′ x 4′ RCB: 2 Cells
Inner Drive	53″ x 83″ HERCP: 2	14′ x 5′ RCB: 1 Cell
Nautilus Drive	53″ x 83″ HERCP 1 Barrel	10′ x 4′ RCB: 1 Cell
Regent Street	42″ RCP: 2 Barrels	6′ x 5′ RCB: 2 Cells

10.7.2 Flood Reduction

The proposed solutions eliminate road overtopping in the 1% Chance Storm.

10.7.3 Land Ownership

The City of Madison, Stormwater Utility and Street Right of Way, and possible adjacent private property owners own the properties where improvements would be needed.

10.7.4 Utility Conflicts

There is potential for multiple utility conflicts within the road ROW that may need to be addressed during design.

10.7.5 Other Known Concerns

There are no known or potential issues that could impact costs or the ability to construct the improvement.

10.7.6 Anticipated Permits

Based on the planning-level design, the following environmental permits would be needed:

- City of Madison Erosion Control
- Wisconsin DNR Construction Site Disturbance (WRAPP)
- If the drainage is considered navigable by the WDNR, a Wisconsin DNR Chapter 30 permit would be needed for a culvert along with water quality certification from the USACE (Section 401/404Water Quality Information)

This project is designed for flood conveyance and is not intended for water quality treatment.

10.8 Local Storm Sewer Improvements

There are numerous local storm sewer improvement projects within the watershed that will be implemented in conjunction with street reconstruction projects. For purposes of this study, storm sewer sizes were sized to meet the City of Madison flood mitigations goals.

The existing discharge into the Nautilus Channel (***Figure 32***) is limited by the weir length in the control structure. After upsizing the local storm sewer on Mineral Point Road, the weir length into the Nautilus Channel would require a length of 20 feet to meet the City's Flood Mitigation Goals. Consideration for the limited available space in the channel should be given prior to designing that section of local storm sewer.

10.8.1 Flood Reduction

The proposed solutions meet the City of Madison flood mitigation goals, except where listed in ***Section 11*** of this report.

10.8.2 Land Ownership

The City of Madison, Stormwater Utility and Street Right of Way own the property where improvements would be needed.

10.8.3 Utility Conflicts

There are no known major utility conflicts for this project. Costs associated with minor utility conflicts that are likely as part of any construction project within developed areas are included in the contingency allowance.

10.8.4 Other Known Concerns

There are several known or potential issues that could impact costs or the ability to construct the improvement:

- Additional concerns will be evaluated during individual street redesign projects.

10.8.5 Anticipated Permits

Local storm sewer improvements will be constructed as part of numerous separate projects. Since most of the local storm sewer improvements are completed within the street right-of-way, environmental permits will likely be limited to:

- City of Madison Erosion Control
- Wisconsin DNR Construction Site Disturbance (WRAPP)

Further, if a local storm sewer project has modifications to an outfall, additional permits may be needed, which could include Wisconsin DNR Chapter 30 / USACE Section 404 permits.

10.8.6 Water Quality Information

These projects will be designed for conveyance and are not intended for water quality treatment.

11. Areas Target Cannot Be Met

This report documents solutions within the Spring Harbor watershed intended to meet the City of Madison Flood mitigation goals. Although this study strived to meet goals within the entire watershed, there are a few areas where solutions were either site, cost, or socially prohibited. In these locations, property acquisition may be the only means to reduce flood damage. Areas where flood mitigation goals are not met may be areas where extra precautions should be taken during flood storms.

Although a feasible solution was not found in this study for areas where the target could not be met, a theoretical required additional conveyance capacity was calculated with information listed in ***Section 11.2***.

11.1 Watershed Performance

11.1.1 10% Chance Storm

- **Goal**: Eliminate flooding from the storm sewer system for up to the 10% Chance Storm; all water shall be contained within the pipes and structures (exception: low spots).
- **Watershed Performance**: Given sufficient inlet capacity in all streets (to be designed when roads are reconstructed), following implementation of the proposed solutions, the entire watershed meets the 10% Chance Storm goal, as shown in ***Figure 34***. There is a small section of roadway on South Hill Drive, north of Garner park that is flooded during the 10% Chance Storm. This section of roadway is a sag, and the source of flooding is caused by Garner pond overtopping the roadway.
- **Areas where the goal is not met**: None

11.1.2 4% Chance Storm

- **Goal**: Centerline of the street to remain passable during the 4% Chance Storm with no more than 0.2 feet of water at the centerline.
- **Watershed Performance**: Given sufficient inlet capacity in all streets (to be designed when roads are reconstructed), following implementation of the proposed solutions, all but two areas of the watershed meet the 4% Chance Storm goal, as shown in ***Figure 35***.
- **Areas where the goal is not met**:
    - The sag on South Hill Drive north of Garner Park

- A portion of South Kenosha Drive and Burnett Drive adjacent to the greenway

11.1.3 1% Chance Storm

- **Goal**:
  - No home or business will be flooded during the 100-year design storm
  - No overtopping of street at greenway crossings during the 1% Chance Storm
- **Watershed Performance**: Given sufficient inlet capacity in all streets (to be designed when roads are reconstructed), following implementation of the proposed solutions, all but 10 primary structures meet the 1% Chance Storm goal, as shown in ***Figure 37***.
- **Areas where the goal is not met**:
  - Gettle Avenue
    - Flooding at the Gettle Ave sag will likely be less than shown in the solutions figures if adequate inlets are incorporated during final design.
  - Oakwood Village
    - Flooding at Oakwood village is due to private drainage issues. Fixing private stormwater facilities is beyond the scope of this project.
  - 7043 Watts Road
    - Flooding shown in this location is likely due to the model resolution as opposed to actual flooding.

11.2 Theoretical Additional Capacity

In areas that do not meet the target, the flow difference between a smaller storm that does meet the target and the larger storm that does not meet the target was calculated within the model. That change in flow is the additional conveyance capacity that would be required to meet the flood mitigation goals.

Table 11.1 on the following page lists the additional capacity required to meet the flood mitigation goal.

Note that Oakwood Village flooding is due to private stormwater management and addressing it is beyond the scope of this project. It is the City's understanding that the village is currently

building a berm on site and results from this study do not reflect the recent modifications. Therefore, an additional theoretical capacity was not calculated for this area.

7043 Watts Road currently has a detention basin next to it. It appears that the model does not fully account for the storage due to smoothing of the terrain. Since it is likely that this area does not actually flood in the 1% Chance Storm, the theoretical additional capacity was not calculated for this area.

Table 11.1 Capacity Requirements for Flood Mitigation

Location	Capacity that meets Goal (cfs)	Proposed Flow (surface and subsurface) (cfs)	Theoretical Additional Capacity Required to Meet Target (cfs)
The sag on South Hill Drive north of Garner Park (affects flooding at Kenosha Ave.)	100	370	270
Burnett Drive (25-year) (greenway capacity listed)	270	340	70
Gettle Avenue (100-Year)	1480	1870	390

12. 0.2% Chance Storm Upgrades

The City of Madison has seen a recent increase in extreme rain events. This trend is predicted to continue as a result of climate change. All storms are expected to reduce their recurrence interval, in particular, the 0.2% chance storm will likely become a more frequent event as the frequency of heavy rainfall events increases.

As part of this study, the proposed solutions were evaluated in the 0.2% annual chance event. Proposed solutions were scaled, where possible, to meet the goal of no home or business flooded. 0.2% chance potential system upgrades are listed below.

12.1 0.2% Chance Analysis Completed

As part of this study, the proposed solutions were evaluated in the 0.2% Chance Storm. Proposed solutions were scaled, where possible, to meet the goal of no home or business flooded. 0.2% Chance Storm potential system upgrades are listed below.

12.2 Infrastructure Medications

12.2.1 Owen Park Floodwall (Along Forsythia Cunnette)

The Owen Park Floodwall (Along Forsythia Cunnette) would require twice the height as proposed in the 1% Chance Storm solution. This would likely more than double the proposed cost.

12.2.2 West Towne Pond Expansion

The West Town pond would require an additional 7.5 feet of excavation and likely three to four times the pumping capacity to drain the pond down in sufficient time so that the storage could be relied upon. This would likely quadruple the project cost, and the potential for groundwater issues would significantly increase.

12.2.3 Local Storm Sewer Improvements

Local storm sewer upgrades were provided to the City as a geodatabase. Incremental costs for the upgrades will vary and will be determined during road reconstruction projects.

13. Cost Estimates

Opinions of probable costs were created for each project and are summarized in ***Table 12.1*** below with detailed cost breakdowns included in ***Appendix M***. City staff provided unit costs based on 2021 dollars, which were adjusted based on project specifics and input from the City. Cost estimates should be considered a Class 4 estimate based on guidance from the Association for the Advancement of Cost Engineering (AACE International), which corresponds to a feasibility study level of design (1% to 15%). A Class 4 estimate is generally considered to have an accuracy range of –15% to -30% (i.e., overestimate the true cost estimate) an +20% to +50% (i.e., underestimate the true cost estimate). Based on input from City staff, a contingency of +25% was assigned to all opinions of probable costs to reflect the feasibility level of design.

Table 12.1 Proposed Improvements: Opinions of Probable Cost

Solution	Cost
West Towne Pond Expansion	$3,652,100
Kenosha Greenway	$1,652,700
Masthead Greenway Ponds	$2,641,600
Gettle Avenue Box Storm Sewer	$9,112,000
Glen Oak Hills Park Greenway	$1,789,900
Owen Park Channel and Floodwall (Along Forsythia Cunnette)	$4,868,200
Nautilus Drive Box Culvert Greenway Crossing	$1,151,900
Inner Drive Box Culvert Greenway Crossing	$773,600
Jetty Drive Box Culvert Greenway Crossing	$530,600
Masthead Drive Box Culvert Greenway Crossing	$896,300
Yellowstone Drive Box Culvert Greenway Crossing	$727,300
Quarterdeck Drive Box Culvert Greenway Crossing	$661,400
Regent Street Box Culvert Greenway Crossing	$886,900
Local Storm Sewer Improvements	To Be Determined with Street Improvement Projects

14. Recommended Implementation Order

14.1 Construction Sequence

Below is a list of sequencing considerations for implementing the proposed solutions within the watershed.

West Towne Pond Expansion – Excavation of the West Towne pond and implementation of the small lift station is not contingent on any other regional projects within the watershed and can occur at any time. The West Town Pond project does need to occur before the adjacent roads can meet their flood mitigation goals. Examples of adjacent roads include Odana Road and Gammon Road.

Kenosha Greenway – Excavation of the Kenosha Greenway is not contingent on any other projects within the watershed. It would be practical to coordinate the Regent Street greenway crossing at the same time.

Glen Oak Hills Park Greenway – Construction of the berms and additional 42" storm sewer should happen before the Regent Street crossing is upsized to be able to convey more stormwater.

Owen Park Channel – Excavation of the channel is not contingent on other projects within the watershed and can happen on its own timeline.

Owen Park Floodwall (Along Forsythia Cunnette)– Construction of the Owen Park floodwall should be completed prior to increasing the capacity at the greenway crossings to handle the increased flow from the crossings. If the greenway crossings are completed first, serious discussions on buyouts / structure raises are needed.

Masthead Greenway Ponds– The Masthead ponds and outlets should be completed prior to increasing the capacity of the greenway crossings.

Gettle Avenue Box Storm Sewer – This project should ideally be completed prior to increasing the capacity at the greenway crossings to handle the increased flow from the crossings. If the greenway crossings are completed first, serious discussions on buyouts / structure raises are needed.

Greenway Crossings – All greenway crossings should be upsized after Owen Park Floodwall and Gettle Avenue Storm Sewer projects are implemented. If the greenway crossings are completed first, serious discussions on buyouts / structure raises are needed. Finally, downstream greenways should generally be constructed before upstream greenways.

Local Storm Sewer improvements – Other than the Gammon Road sag by Memorial High School north of Mineral Point Road, they can generally be on their own timeline. The Gammon Road sag should be treated as a greenway crossing, and downstream greenway crossings should be done before the Gammon Road sag storm sewer is increased.

14.2 Solutions that Work Together to Meet Goals

Both regional and local solutions are needed in combination with each other to meet the flood reduction levels shown in the Proposed Solutions Flooding Figures. Further, several regional solutions work together to meet flood reduction goals in specific areas:

Flooding at Gettle Avenue – Both the Gettle Avenue box storm sewer and Glen Oak Hills Park greenway improvements are needed to reduce surface flow to the sag on Gettle Avenue.

Flooding at Inner Drive – Both the Masthead Greenway Ponds project and Inner Drive culvert crossing improvements are needed to reduce flooding in the Inner Drive / Nautilus Drive area.

Flooding at Yellowstone Drive – Both the Quarterdeck Drive and Yellowstone Drive culvert crossing improvements are needed to eliminate Yellowstone Drive overtopping in the 1% Chance Storm.

14.3 Signage

There are several potential flood event precautions that could be undertaken in locations where flood control goals cannot be met. These precautions are also potentially applicable in locations where mitigation measures will not be implemented in the near future due to scheduling limitations.

14.3.1 Temporary Signage

In some known flooding locations, it may be possible to use temporary signage prior to, or during, flood events/large storm events to warn residents that flooding is occurring or is likely. This may not be feasible in places that experience flash flood problems that are difficult to predict. Additionally, the use of temporary signage requires staff and equipment to mobilize and place signage. This can be difficult to implement due to lack of staff/equipment availability. Environmental factors, such as on-going rain or flooding, can also be a barrier to mobilizing and installing temporary signs. In the case of flash flooding, by the time a flood problem is identified, it may be challenging to reach the site, or the flooding may be over before it can be reached. However, in locations where antecedent conditions can increase the likelihood of flooding in the near future, temporary signage could be useful.

14.3.2 Permanent Signage

In some locations with very frequent, or particularly intense flooding, permanent signage could also be considered. For known flooding areas that are low on the City's implementation schedule, permanent signage may help alert the public to the risk of flooding.

The City could develop a citywide set of criteria to use to determine whether a location is appropriate for permanent flood risk signage. Criteria could include the frequency of flooding, the depth of flooding for a given return interval, and proximity to certain priority areas such as schools or medical facilities.

14.4 Citywide Priority

The City is conducting similar watershed studies for all the watersheds in the City. All watersheds are expected to have numerous recommendations resulting from the studies. The City is developing a process to rank and prioritize the order in which the solutions might be implemented if and when funding and public support are obtained. Information on this process will be shared by the City when it is available.

15. Limitations

This document was prepared solely for city of Madison (City) in accordance with professional standards at the time the services were performed and in accordance with the contract between the City and AE2S, LLC dated March 19, 2019. This document is governed by the specific scope of work authorized by the City; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the City and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information. Further, AE2S, LLC makes no warranties, express or implied, with respect to this document, except for those, if any, contained in the agreement pursuant to which the document was prepared. All data, drawings, documents, or information contained this report have been prepared exclusively for the person or entity to whom it was addressed and may not be relied upon by any other person or entity without the prior written consent of AE2S, LLC unless otherwise provided by the Agreement pursuant to which these services were provided

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Performance Summary				
% Chance Storm	System Component	Total	Number with Criteria Exceeded	% of Criteria Exceeded
10%	Storm Sewer Surcharge	21.9 Miles	3.9 Miles	18%
4%	Street Flooding	170 Miles	23.9 Miles	14%
1%	Structure Flooding	3,294	334	10%
1%	Greenway Overtopping	10	10	100%

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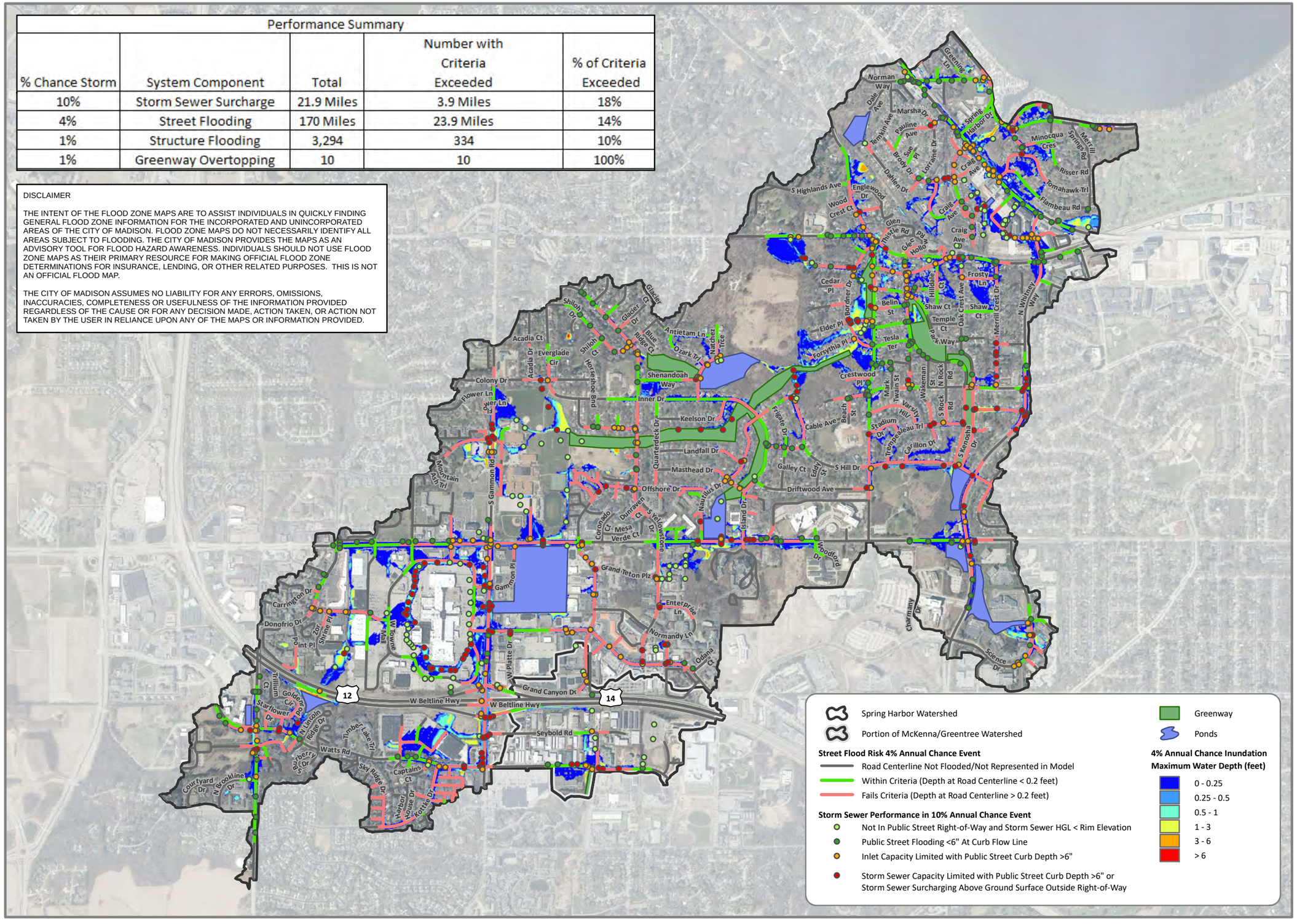

N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure ES-1

EXISTING CONDITIONS FLOOD MITIGATION GOALS PERFORMANCE SUMMARY

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 10/14/2021

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure ES-1- Existing Conditions Flood Mitigation Goals Performance Summary.mxd

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Performance Summary				
% Chance Storm	System Component	Total	Number with Criteria Exceeded	% of Criteria Exceeded
10%	Storm Sewer Surcharge	27.1 Miles	0 Miles	0%
4%	Street Flooding	170 Miles	0.2 Miles	0.1%
1%	Structure Flooding*	3,294	10*	0.3%
1%	Greenway Overtopping	10	0	0%

***Accessory Building Not Included**

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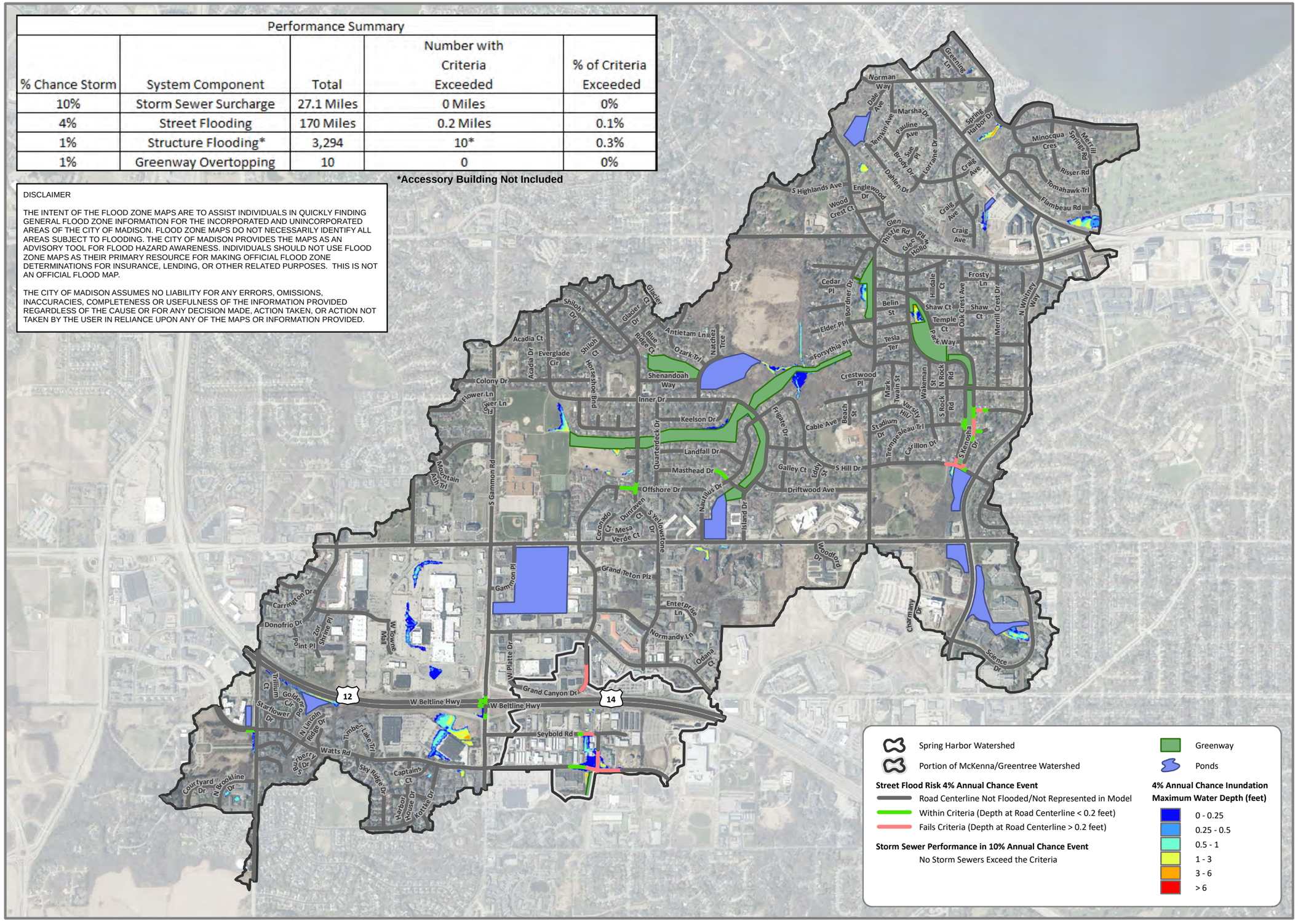


N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure ES-2

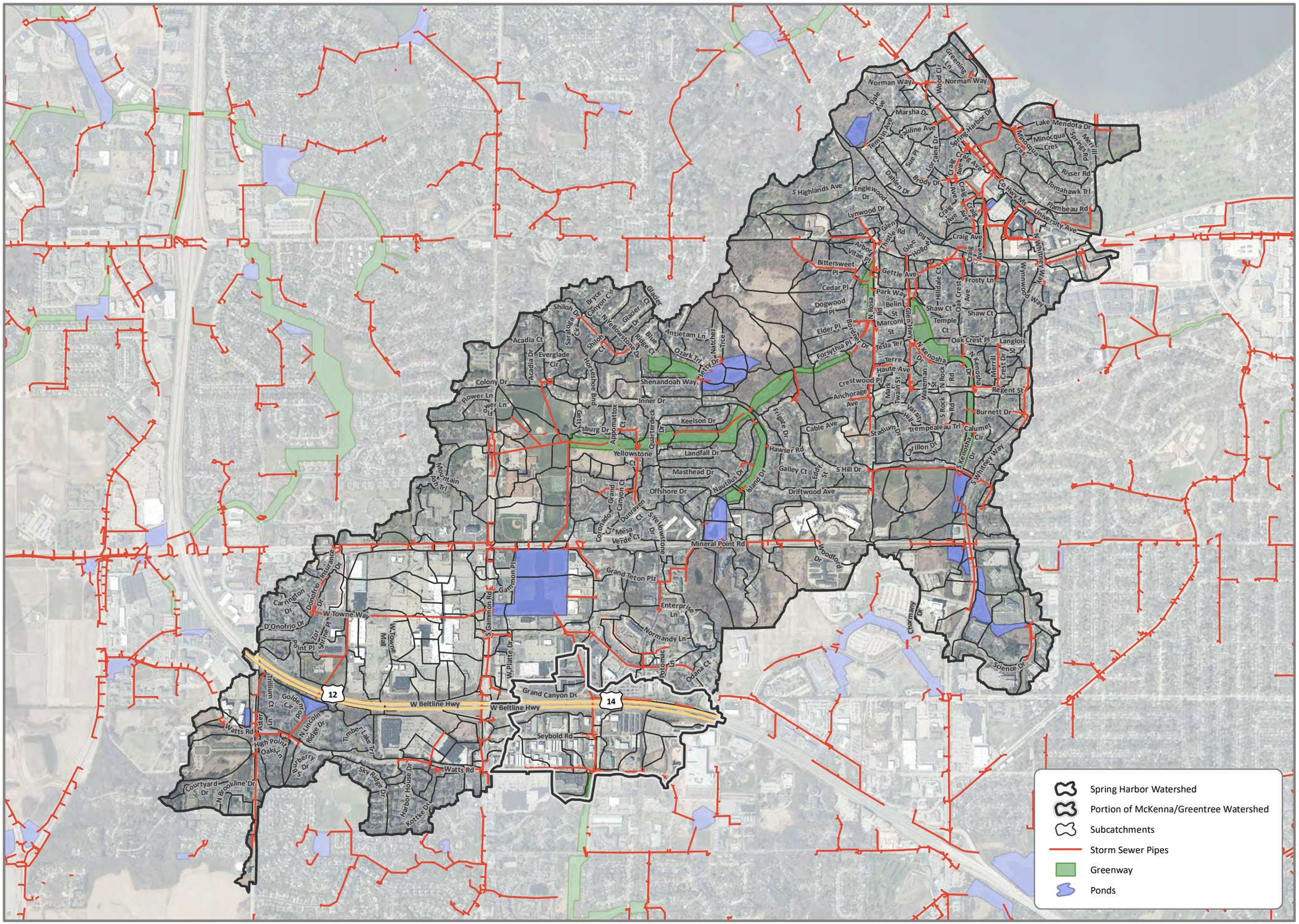
PROPOSED CONDITIONS FLOOD MITIGATION GOALS PERFORMANCE SUMMARY

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 10/14/2021

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure ES-2- Proposed Conditions Flood Mitigation Goals Performance Summary.mxd



N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 1

WATERSHEDS AND SUBCATCHMENTS

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 7/20/2021

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 01- Watershed and Subcatchments.mxd

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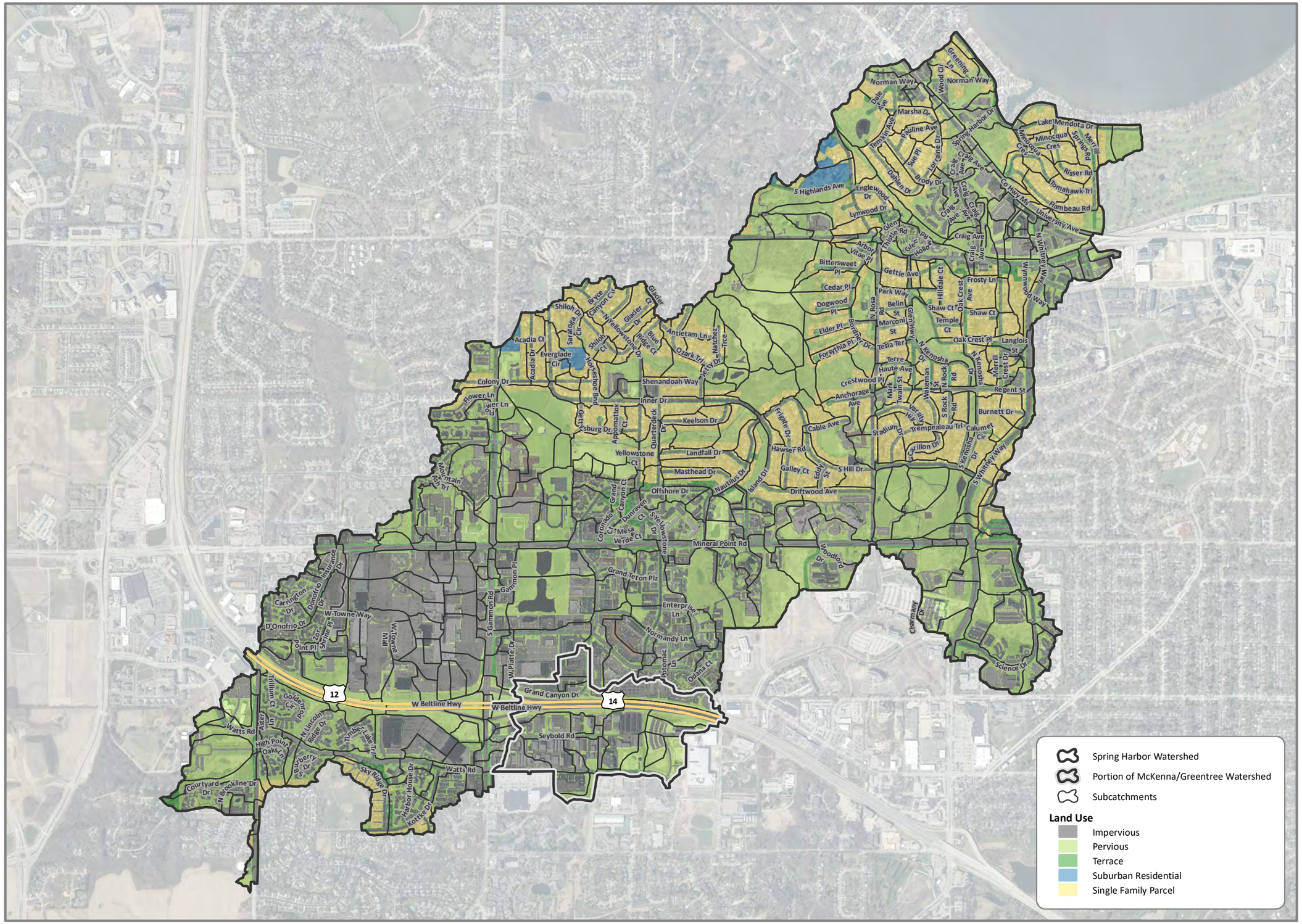

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Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 02- Land Use for Subcatchment Runoff.mxd

N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

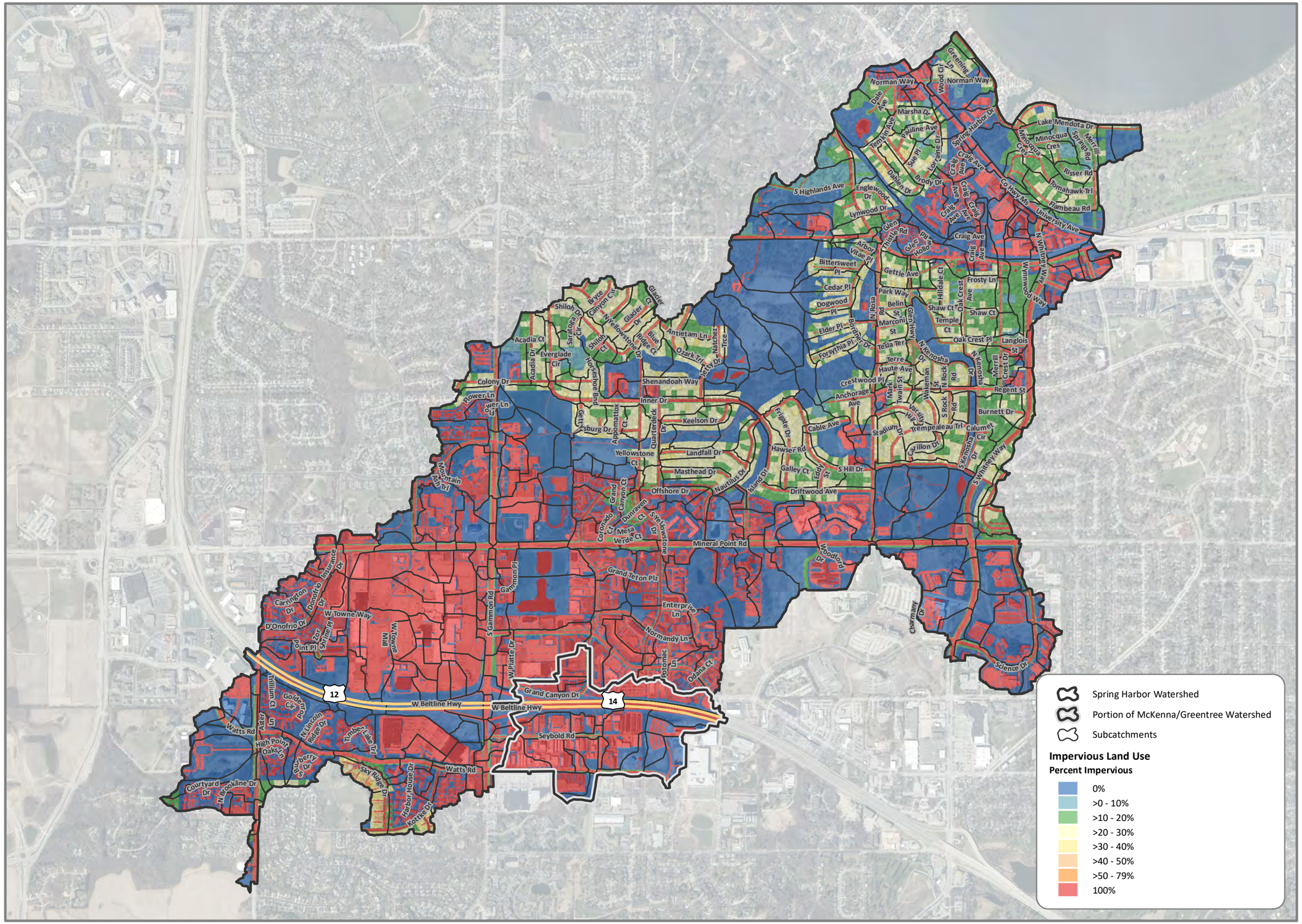
City of Madison
Dane County, WI

Figure 2

LAND USE FOR SUBCATCHMENT RUNOFF

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 7/20/2021



N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 3

IMPERVIOUS PERCENTAGE

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 7/20/2021

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 03- Impervious Percentage.mxd

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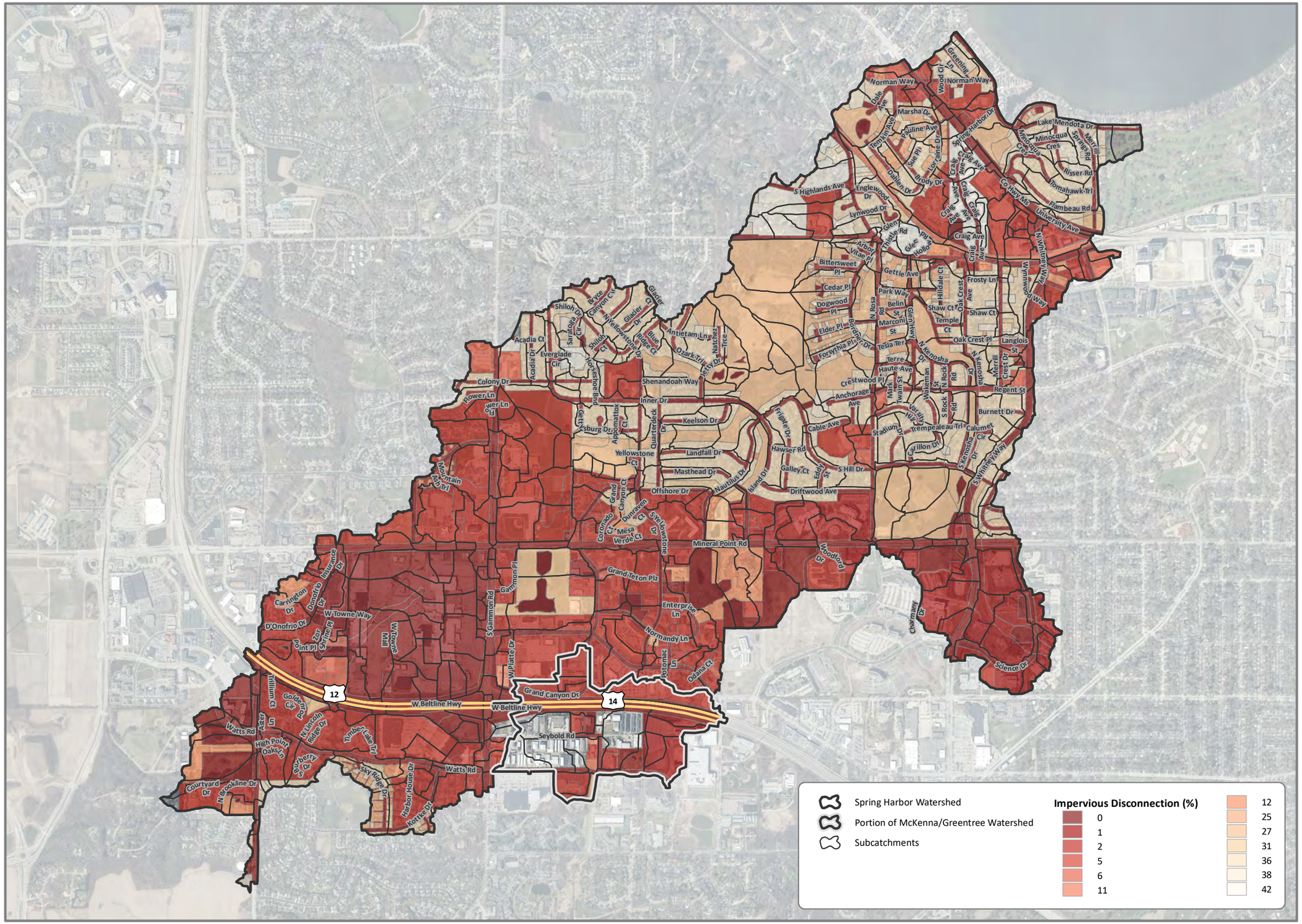

N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 4

IMPERVIOUS DISCONNECTION PERCENTAGE

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 7/20/2021

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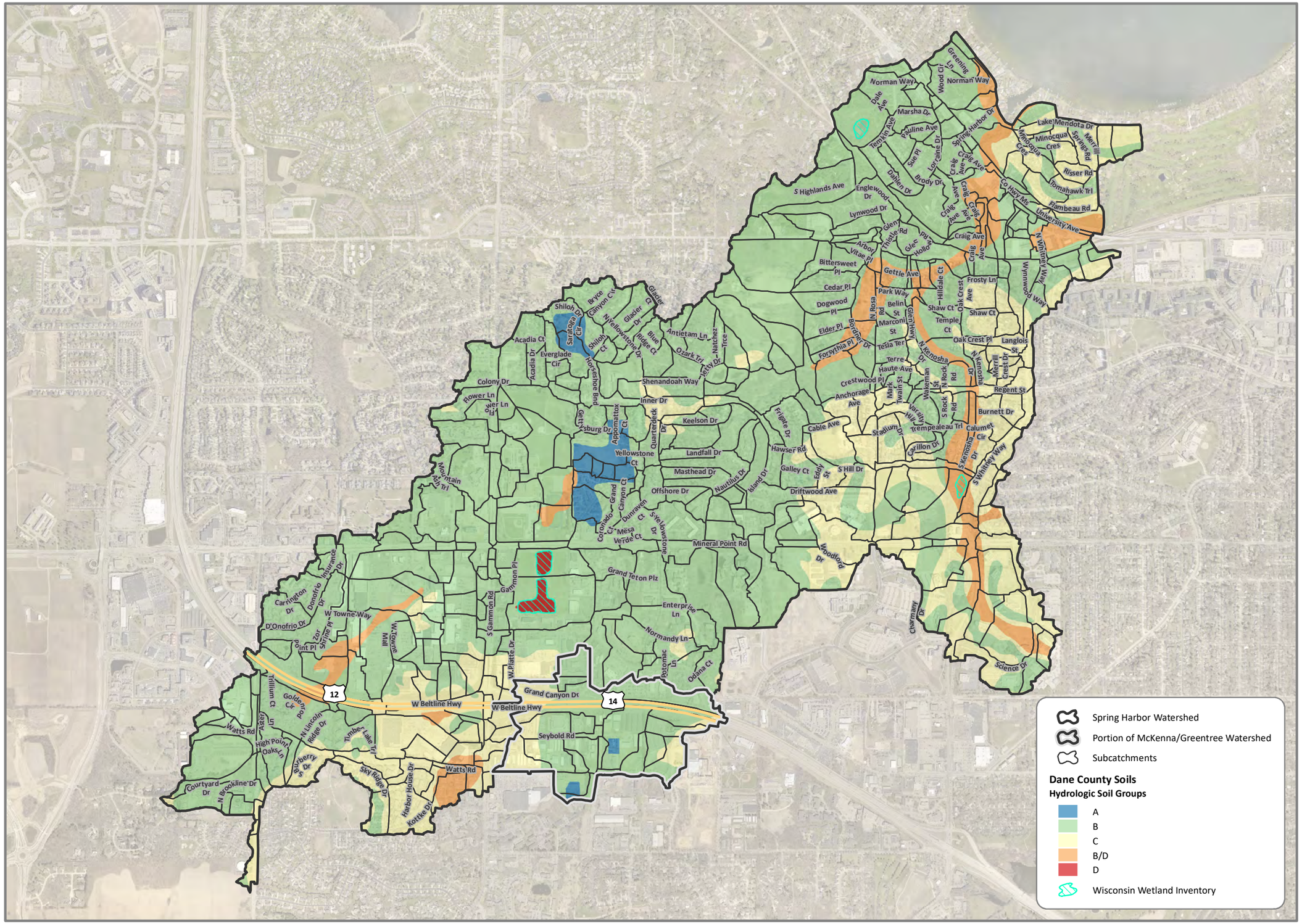
Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 04- Impervious Disconnection Percentage.mxd



N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 5

SOILS AND WETLANDS

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 7/20/2021

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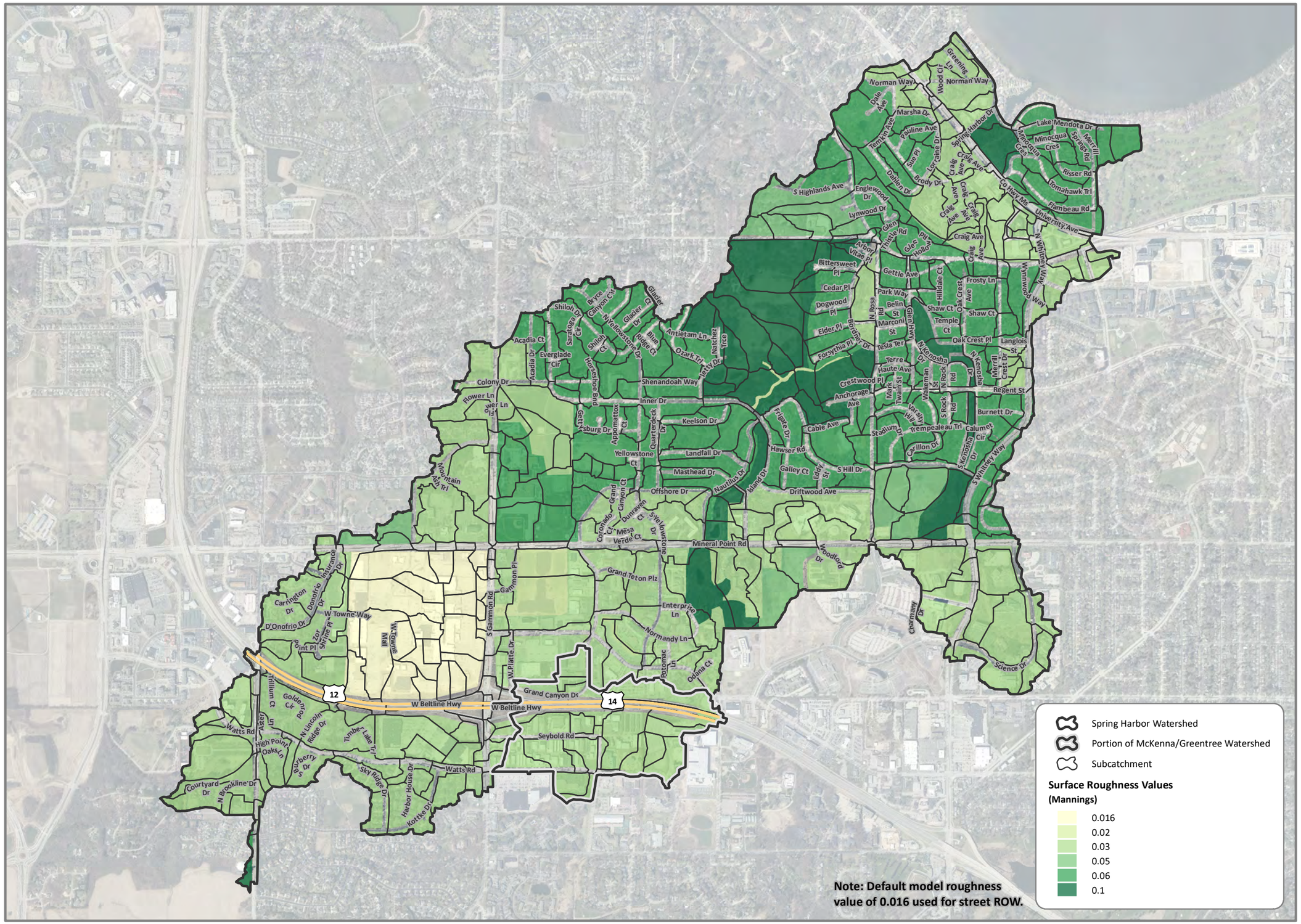
Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 05- Soils and Wetlands.mxd



N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 6

2D SURFACE ROUGHNESS VALUES

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 7/20/2021

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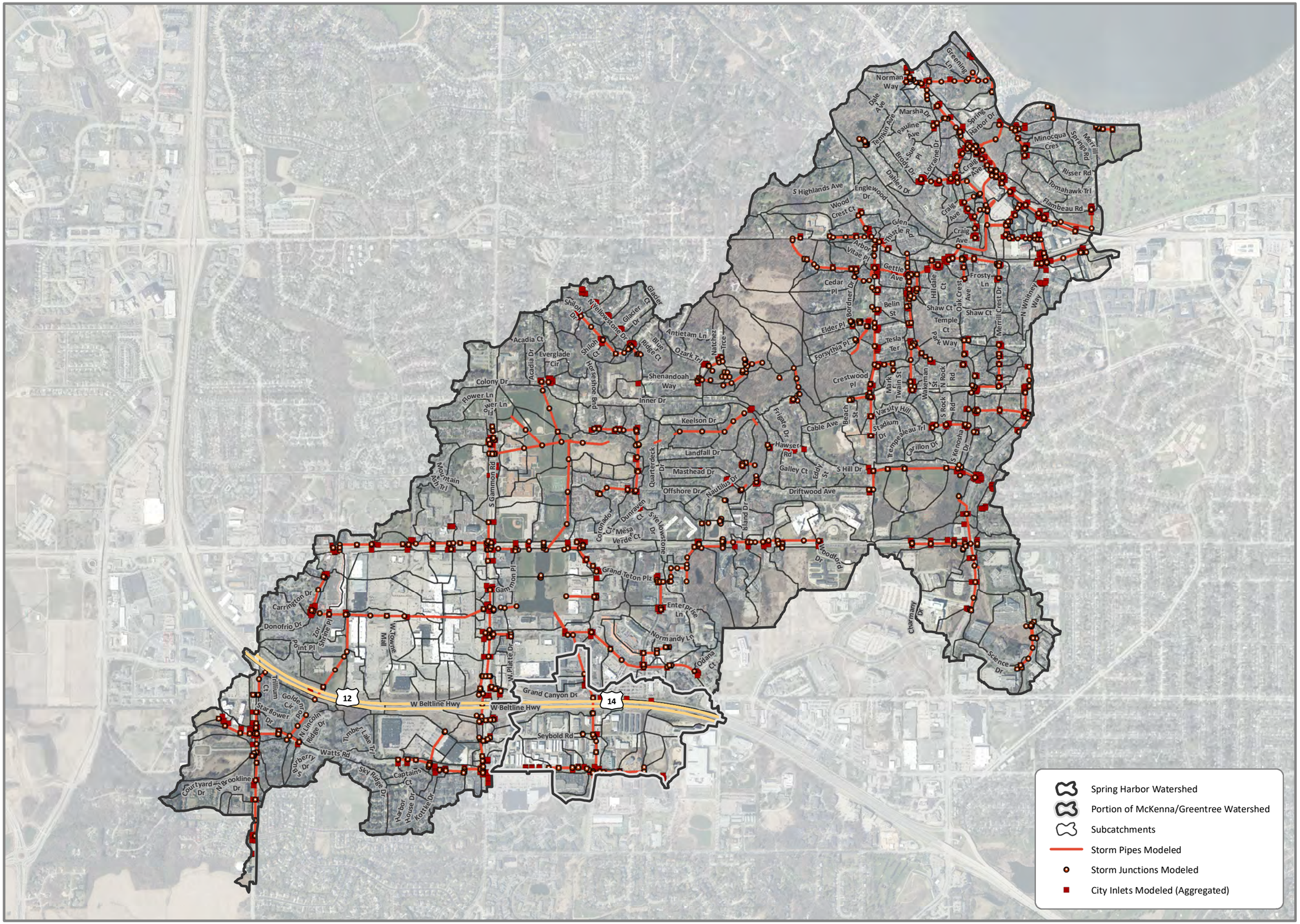
Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 06- 2D Surface Roughness Values.mxd



N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 7

1D MODEL NETWORK

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 7/20/2021

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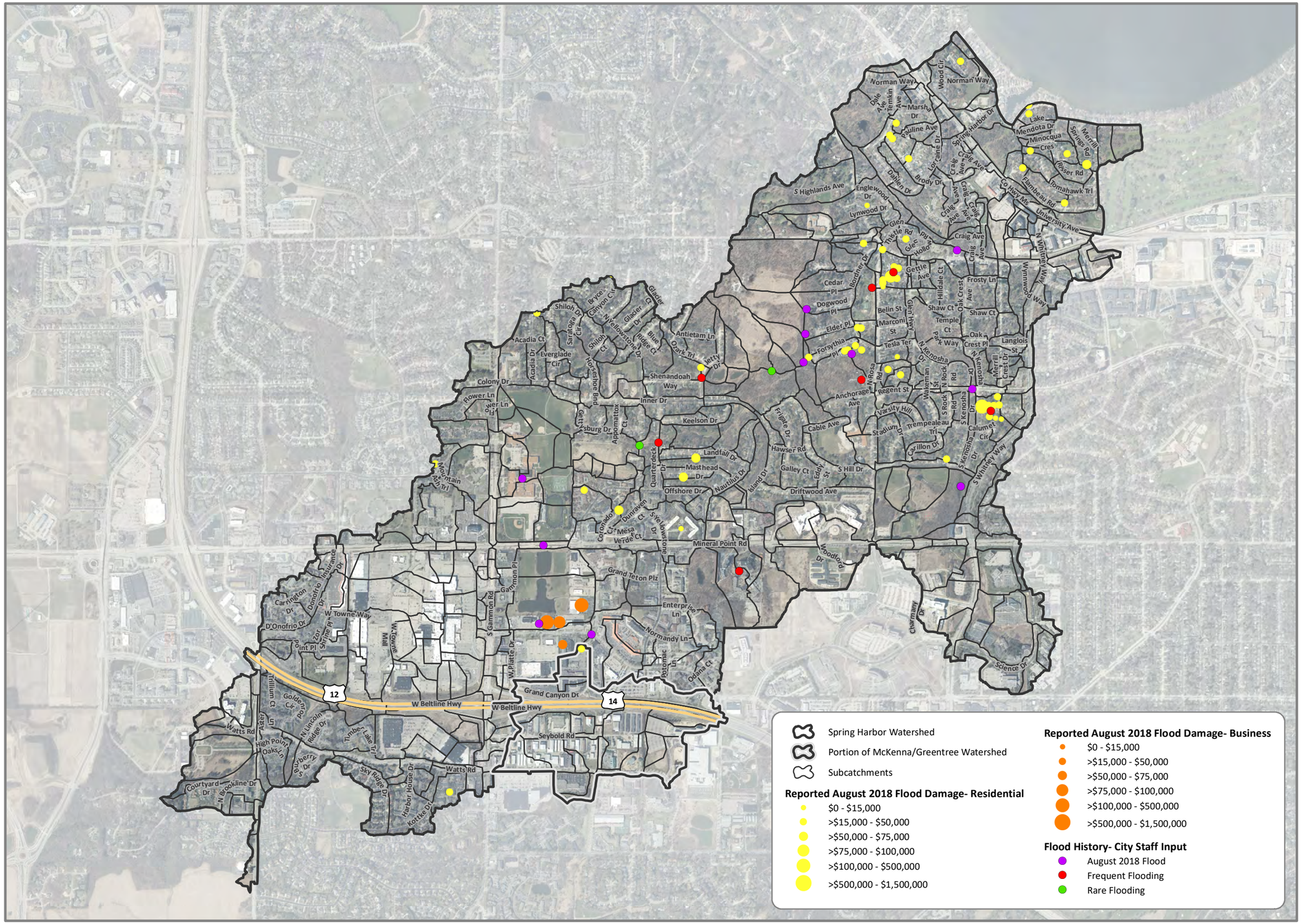
Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 07- 1D Model Network.mxd



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Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 08- Historic Flooding Locations.mxd

N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

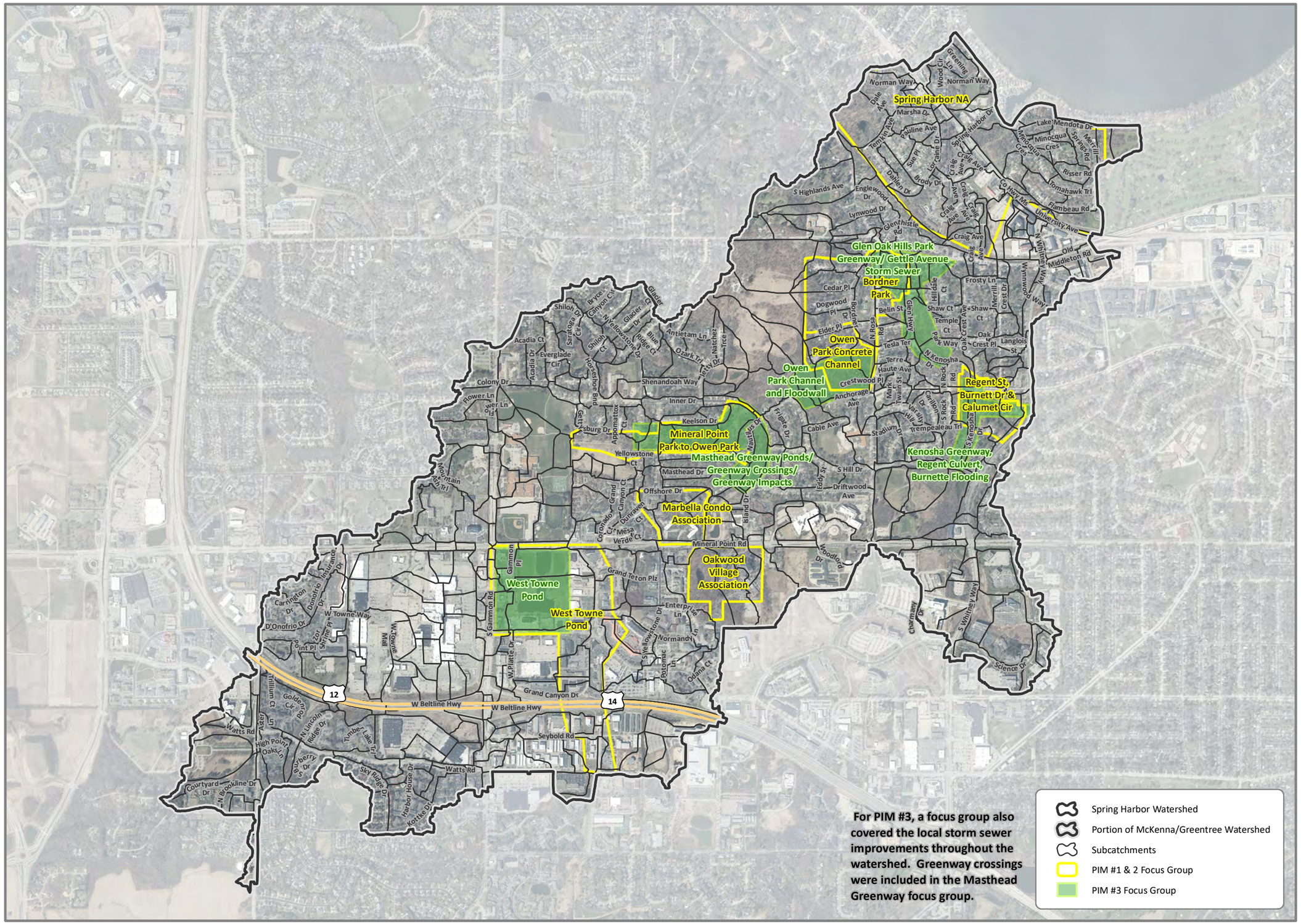
City of Madison
Dane County, WI

Figure 8

HISTORIC FLOODING LOCATIONS

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 7/20/2021



N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 9

FOCUS GROUP LOCATIONS

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/2/2021

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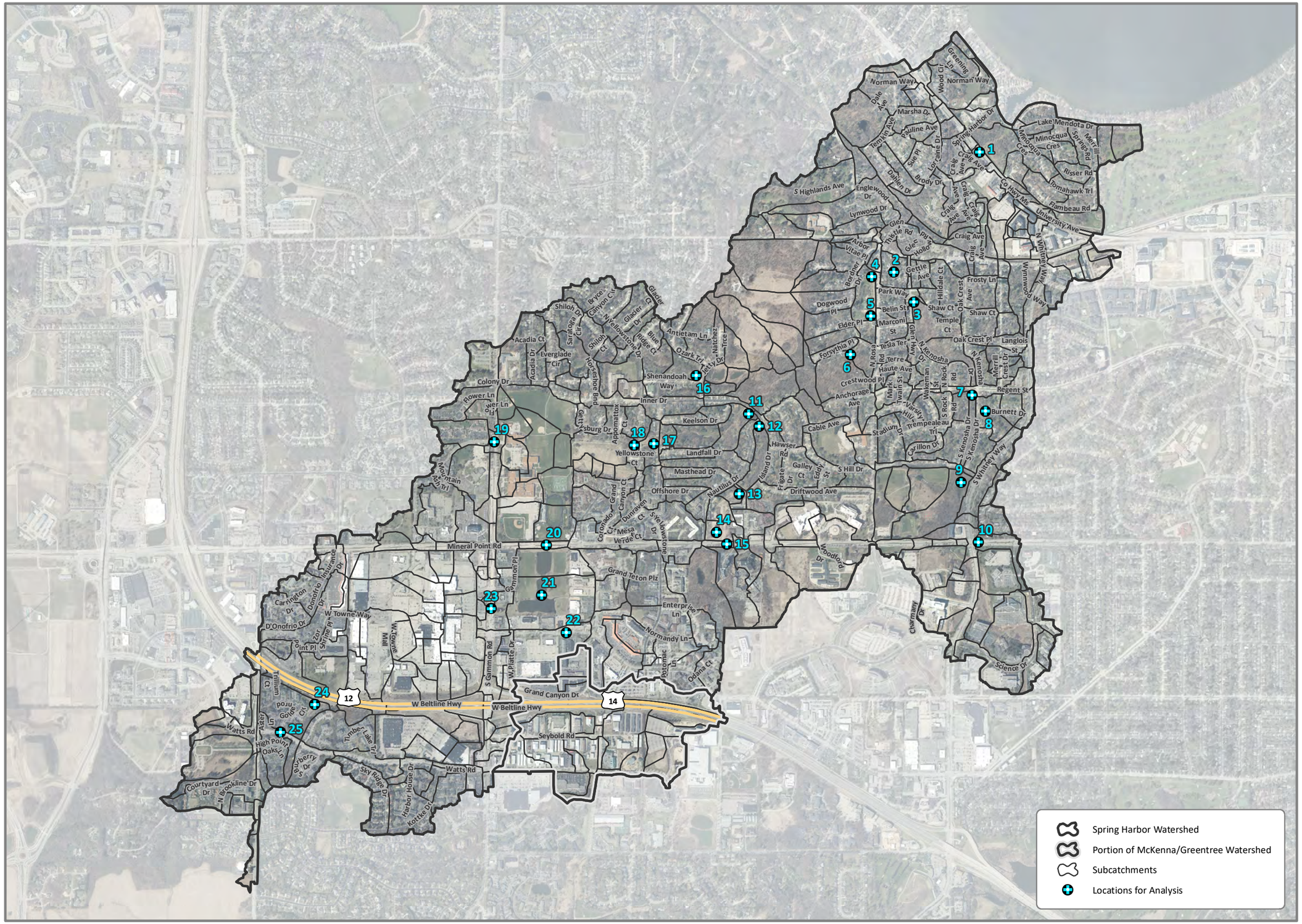

N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 10

MAP OF LOCATIONS FOR DEPTH AND DURATION SUMMARIES

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/2/2021

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Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 10- Map of Locations for Depth and Duration Summaries.mxd

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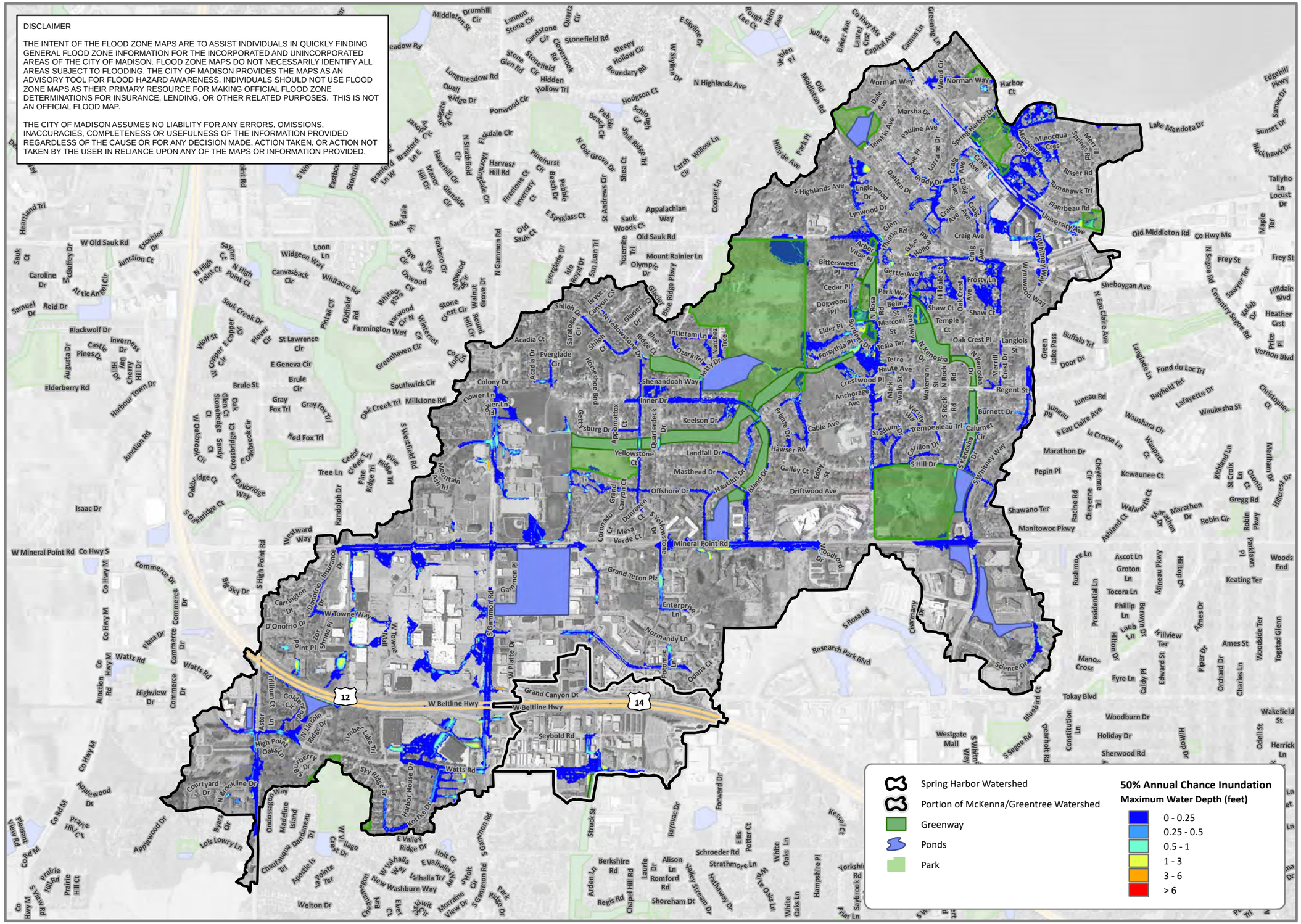

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 11

EXISTING: 50% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

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Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 11- Existing 50% Chance Flooding.mxd

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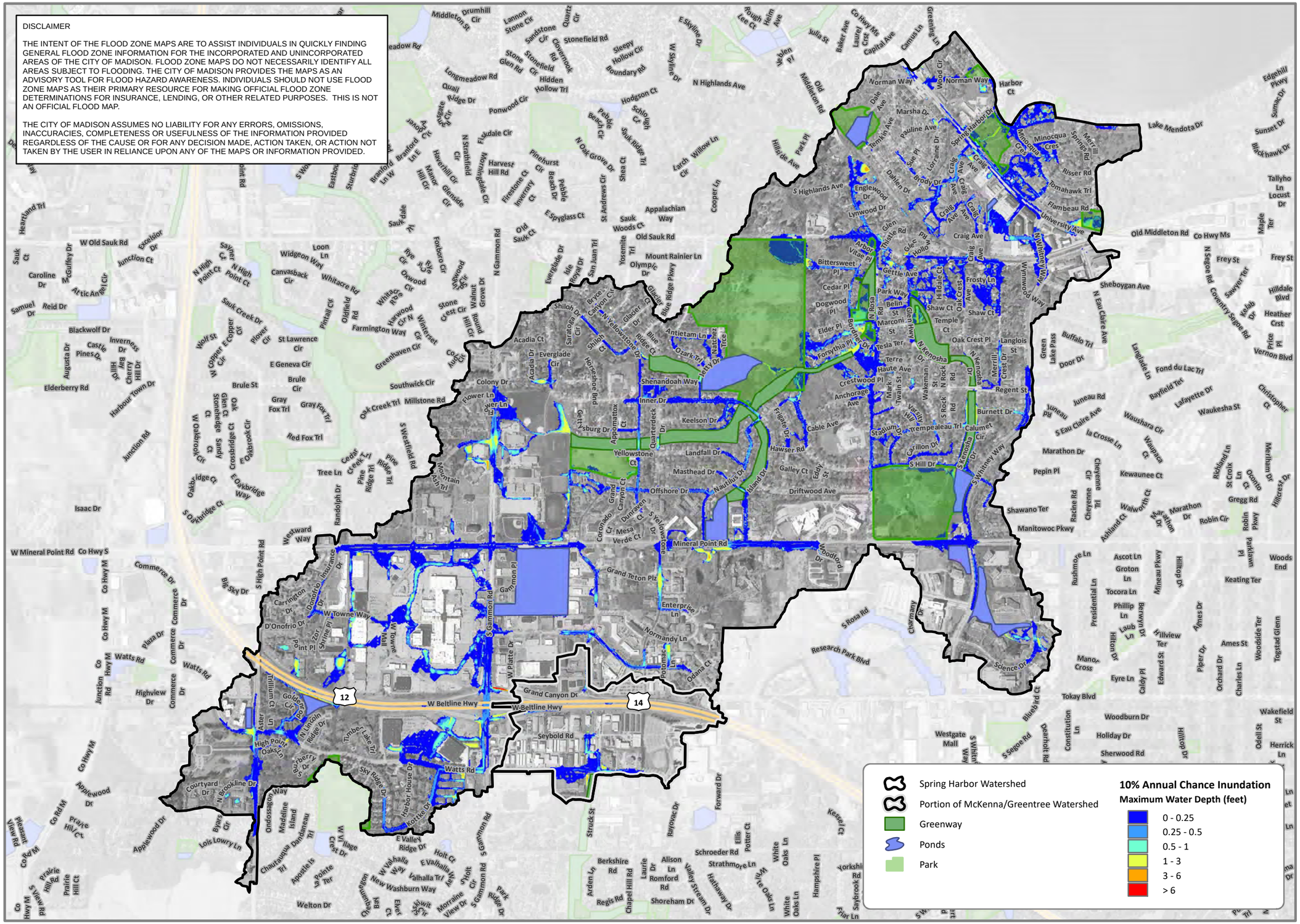

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 12

EXISTING: 10% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

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Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 12- Existing 10% Chance Flooding.mxd

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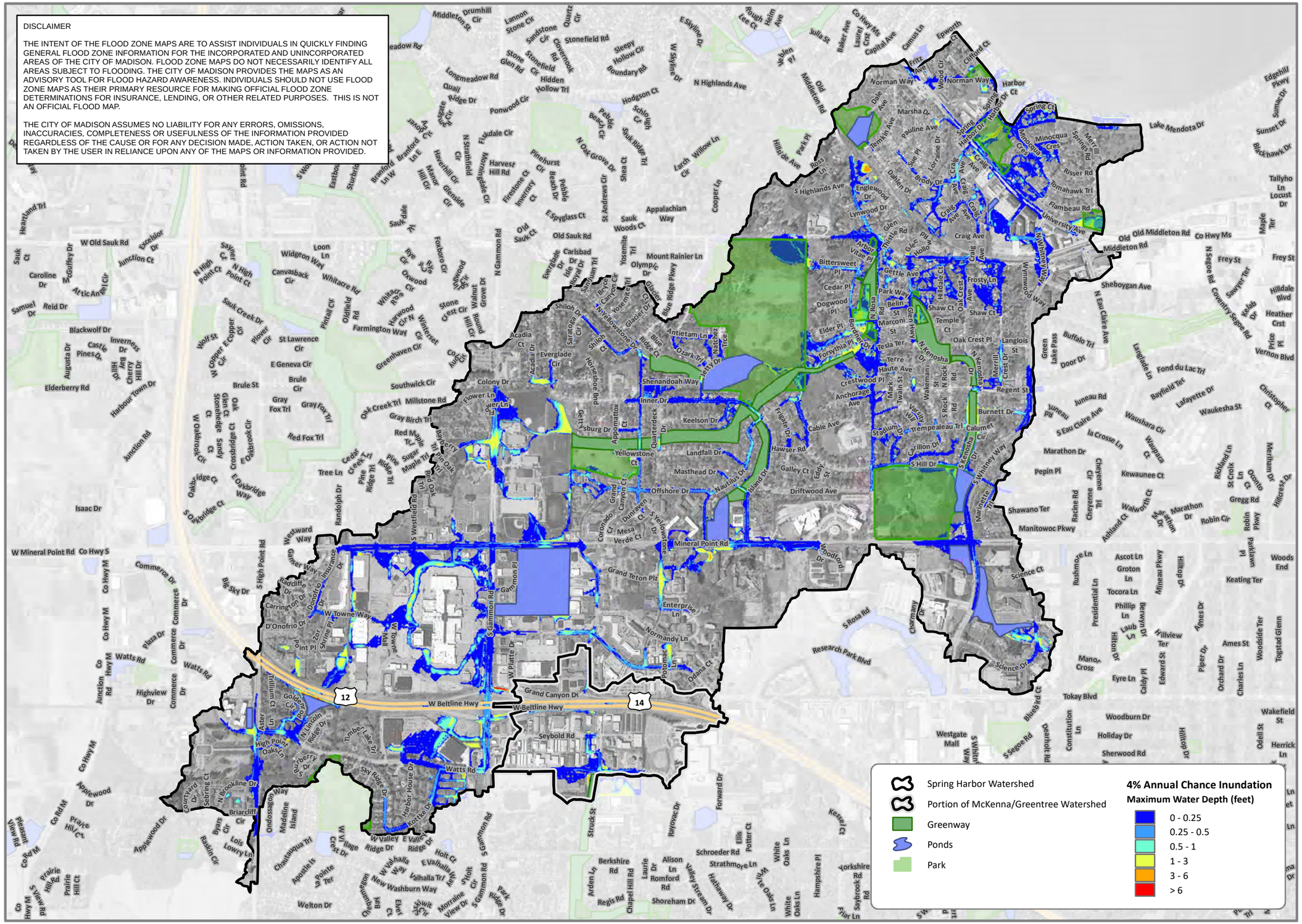

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 13

EXISTING: 4% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

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Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 13- Existing 4% Chance Flooding.mxd

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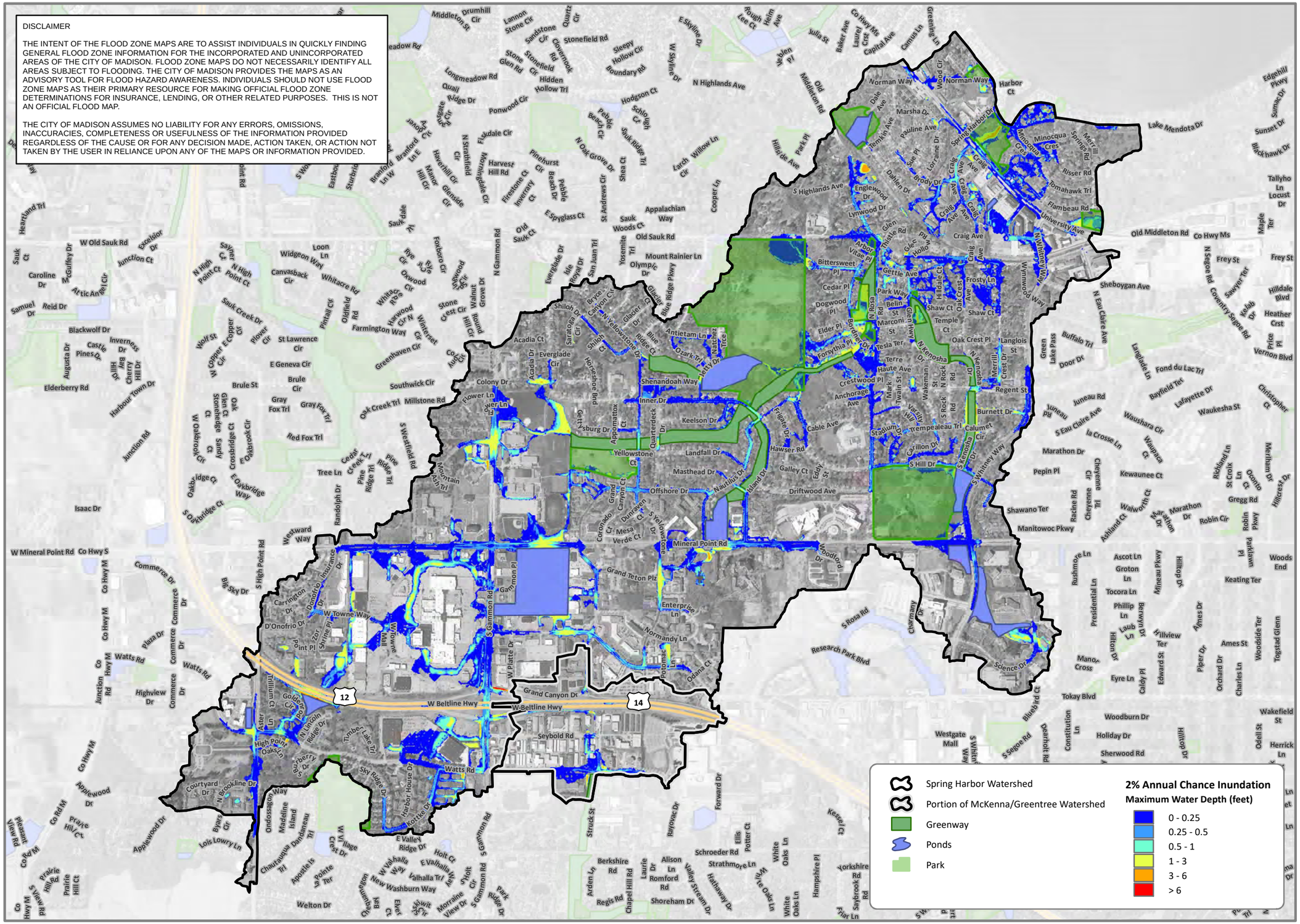

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N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 14

EXISTING: 2% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

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Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 14- Existing 2% Chance Flooding.mxd

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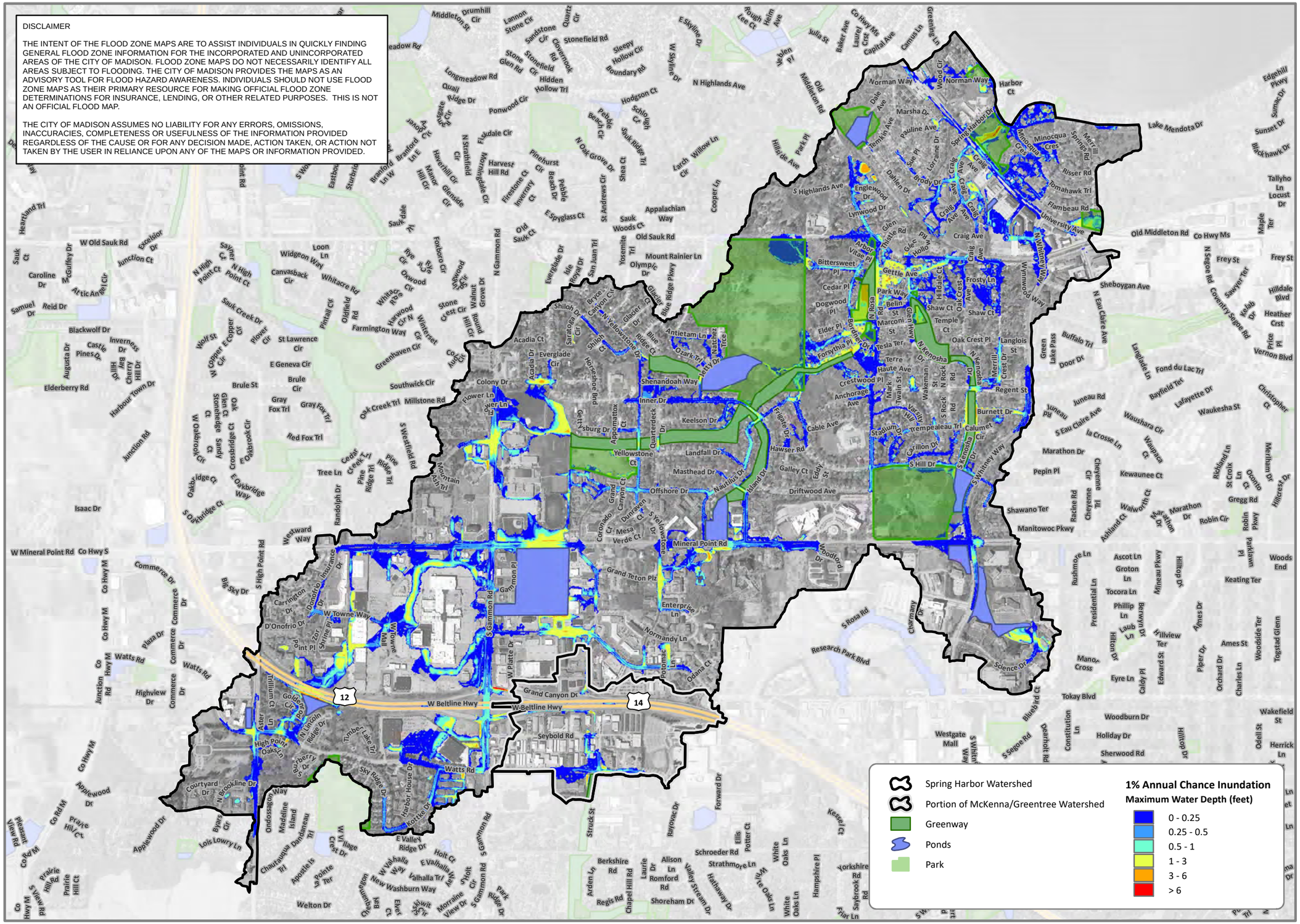

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 15

EXISTING: 1% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

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Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 15- Existing 1% Chance Flooding.mxd

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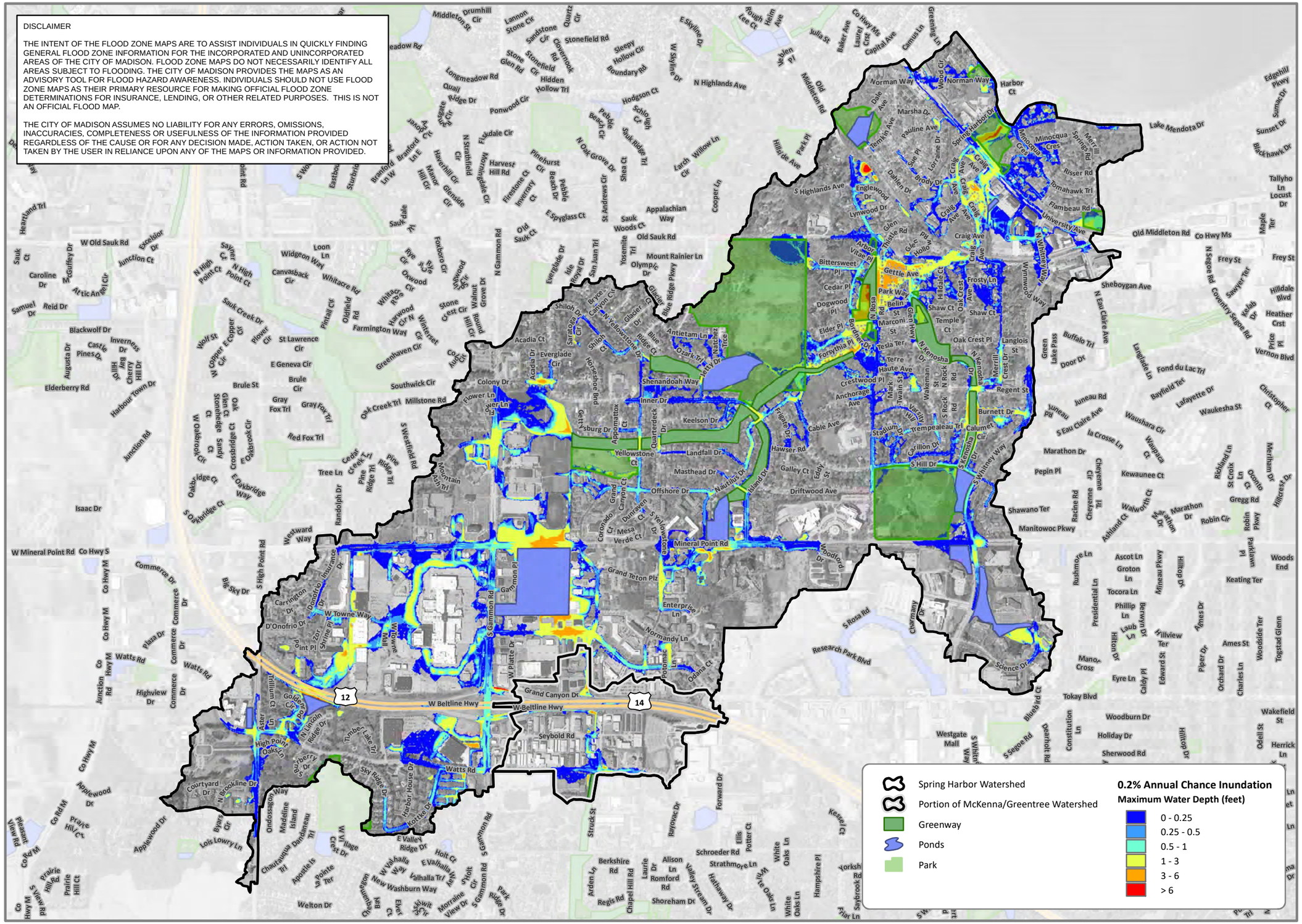

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 16

EXISTING: 0.2% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 16- Existing 0.2% Chance Flooding.mxd

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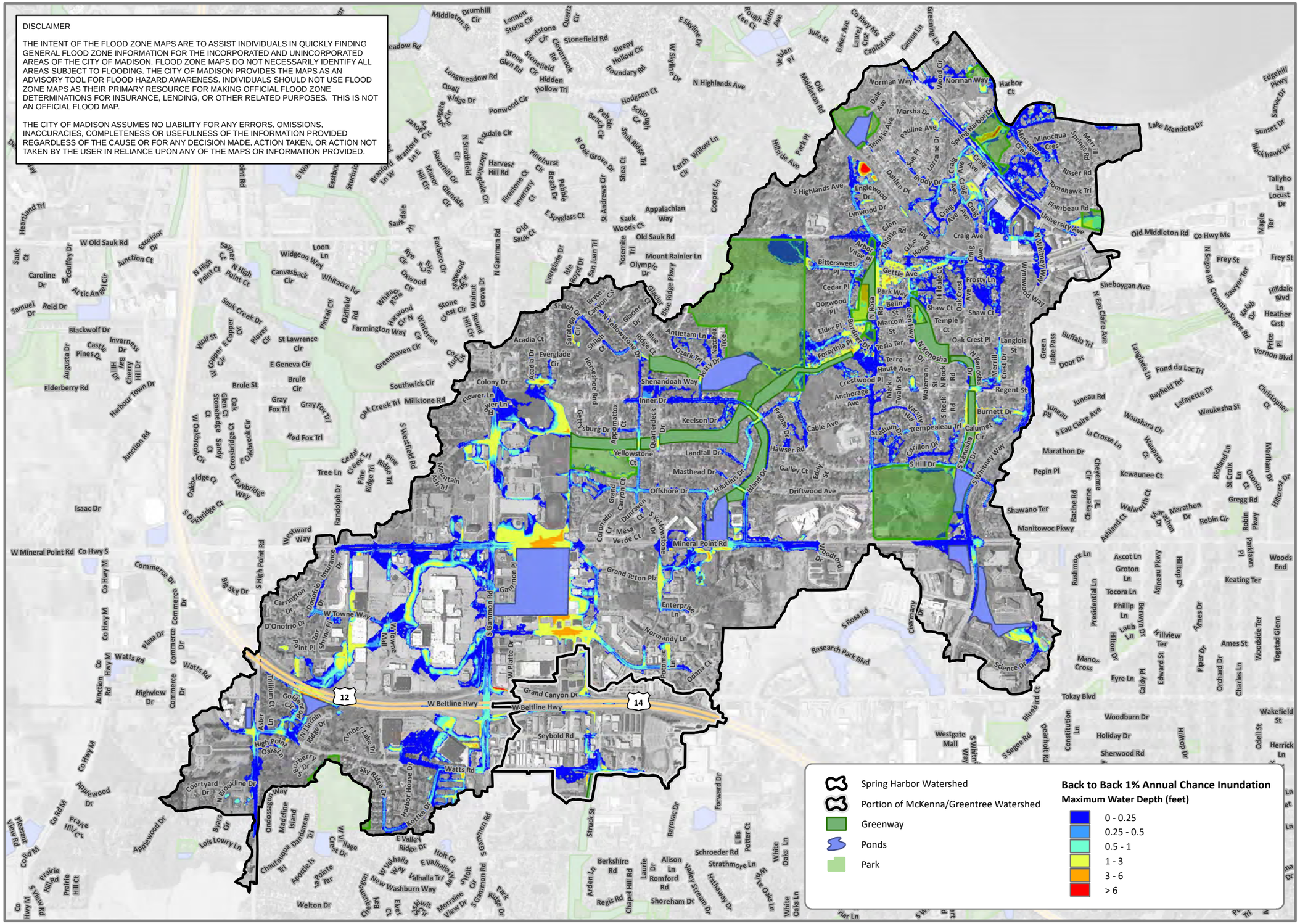

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 17

EXISTING: BACK TO BACK 1% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 17- Existing Back to Back 1% Chance Flooding.mxd

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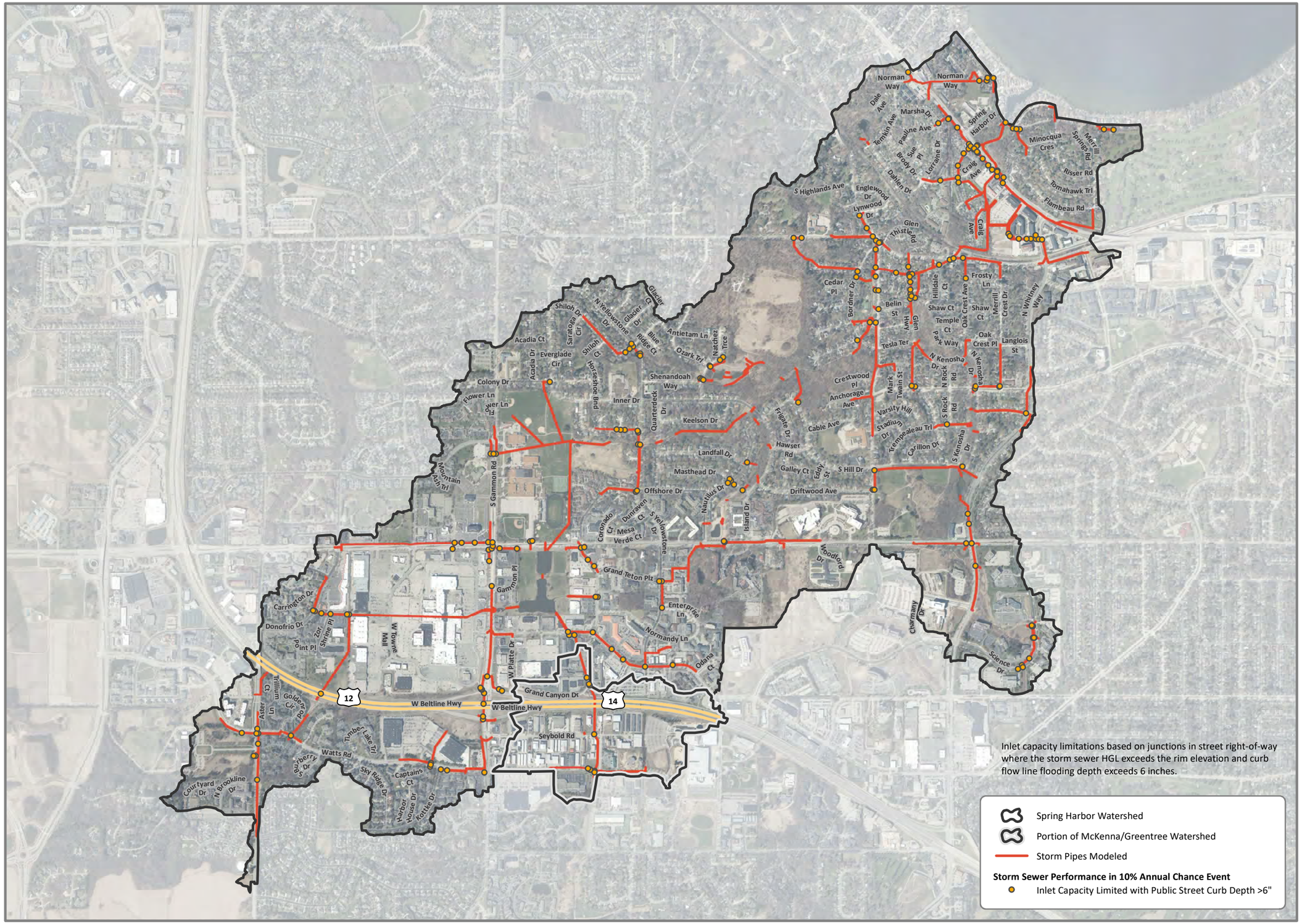


N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 18

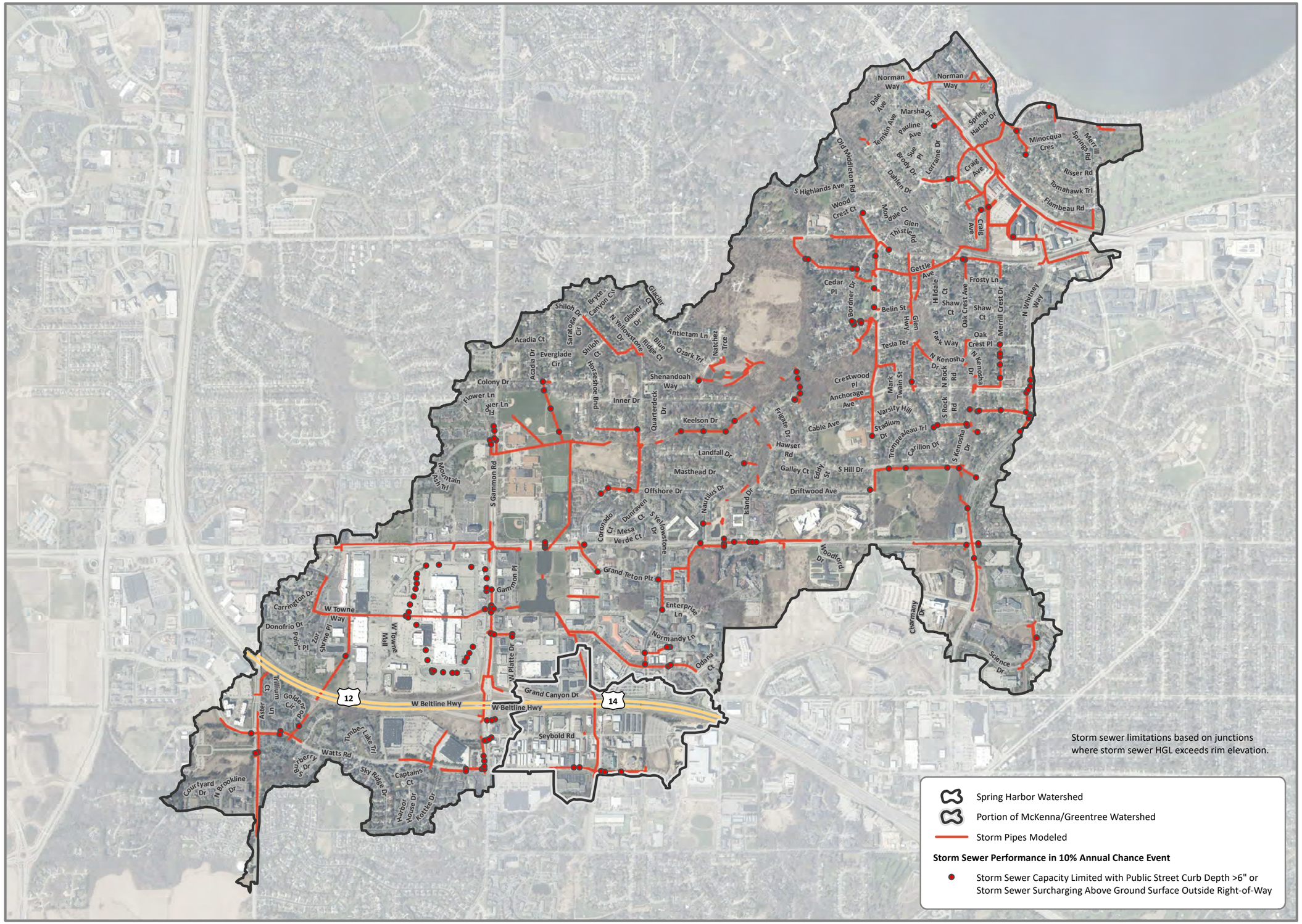
EXISTING: INLET CAPACITY FOR 10% ANNUAL CHANCE STORM EVENT

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 9/1/2021

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 18- Existing Inlet Capacity for 10% ACE Design Storm.mxd



Storm sewer limitations based on junctions where storm sewer HGL exceeds rim elevation.

Spring Harbor Watershed

Portion of McKenna/Greentree Watershed

Storm Pipes Modeled

Storm Sewer Performance in 10% Annual Chance Event

Storm Sewer Capacity Limited with Public Street Curb Depth >6" or Storm Sewer Surcharging Above Ground Surface Outside Right-of-Way

N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 19

EXISTING: PIPE CAPACITY FOR 10% ANNUAL CHANCE STORM EVENT

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 9/1/2021

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 19- Existing Pipe Capacity for 10% ACE Design Storm.mxd

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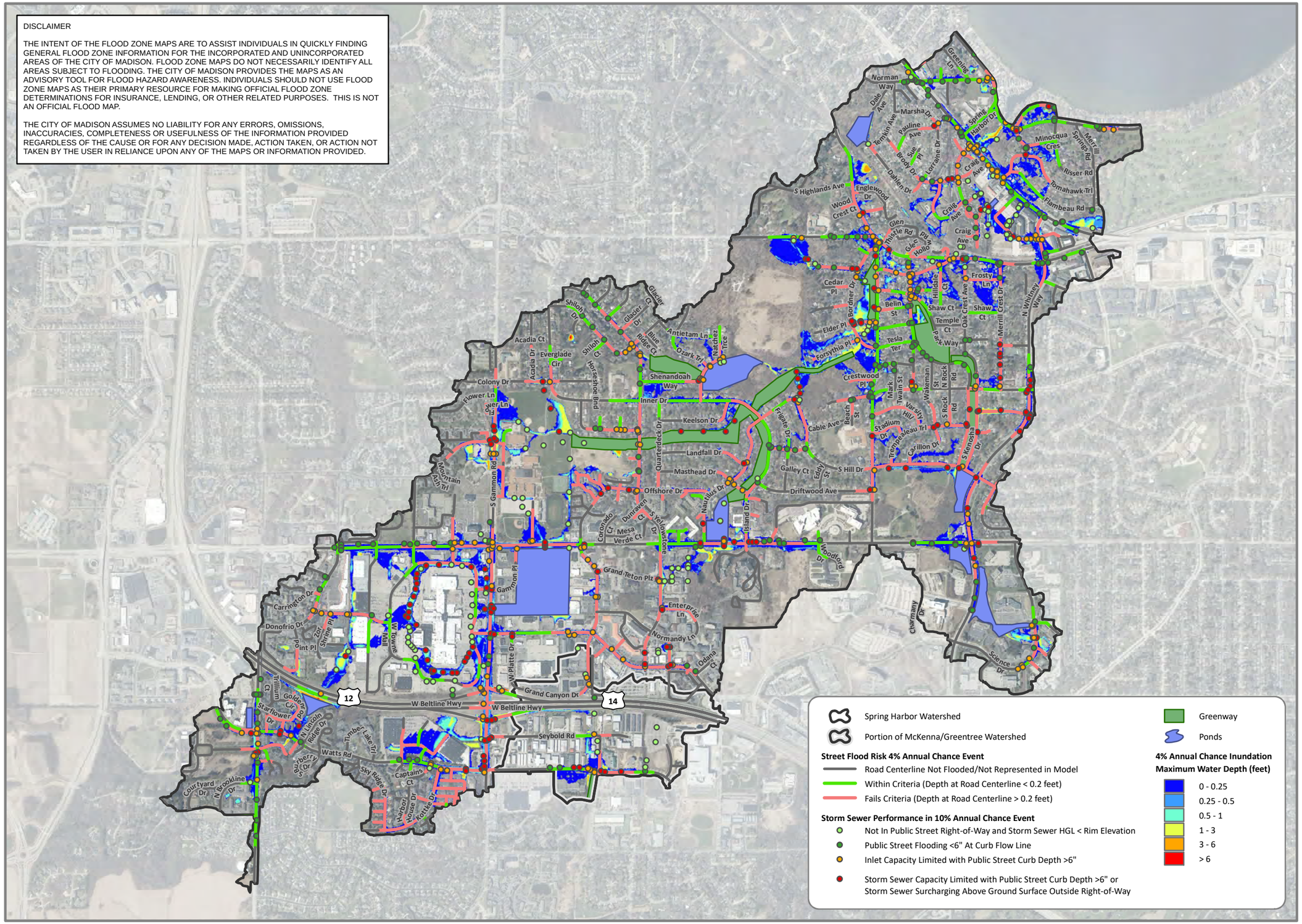

N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 20

EXISTING: 10% AND 4% ANNUAL CHANCE EVENT

FLOOD MITIGATION GOAL PERFORMANCE

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 20- Existing 10% and 4% Flood Mitigation Goal Performance.mxd

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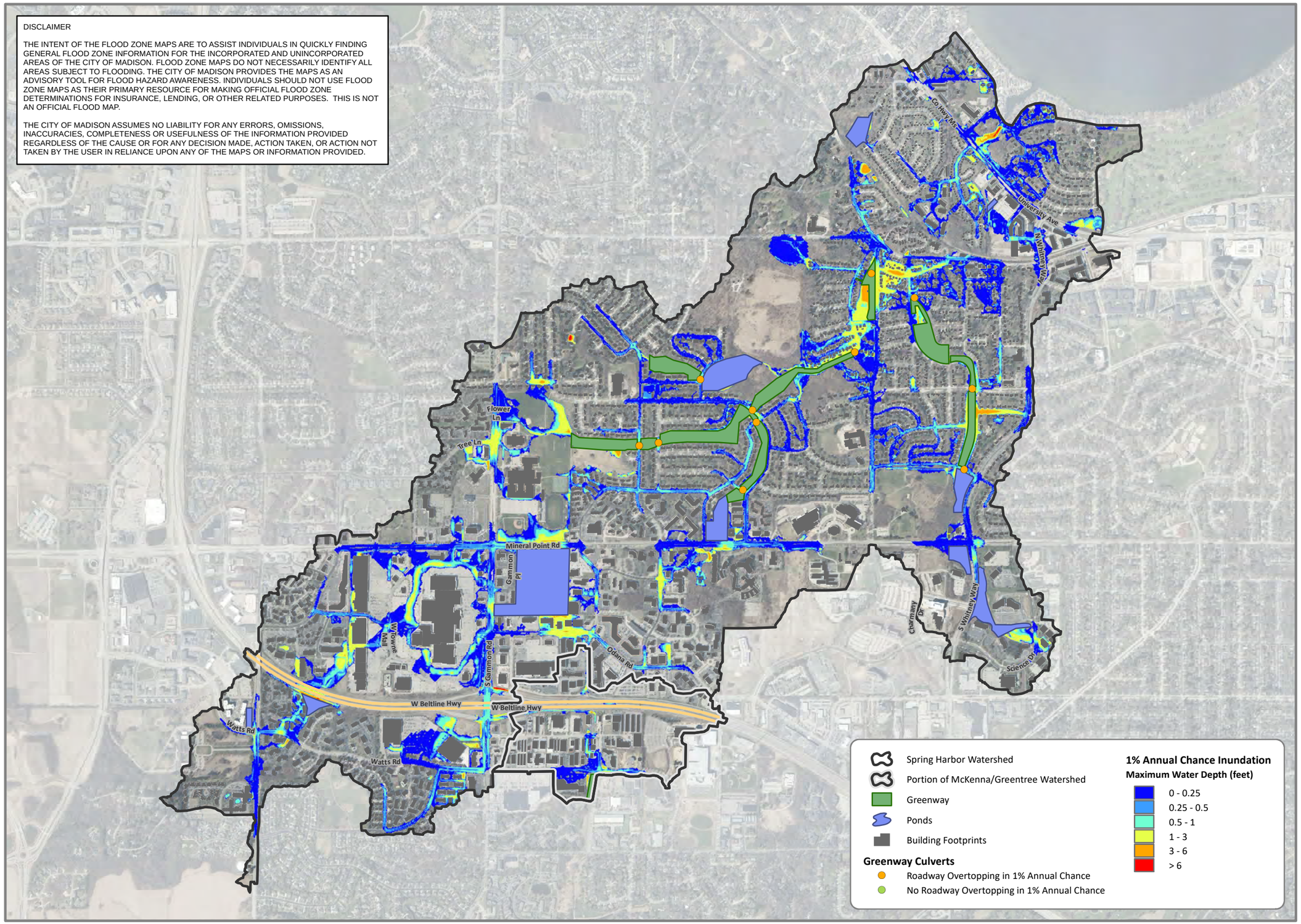

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 21

EXISTING: 1% ANNUAL CHANCE EVENT

FLOOD MITIGATION GOAL PERFORMANCE

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

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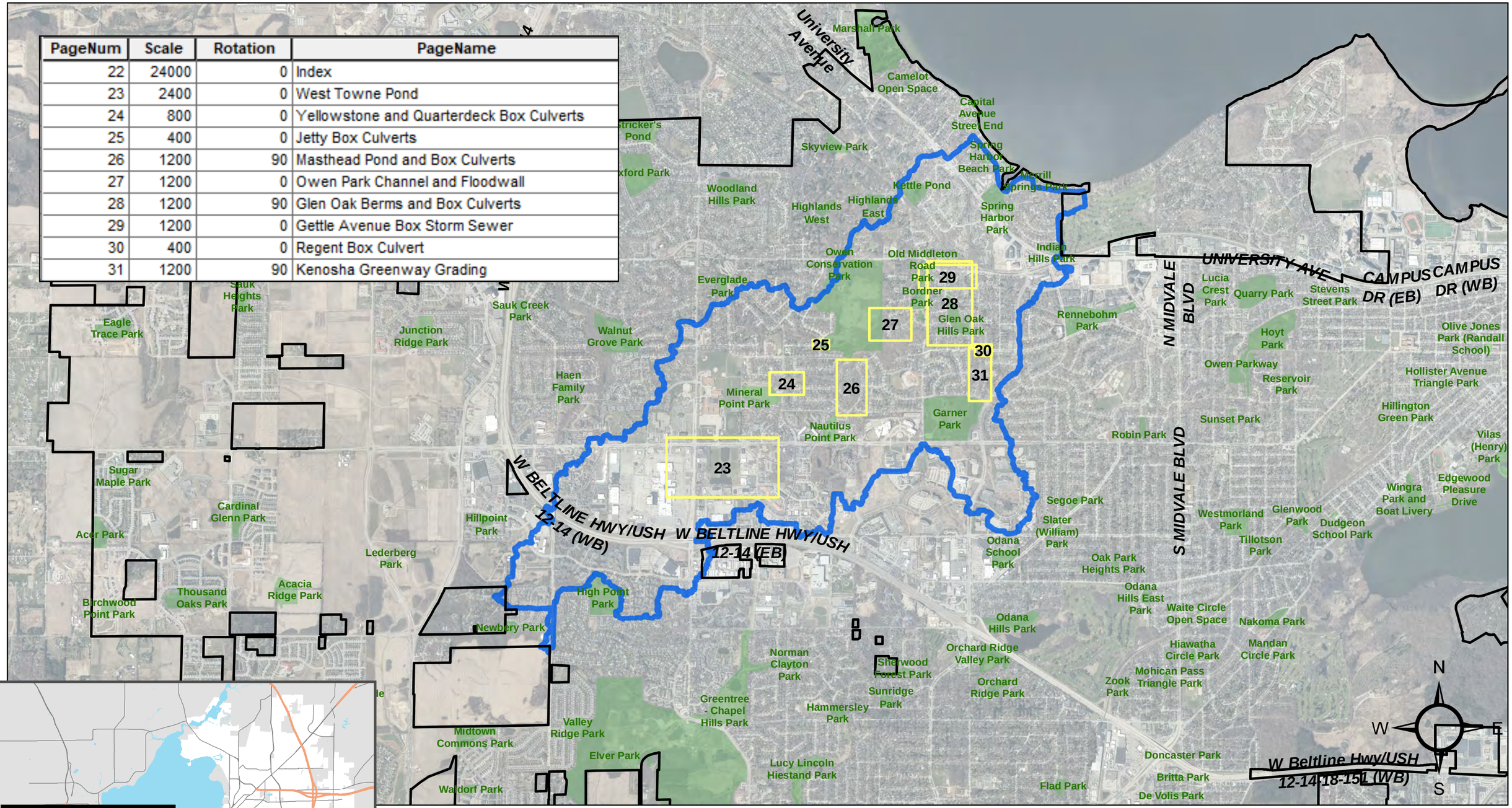
Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 21- Existing 1% Flood Mitigation Goal Performance.mxd

PageNum	Scale	Rotation	PageName
22	24000	0	Index
23	2400	0	West Towne Pond
24	800	0	Yellowstone and Quarterdeck Box Culverts
25	400	0	Jetty Box Culverts
26	1200	90	Masthead Pond and Box Culverts
27	1200	0	Owen Park Channel and Floodwall
28	1200	90	Glen Oak Berms and Box Culverts
29	1200	0	Gettle Avenue Box Storm Sewer
30	400	0	Regent Box Culvert
31	1200	90	Kenosha Greenway Grading



Detailed Sheet

Municipal Limits

Spring Harbor Watershed

Park

Spring Harbor Watershed Study

Figure 22: Proposed Solutions: Index

0 4 8 Miles

Date: 6/9/2022

User Name: ehau

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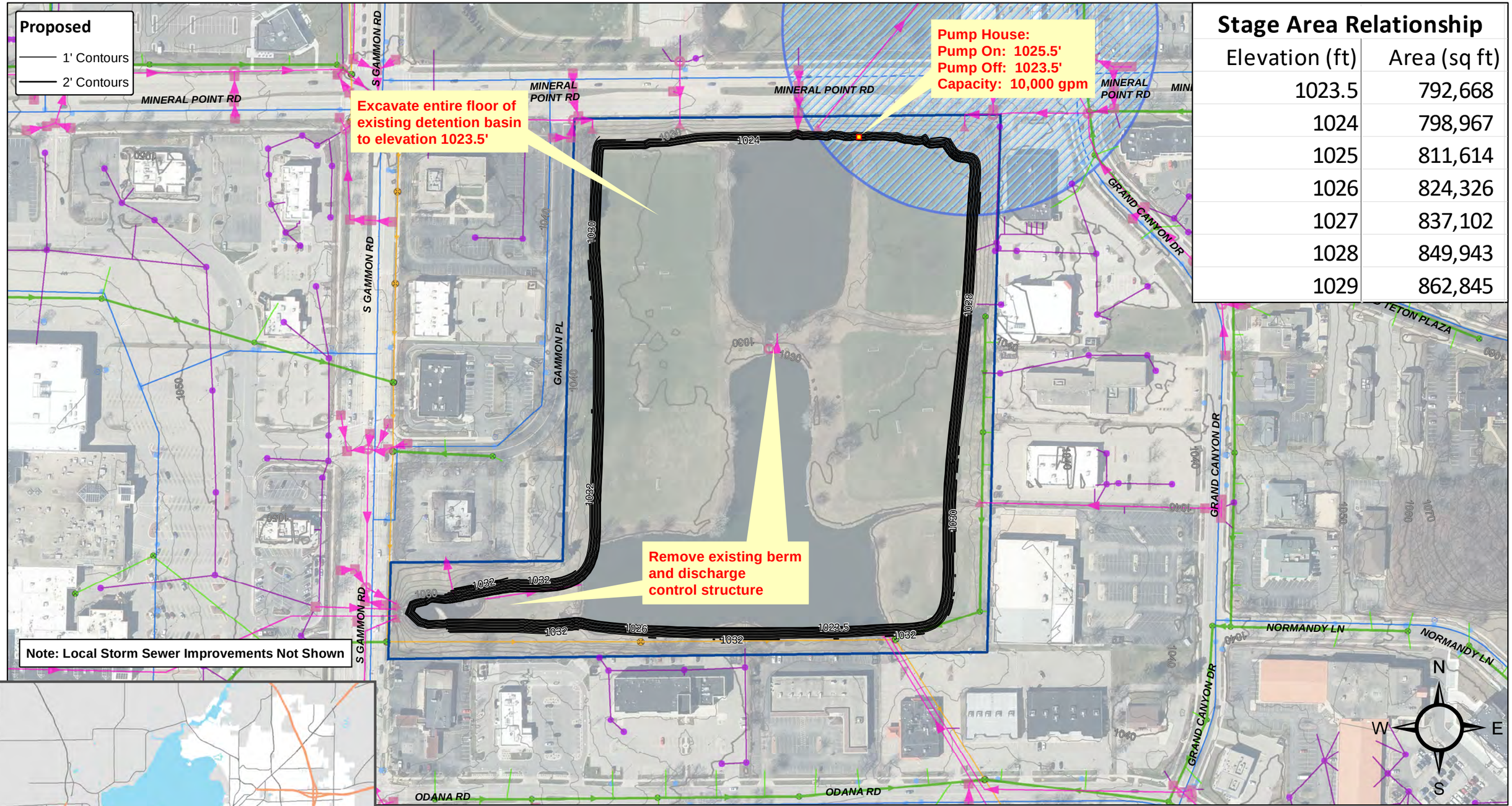
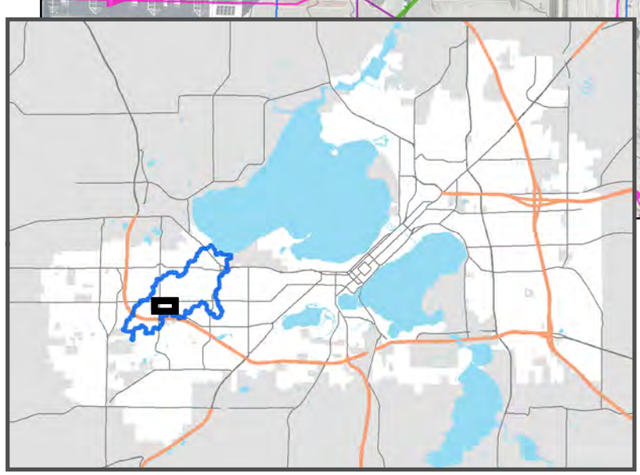


Stage Area Relationship

Elevation (ft)	Area (sq ft)
1023.5	792,668
1024	798,967
1025	811,614
1026	824,326
1027	837,102
1028	849,943
1029	862,845



Pond
Storm Pipe
Other Storm Structure
Access Structures
Apron
Inlet
Private Storm Pipes-Approx
Private Storm Structures-A...
Sanitary Mains
SAS
Sanitary Laterals
MMSD Mains
MMSD SAS
Water Main
Water Valve
Water Hydrant
No Wet Pond Within 400' of Well
Existing
2' Contour
10' Contour

Spring Harbor Watershed Study

Figure 23: Proposed Solutions: West Towne Pond

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
-Wellhead protection zone - depth to groundwater
-Relocated soccer fields
-Allow for forebays and access roads with final design, which may reduce pond footprint

0 200 400 Feet

Date: 6/9/2022

Document Path: P:\1869 AE2S\0001 Madison Spring Harbor Watershed\09_GIMS\SolutionFigures_ALL\individual sheet mxd\Sheet2_WestTowne_Fig23.mxd

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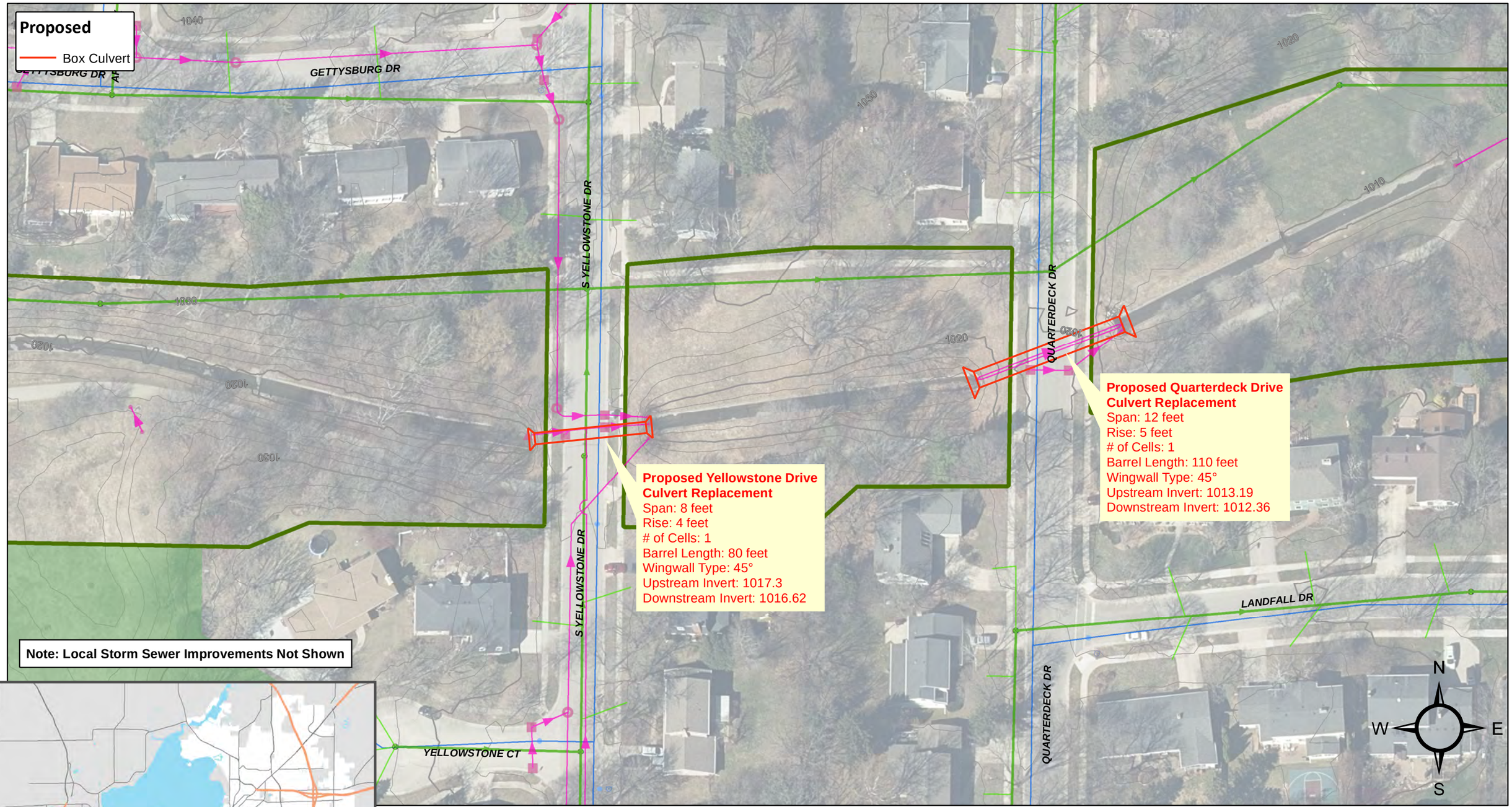

Greenway
Park
Storm Pipe
Other Storm Structure
Access Structures
Apron
Inlet
Other
Sanitary Mains
SAS
Sanitary Laterals
Water Main
Water Valve
Water Hydrant
Existing
2' Contour
10' Contour

Spring Harbor Watershed Study

Figure 24: Proposed Solutions: Yellowstone and Quarterdeck Box Culverts

0 50 100 Feet

Date: 6/9/2022

Document Path: P:\1869 AE2S\0001 Madison Spring Harbor Watershed\09_GIMS\SolutionFigures_ALL\Individual sheet mxd\Sheet3_Yellowstone_Quarterdeck_Fig24.mxd

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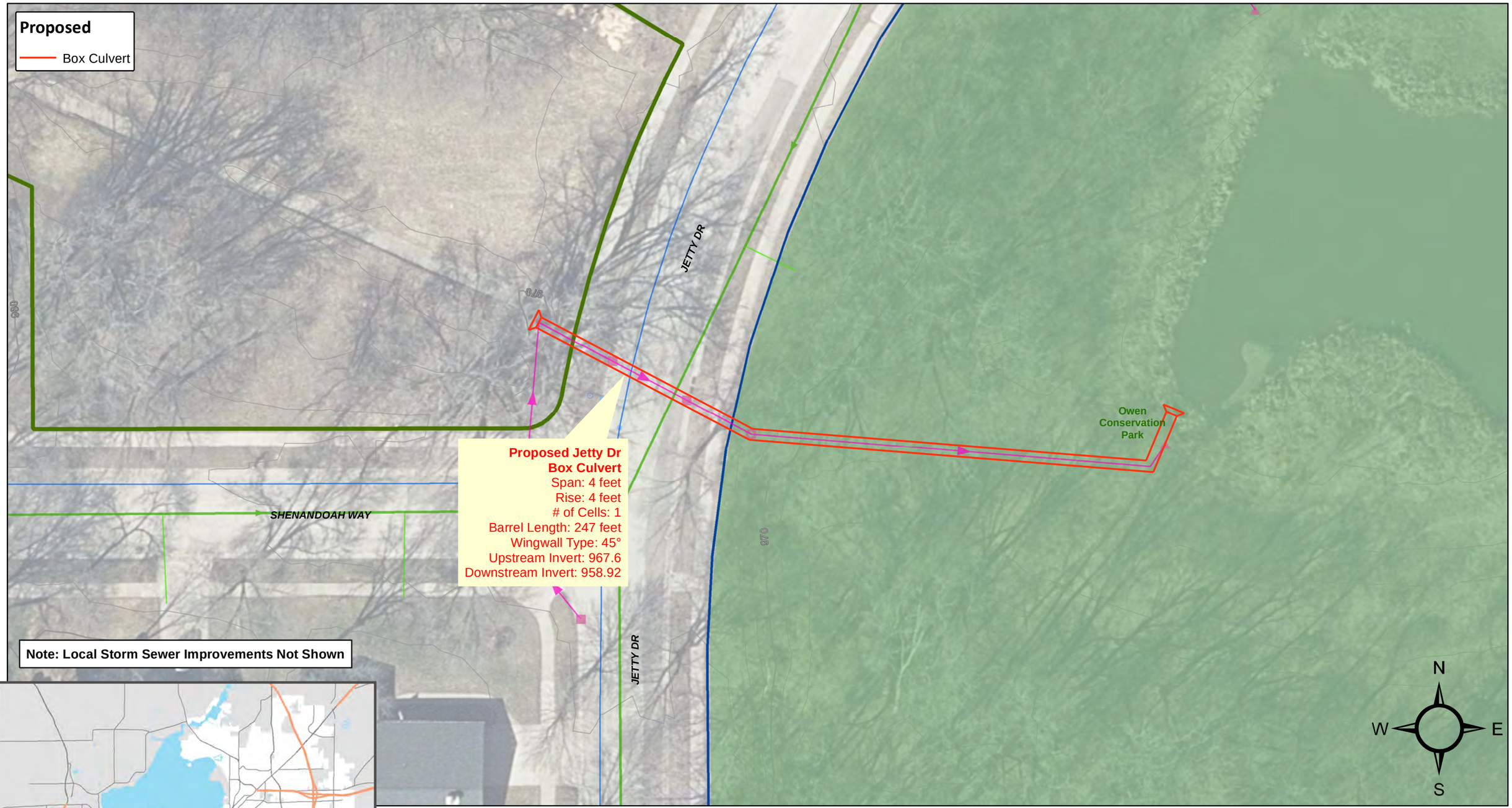

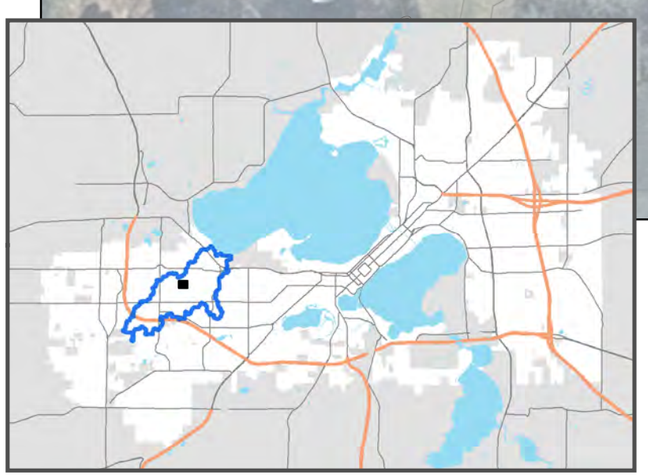

Greenway
Pond
Park
Storm Pipe
Access Structures
Apron
Inlet
Other
Sanitary Mains
SAS
Sanitary Laterals
Water Main
Water Valve
Water Hydrant
Existing
2' Contour
10' Contour

Spring Harbor Watershed Study

Figure 25: Proposed Solutions: Jetty Box Culverts

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
- Conservation Park

0 50 100 Feet

Date: 6/9/2022

Document Path: P:\1869 AE2S\0001 Madison Spring Harbor Watershed\09_GIMS\SolutionFigures_ALL\Individual sheet mxd\Sheet4_Jetty_Fig25.mxd

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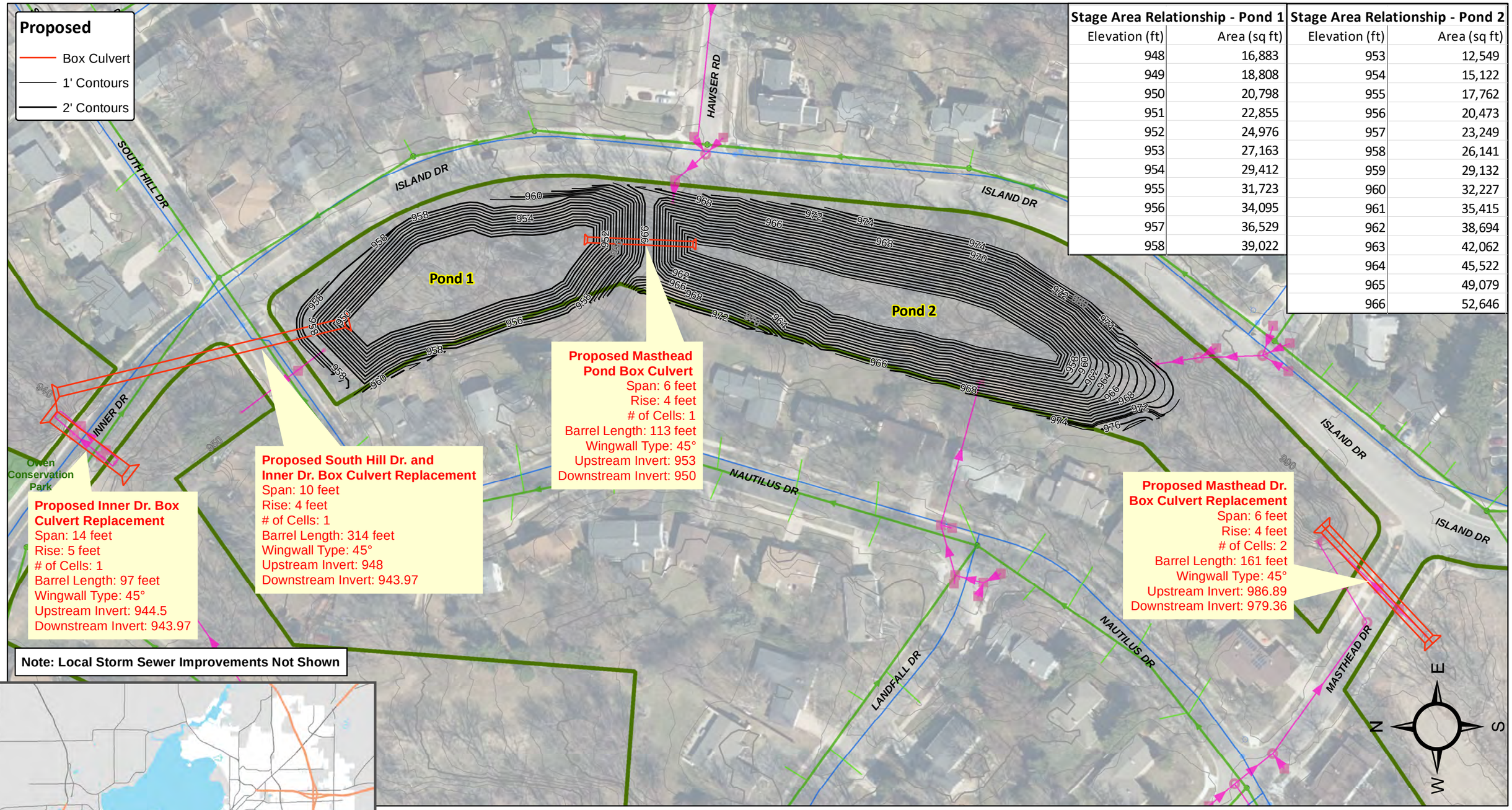
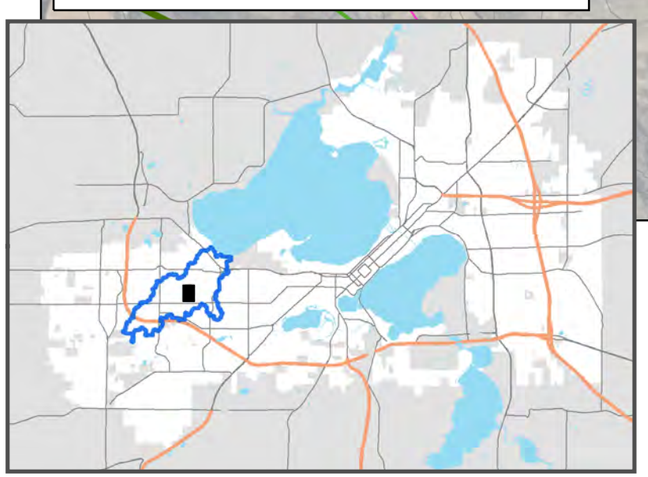


Stage Area Relationship - Pond 1

Elevation (ft)	Area (sq ft)
948	16,883
949	18,808
950	20,798
951	22,855
952	24,976
953	27,163
954	29,412
955	31,723
956	34,095
957	36,529
958	39,022

Stage Area Relationship - Pond 2

Elevation (ft)	Area (sq ft)
953	12,549
954	15,122
955	17,762
956	20,473
957	23,249
958	26,141
959	29,132
960	32,227
961	35,415
962	38,694
963	42,062
964	45,522
965	49,079
966	52,646



Greenway
Park
Storm Pipe
Other Storm Structure
Access Structures
Apron
Inlet
Other
Sanitary Mains
SAS
Sanitary Laterals
Water Main
Water Valve
Water Hydrant
Existing
2' Contour
10' Contour

Spring Harbor Watershed Study

Figure 26: Proposed Solutions: Masthead Pond and Box Culverts

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
- Depth to water table
- Grading easement may be needed for private lands west of ponds.

CITY OF MADISON ENGINEERING

0 50 100 Feet

Date: 6/9/2022

Document Path: P:\11869 AE2S\0001 Madison Spring Harbor Watershed\09_GIMS\SolutionFigures_ALL\individual sheet mxd\Sheet5_Masthead_Fig26.mxd

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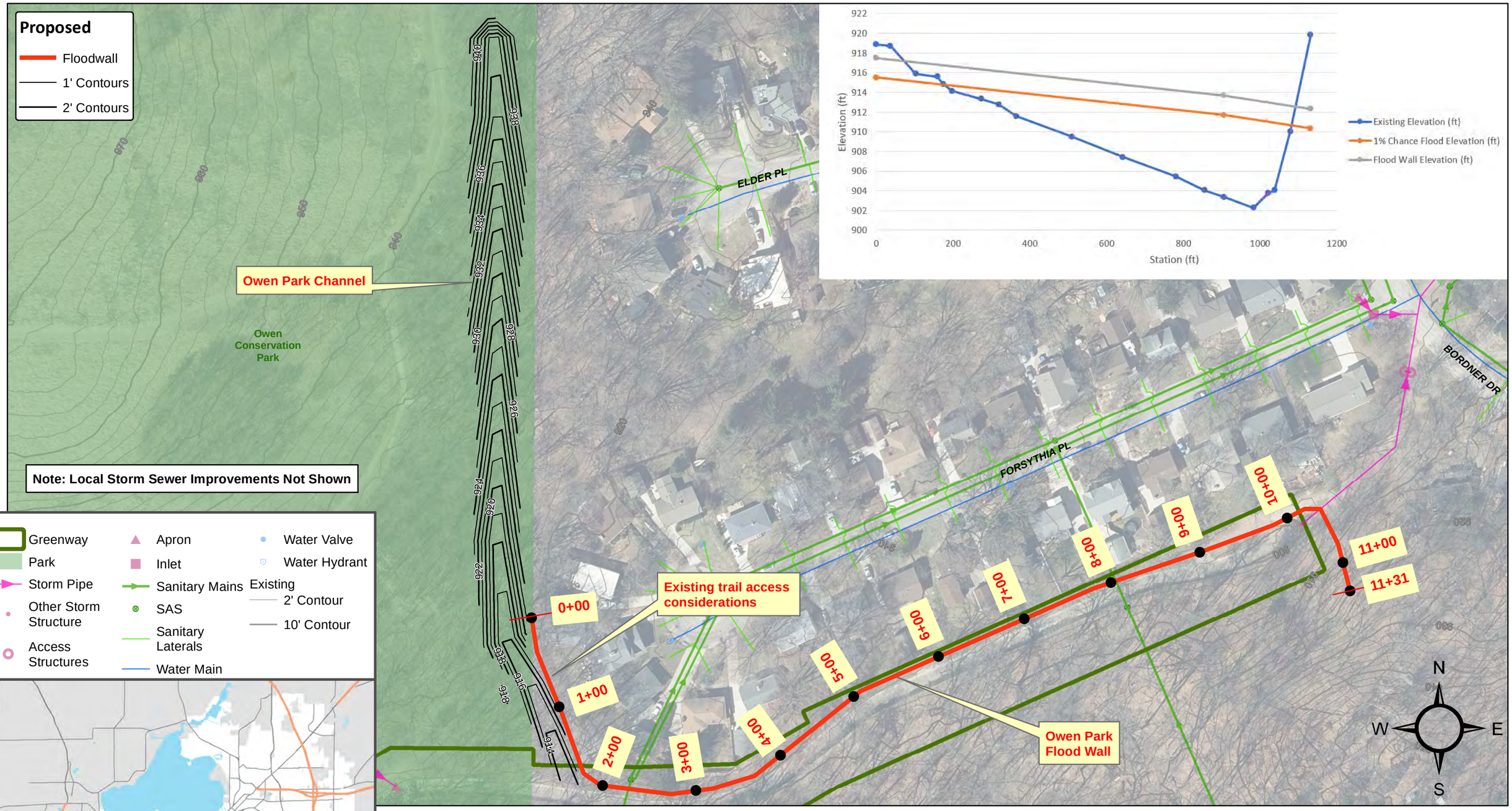


Greenway
Park
Storm Pipe
Other Storm Structure
Access Structures
Apron
Inlet
Sanitary Mains
SAS
Sanitary Laterals
Water Main
Water Valve
Water Hydrant
Existing
2' Contour
10' Contour

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
- Property ownership south of existing Owen Park concrete channel
- Access / removable floodwall section needed near station 10+00
- Sanitary sewer depth relative to footing depth / design
- Floodwall height / overturning stability
- Coordination needed on impacts to existing walking paths within Owen Conservation Park and on Crestwood Neighborhood land
- Design to consider drainage on north side of wall, which may include piping downspouts through wall with backflow preventers or a drainage pipe to Bordner Park via Bordner Drive

Spring Harbor Watershed Study
Figure 27: Proposed Solutions: Owen Park Channel and Floodwall

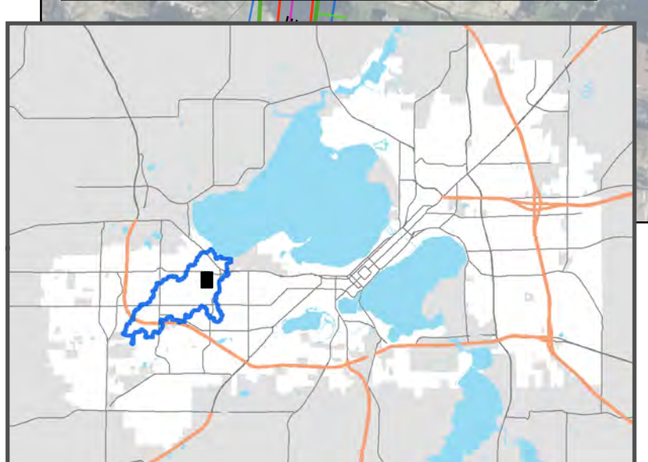
CITY OF MADISON ENGINEERING

0 50 100 Feet

Date: 6/9/2022

User Name: ehau

Document Path: P:\1869 AE2S\0001 Madison Spring Harbor Watershed\09_GIMS\SolutionFigures_ALL\Individual sheet mxd\Sheet6_Owen_Fig27.mxd



Greenway
Park
Storm Pipe
Other Storm Structure
Access Structures
Inlet
Other
Sanitary Mains
SAS
Sanitary Laterals
Water Main
Water Valve
Water Hydrant
Existing
2' Contour
10' Contour

Spring Harbor Watershed Study

Figure 28: Proposed Solutions: Glen Oak Berms and Box Culverts

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
- Park Impacts

0 100 200 Feet

Date: 6/9/2022

Document Path: P:\1869 AE2S\0001 Madison Spring Harbor Watershed\09_GIMS\SolutionFigures_ALL\individual sheet mxd\Sheet7_GlenOak_Fig28.mxd

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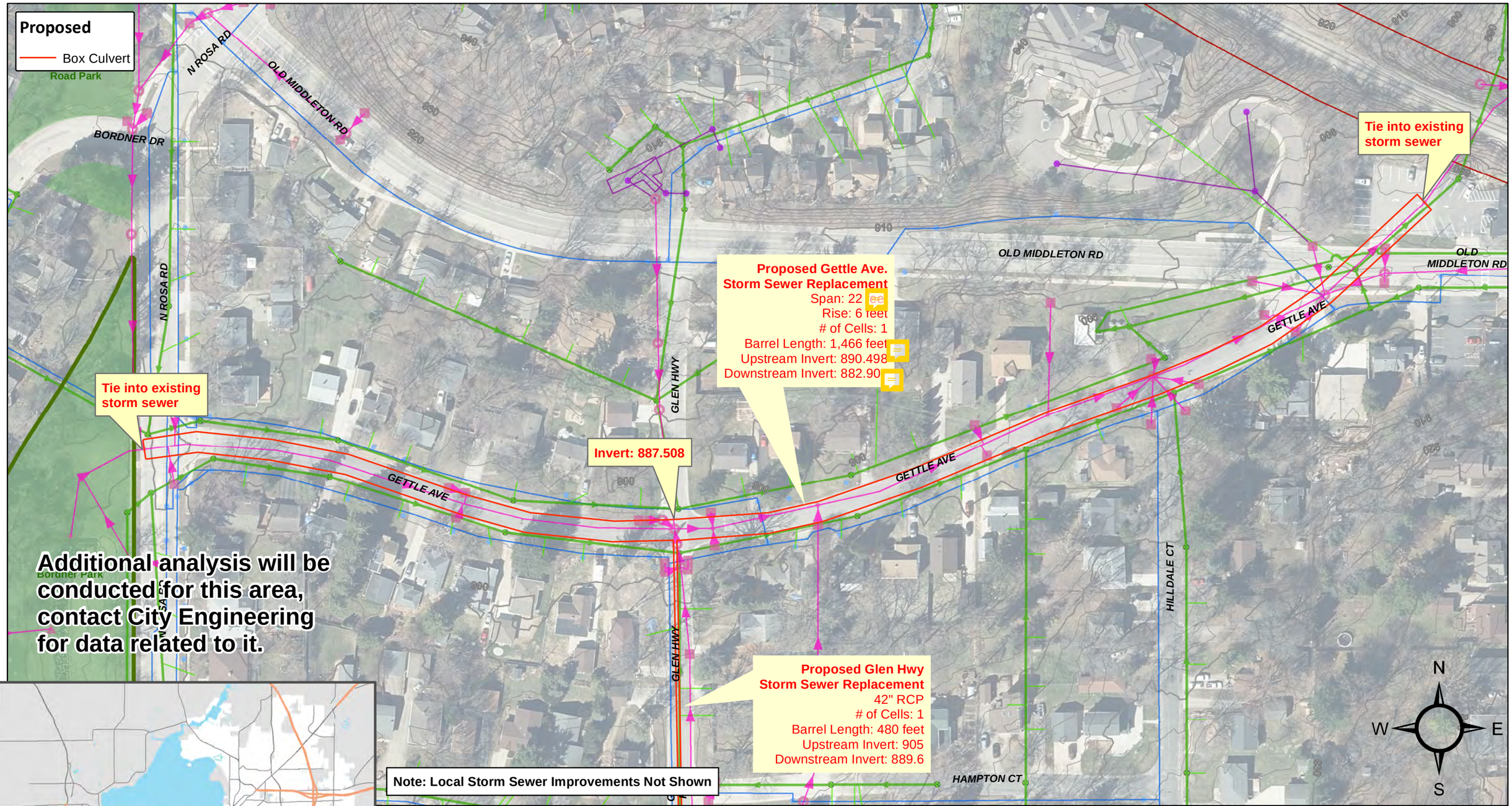

Greenway
Park
Storm Pipe
Other Storm Structure
Access Structures
Apron
Inlet
Other
Private Storm Pipes-Approx
Private Storm Structures-A...
Sanitary Mains
SAS
Sanitary Laterals
Water Main
Water Valve
Water Hydrant
Railroad ROW
Existing
2' Contour
10' Contour

Spring Harbor Watershed Study

Figure 29: Proposed Solutions: Gettle Avenue Box Storm Sewer

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
- Utility conflicts

0 100 200 Feet

Date: 6/9/2022

Document Path: P:\1869 AE2S\0001 Madison Spring Harbor Watershed\09_GIMS\SolutionFigures_ALL\Individual sheet mxd\Sheet8_Gettle_Fig29.mxd

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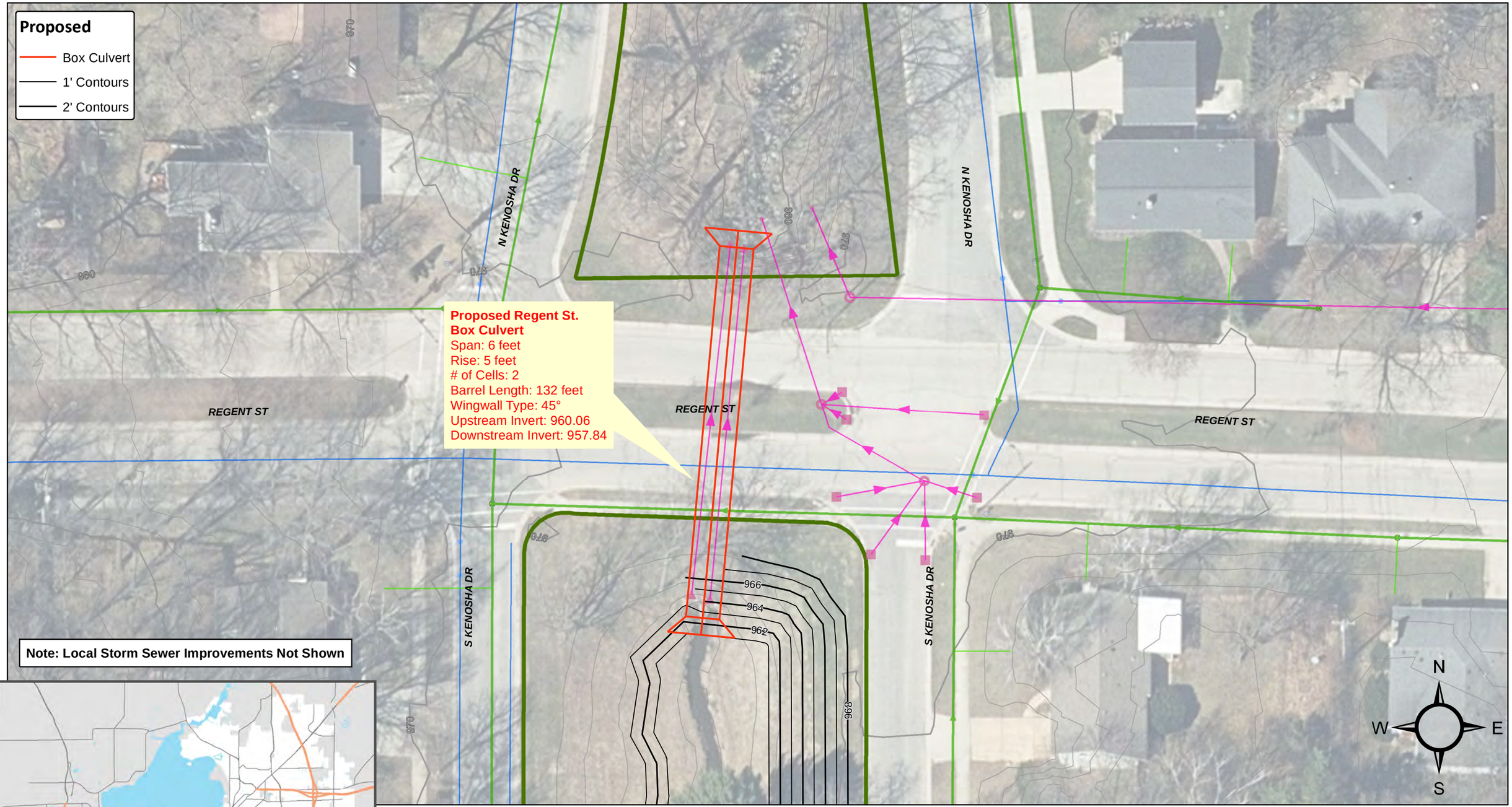

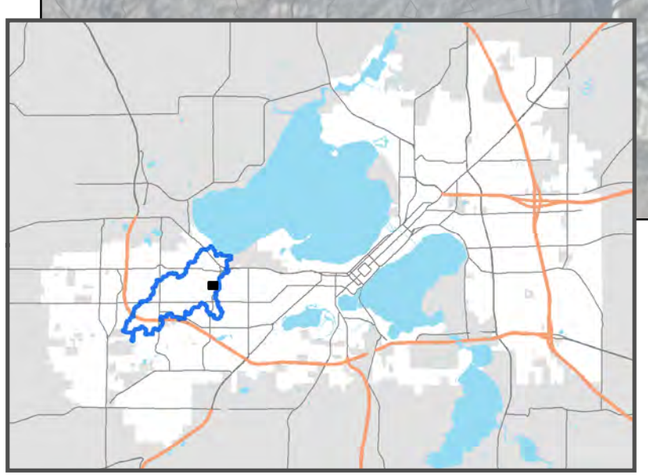

Greenway
Storm Pipe
Other Storm Structure
Access Structures
Apron
Inlet
Sanitary Mains
SAS
Sanitary Laterals
Water Main
Water Valve
Water Hydrant
Existing
2' Contour
10' Contour

Spring Harbor Watershed Study

Figure 30: Proposed Solutions: Regent Box Culvert

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
- None

0 25 50 Feet

Date: 6/9/2022

Document Path: P:\1869 AE2S\0001 Madison Spring Harbor Watershed\09_GIMS\SolutionFigures_ALL\Individual sheet mxd\Sheet9_Regent_Fig30.mxd

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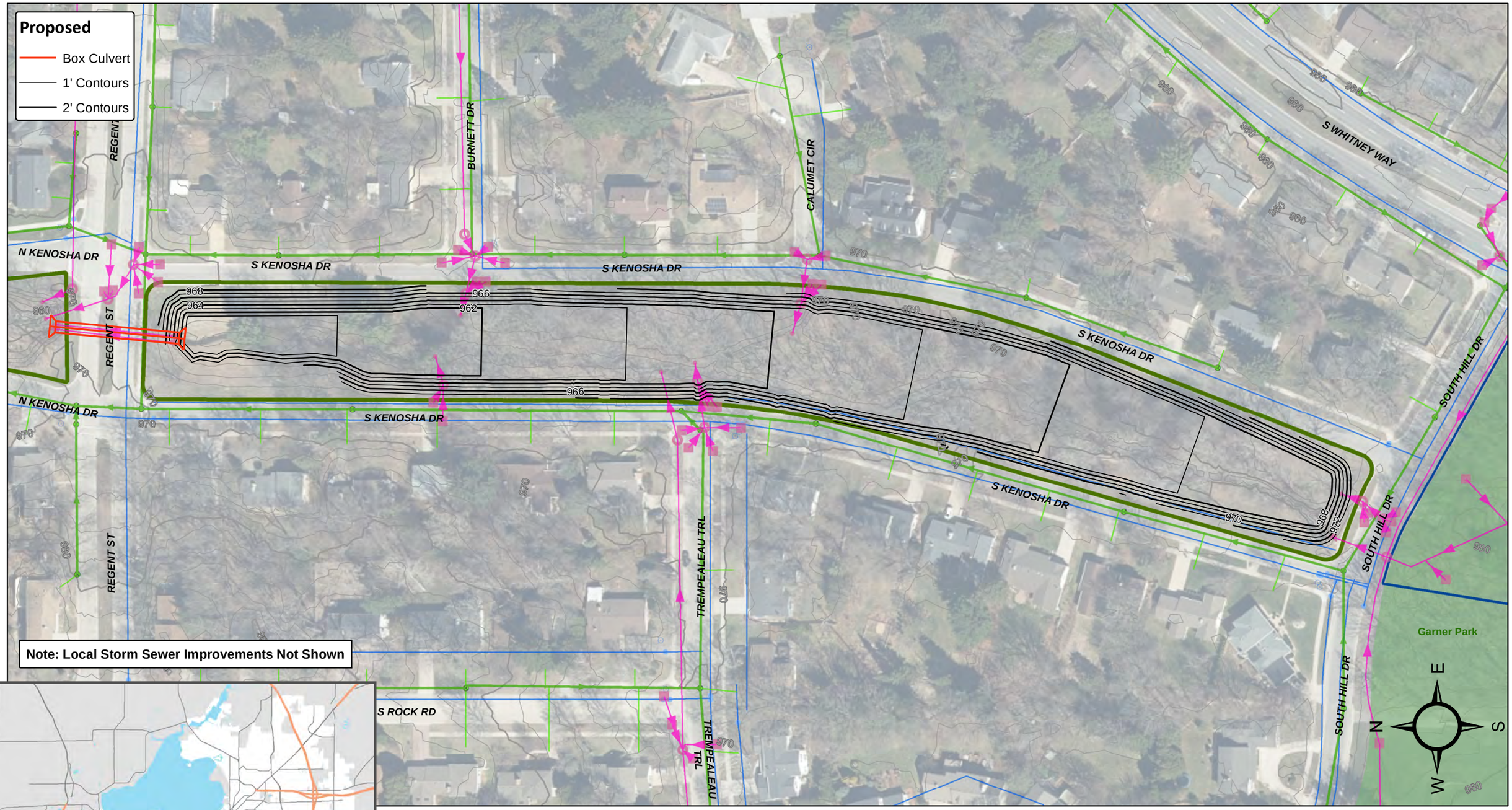

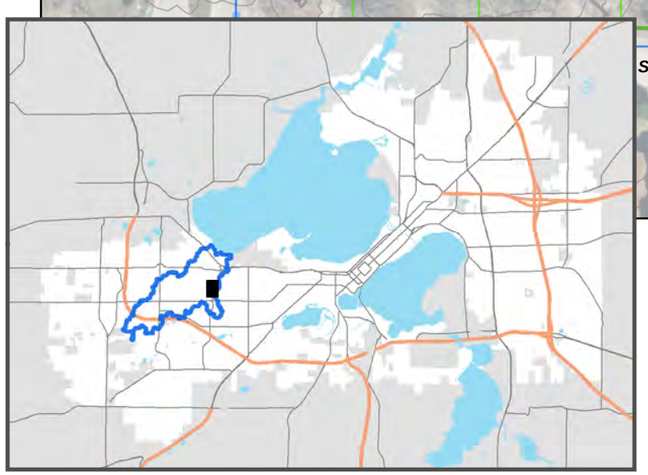

Greenway
Pond
Park
Storm Pipe
Other Storm Structure
Access Structures
Apron
Inlet
Other
Sanitary Mains
SAS
Sanitary Laterals
Water Main
Water Valve
Water Hydrant
Existing
2' Contour
10' Contour

Spring Harbor Watershed Study

Figure 31: Proposed Solutions: Kenosha Greenway Grading

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
- Potential for significant tree impacts.

0 100 200 Feet

Date: 6/9/2022

Document Path: P:\1869 AE2S\0001 Madison Spring Harbor Watershed\09_GIMS\SolutionFigures_ALL\individual sheet mxd\Sheet10_Kenosha_Fig31.mxd

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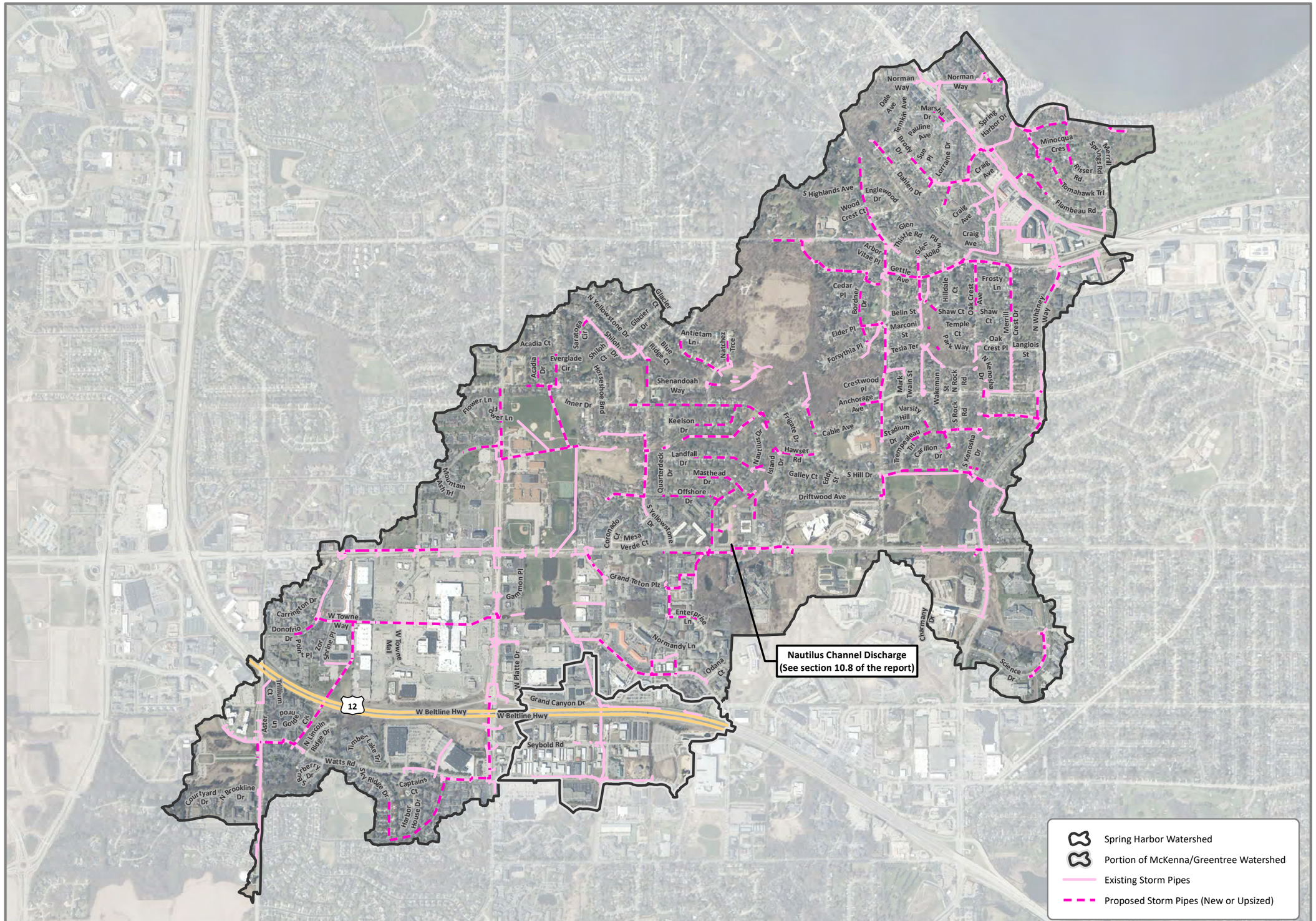

N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 32

PROPOSED SOLUTIONS: LOCAL STORM SEWER IMPROVEMENTS

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 9/1/2021

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Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 32- Proposed Solutions Local Storm Sewer Improvements.mxd

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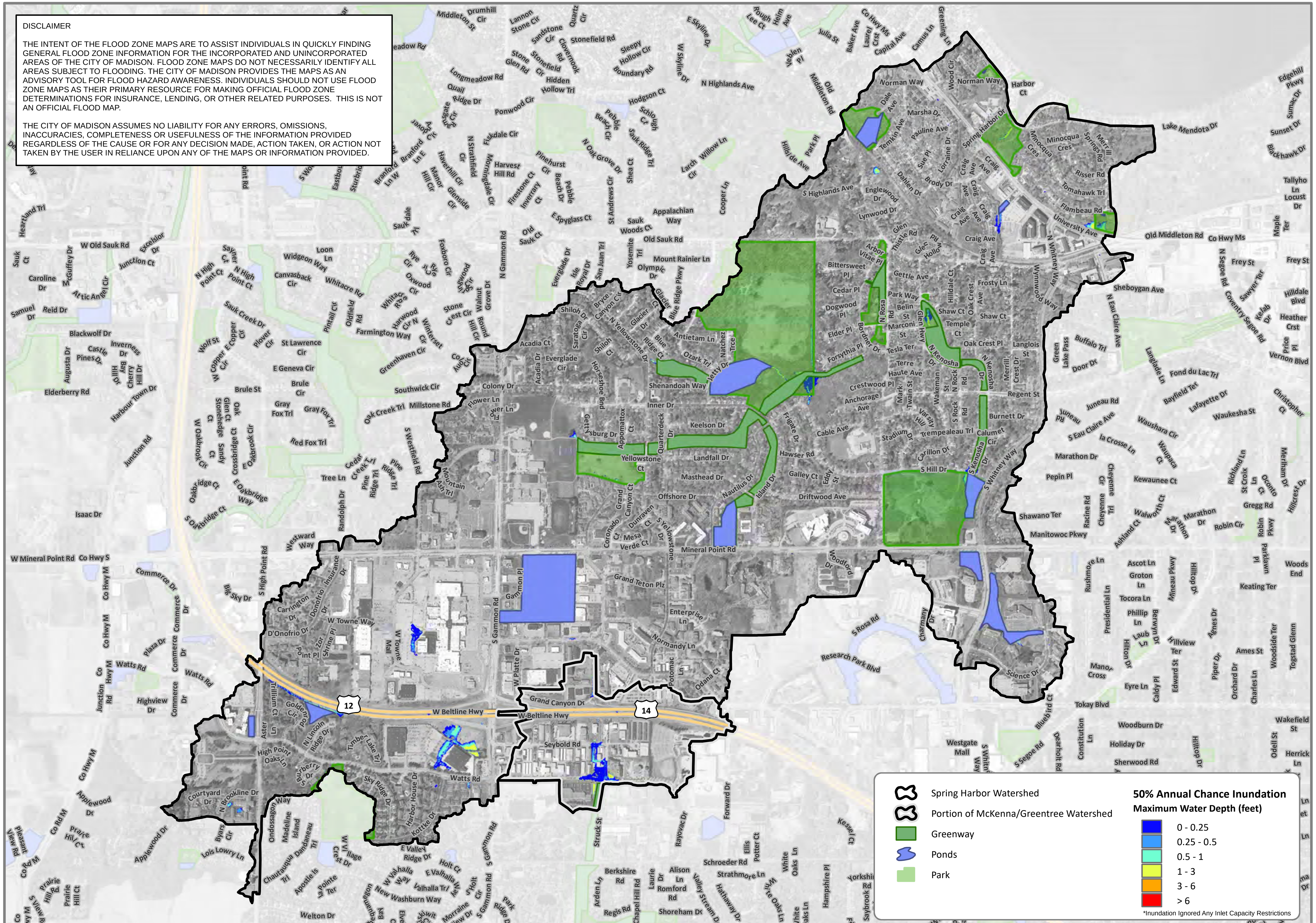

N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 33

PROPOSED SOLUTIONS: 50% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

AE2S

CITY OF MADISON WISCONSIN

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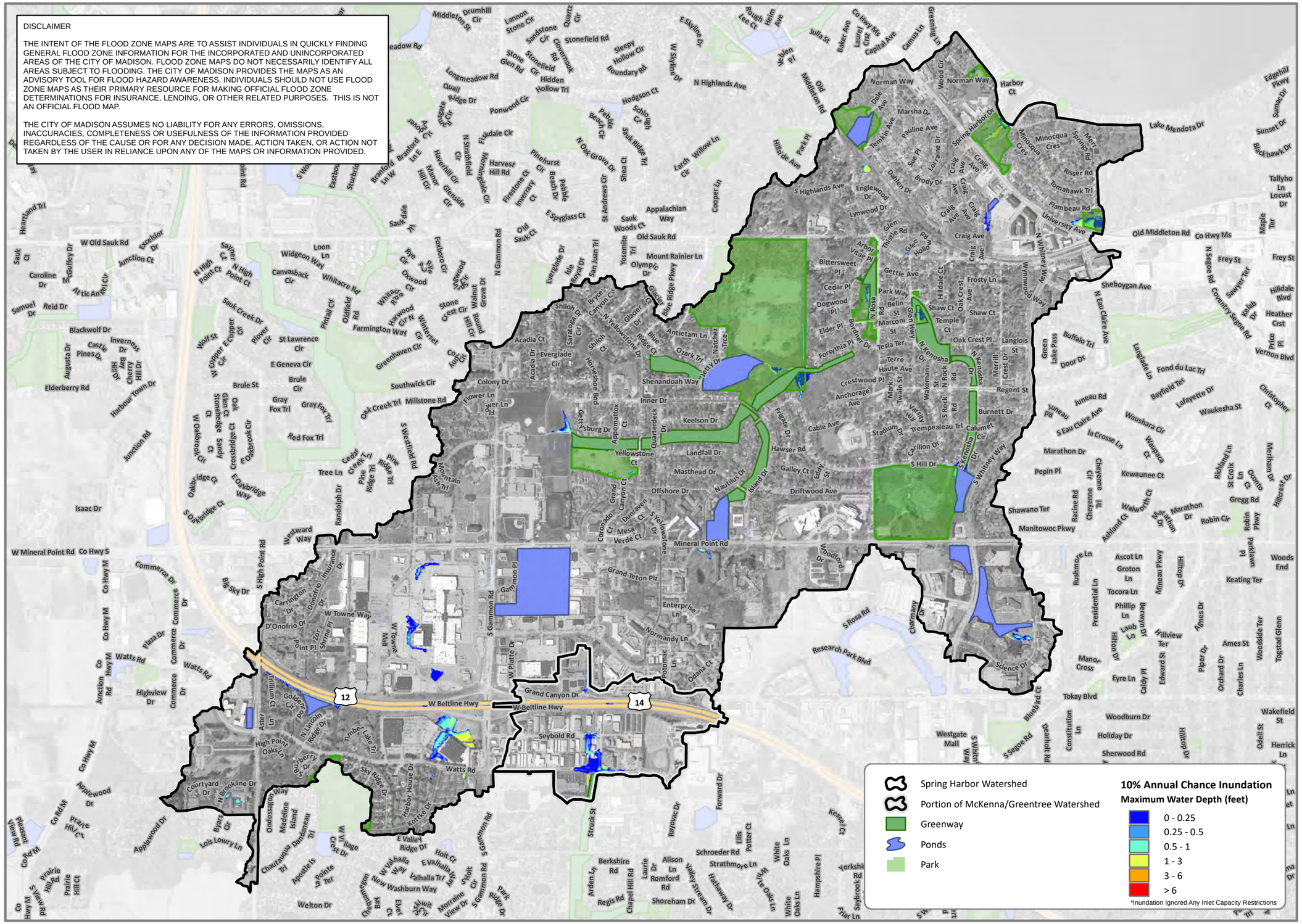

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 34

PROPOSED SOLUTIONS: 10% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

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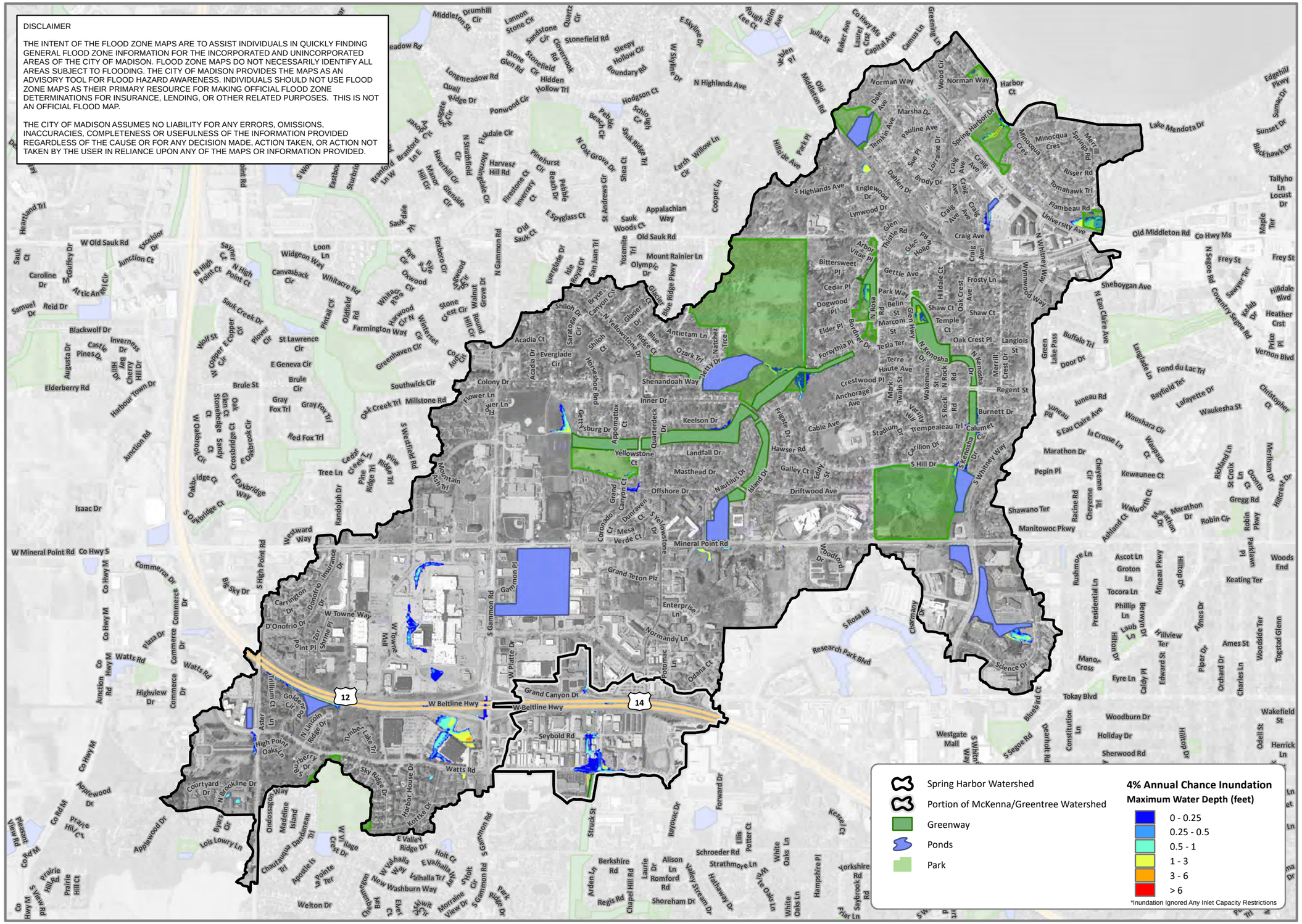

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 35

PROPOSED SOLUTIONS: 4% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

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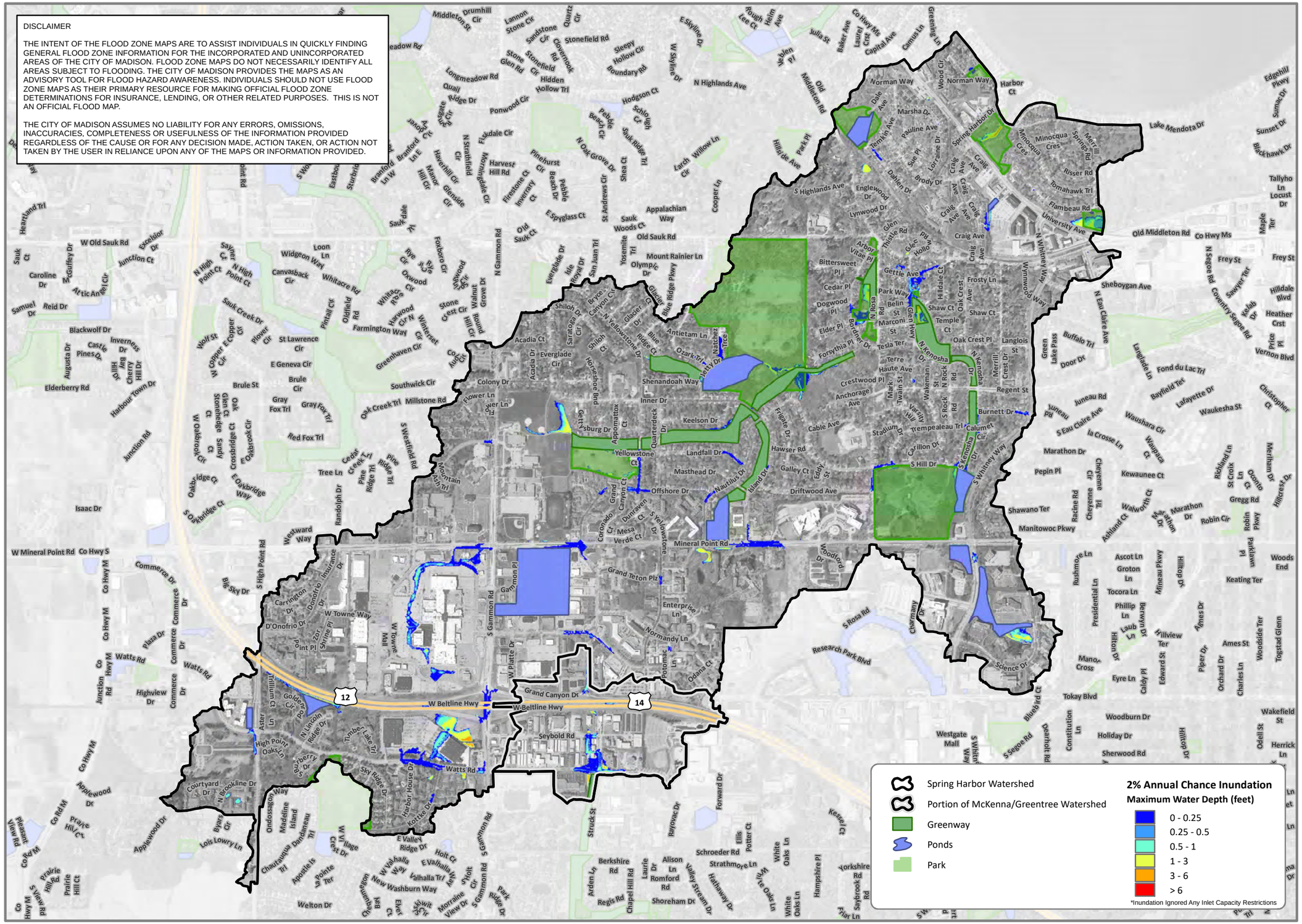

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 36

PROPOSED SOLUTIONS: 2% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

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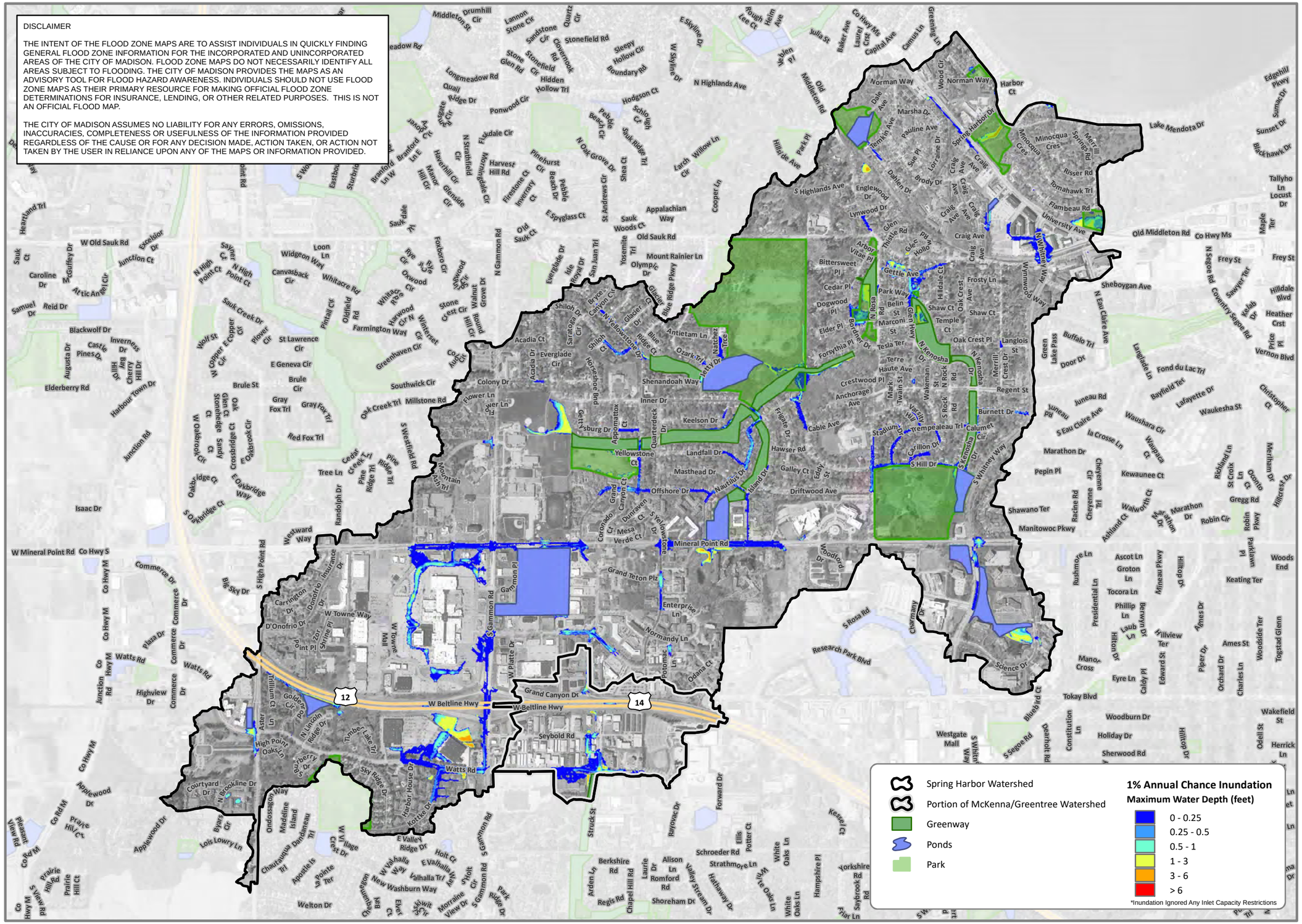

N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 37

PROPOSED SOLUTIONS: 1% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

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Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 37- Proposed Solutions 1% Chance Flooding.mxd

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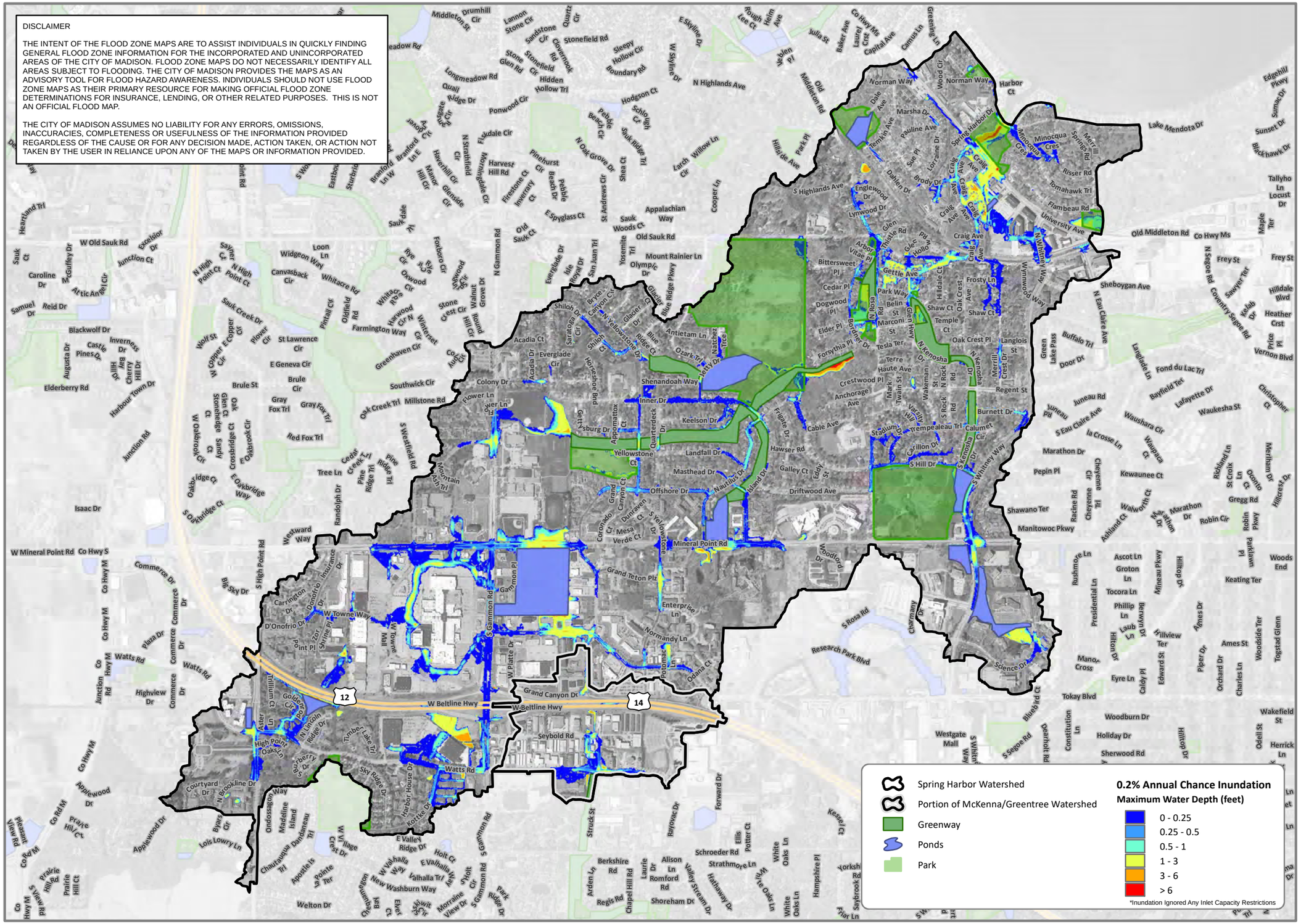

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 38

PROPOSED SOLUTIONS: 0.2% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

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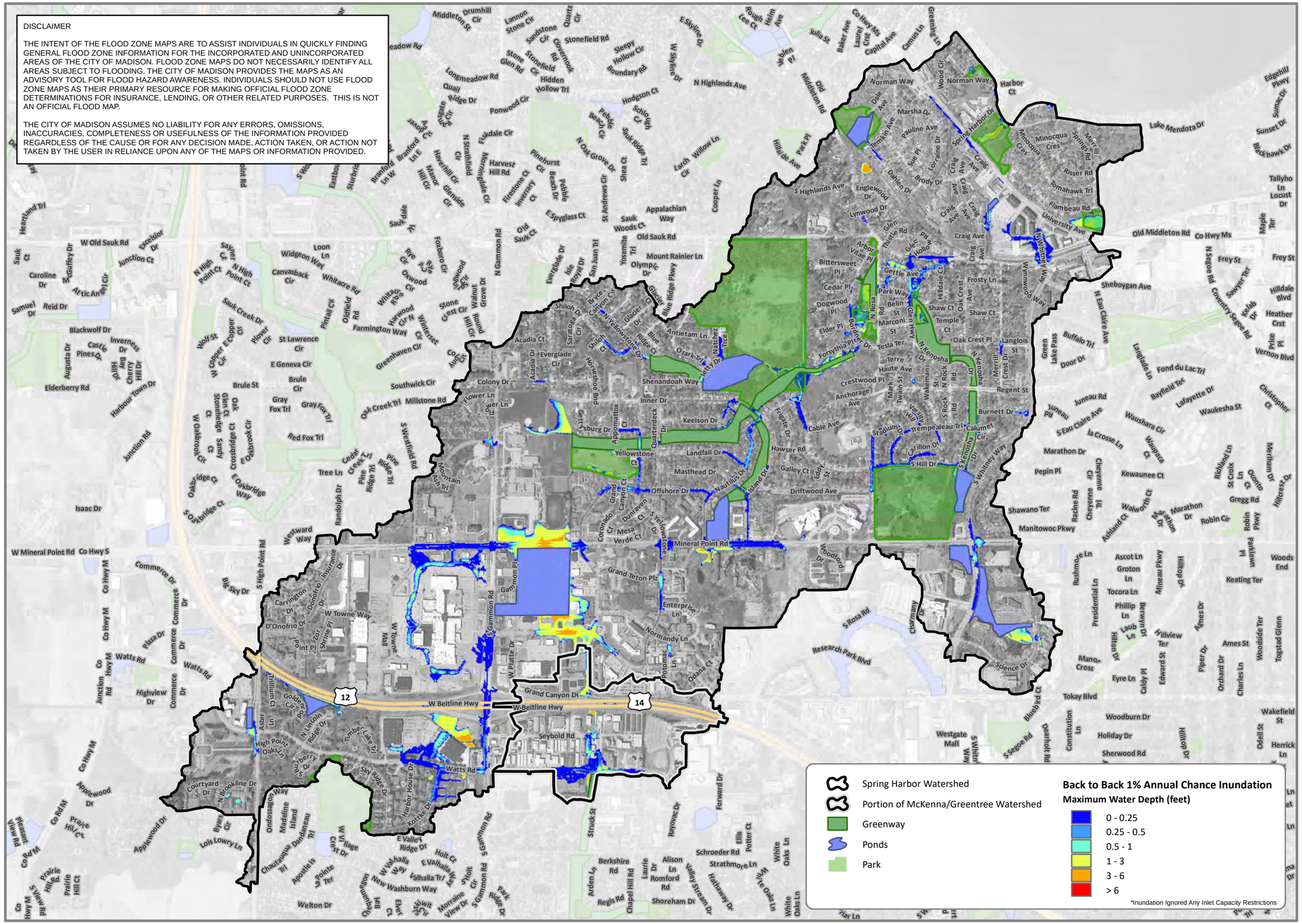

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N

0 800 1,600
Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure 39

PROPOSED SOLUTIONS: BACK TO BACK 1% ANNUAL CHANCE FLOODING

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/30/2021

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlissick | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Figure 39- Proposed Solutions Back to Back 1% Chance Flooding.mxd

Appendix A – Modeling Guidance Document

MODELING GUIDANCE

Version 2019-11-18 (DRAFT)

The City recognizes that an important aspect of modeling is professional judgement; and it will be up to the Consultant to appropriately define parameters, variables, and methodology. However, it is in the City's best interest to aim for relative uniformity amongst all City models. Therefore, the Consultant may be expected to justify, document, and in some instances, modify various model inputs and assumptions.

City of Madison Flood Mitigation Goals

1. No home or business will be flooded during the 100-year design storm.
2. Eliminate flooding from the storm sewer system for up to the 10-year design storm; all water shall be contained within the pipes and structures (exception: low points).
3. Allow no more than 0.5 feet of water above storm sewer inlet rim at inlet-restricted low points for up to the 10-year design storm.
4. Centerline of street to remain passable during 25-year design storm with no more than 0.2 feet of water at the centerline.
    a. Note that the Watershed Study modeling approach will not explicitly account for cross flow conditions where more gutter flow on one side of the street can overtop the crown.
5. Enclosed depressions to be served to the 100-year design storm (which can include safe overland flow within street, easements, greenways or other public lands).
6. Greenway crossings at streets to be served to the 100-year design storm.
7. Provide flooding solutions that do not negatively impact downstream properties.
8. For the purpose of the watershed studies "deficiencies" in the system shall be defined as existing infrastructure, drainage capacity or system limitations that fail to meet the goals stated in 1-7 above.

Guidance for Solutions

1. Watershed deficiencies will be reviewed, and solutions will be provided up to the 100-yr design storm.
2. In areas where flooding occurs in events exceeding the 100-year storm, those areas will not be prioritized for engineering solutions, but will be identified in existing conditions model for 500-year event storms.
3. Proposed solutions will be identified for only the publicly owned drainage system. Drainage issues that are private (water from the public infrastructure such as streets, greenways, ponds and/or easements is not the cause of the drainage issue) will not require modeling solutions but should be identified where possible in the existing conditions analysis so staff may work with property owners if necessary. (See Also Hydraulics section of Modeling Guidance for discussion on private system existing conditions modeling.)

DATA SOURCES:

In the report, document the file name and date for the following data sources:

- Land Use
- LiDAR
- Storm Sewer
- Culverts
- Greenways
- Planimetric Data
- Aerial Imagery

MODELING PARAMETERS:

Initial model parameters are the following items:

1. Model all storm sewer and culvert segments 18 inches in diameter (or equivalent) and larger, noting that the model will be required to identify all watershed deficiencies, including inlet capacity. Inclusion of smaller diameter pipes may be required to meet the goals of the model.
2. Street inlets are to be aggregated within the model to the 18-inch diameter (or equivalent) storm sewer level.
3. Incorporate existing storm water management facilities (public and private) into the model.
4. Subdivide provided outfall basins into smaller watersheds as needed in order to properly execute the model.
5. Coordinate System and Vertical Datum
    a. Horizontal Coordinate System: Wisconsin County Coordinate System – Dane Zone NAD83 (HARN).
    b. Vertical Datum: NAVD88 (pre 2007 adjustment) ft (City of Madison Datum + 845.6)
6. Naming convention
    a. Names are limited to 20 characters
    b. Subcatchments:
        i. Begin with Subcatchments naming convention provided by the City in the Outfall Basin feature class.
            1. Add a three-digit designator to the end of the name, beginning with 000
            2. As subcatchments are subdivided, increase the added designator by 1.
            3. Example: ME04-A-0014-H *(Provided by City)* → ME04-A-0014-H-MAD-C-000 *(For the original basin)* → ME04-A-0014-H-001 *(For first subdivision)*
        ii. Final outfall basin feature class file, including supporting files used to compute runoff timing and volume parameters shall be part of the deliverables provided to the City of Madison.
    c. Structures and Junctions:
        i. Node (Junction/Storage/Outfall) names for existing structures shall retain the asset identification provided by the City.
        ii. Proposed Structure names are to be determined by the Consultant but shall be given a "logical" name that reflects general location, function, or other.
        iii. For junctions that need to be added that are storm sewer tees as constructed, use the downstream manhole / structure with "_01" added in increasing order moving from downstream to upstream. For example, the first junction added for a tee upstream of MI3350-001 would be MI3350-001_01
    d. Pipes:
        i. Conduit names for existing pipes shall retain the asset identification provided by the City, except that:
            1. The first two letters (i.e AE, IN, etc) will be removed
            2. Leads with an asset ID that takes up all 20 characters can be shortened to the corresponding assigned ID. For example, 3350-032_3350-007_3350-001 can be changed to 3350-032_3350-001_01
        ii. Proposed Pipe names are to be determined by the Consultant but shall be named in a manner similar to the City pipe naming convention, which includes the upstream and downstream structure names.
    e. Channel/Street Flow Segments:
        i. Conduit names for drainage-ways shall be named in a manner that identifies the greenway segment it represents by Greenway Node Number and the distance from the upstream end. Example: GR7541-062_125 would represent a channel segment that begins 125 feet into the North Door Creek Greenway – Sprecher Road Section.
        ii. Conduit names for streets shall be named with "Rd_"[US_Node_Name]_[DS_Node_Name] and remove the first two letters in the node name similar to how pipes are named.
    f. Natural Channels:
        i. Natural channel transects shall be named with the same ID as the conduit name.
        ii. Street models as natural channels shall be named in a manner that is easily identifiable for the street or street type it represents.

iii. A shapefile shall be created documenting where natural channel transects are cut.

g. Other SWMM Features (Weirs, orifices, etc)
   i. Other SWMM features shall have readily identifiable names corresponding to the type of feature they are trying to model. For example, an orifice for a detention pond should have an ID that is "<Detention Pond ID>_ORIF_01", keeping within a 20 character limit.

h. Ponds
   i.

7. Rainfall
   a. MSE4 24-hour Distribution and NOAA Atlas 14 Depths

Recurrence Interval (years)	Rainfall Depth (inches)
2	2.8
5	3.5
10	4.1
25	5.0
50	5.7
100	6.6
500	8.8

   b. Long-Duration Storm – Two 24-hour, 100-year MSE4 storm events with the time between peak rainfalls shorted from 24 hours to 12 hours.

8. Hydrology (SWMM Method with Horton Infiltration) (References: A, B, C)
   - Parameters listed are default parameters and may need to be adjusted based on calibration data.

   a. Subcatchment Detail for Street Drainage
      i. Contributing area to the existing storm sewer system that is to be modeled (Determined on a watershed by watershed basis)
      ii. Provides information that there is or is not an issue with upstream street flooding / storm sewer capacity that would be detailed out as part of a future street improvement design project.

   b. SWMM Routing Parameters (if calibration is not available to adjust parameters)
      i. Percent Impervious - Follow Step 1 (pages 1-3) of the "HowTo_CalculateCN" document.
      ii. DCIA – Reference WinSLAMM Standard Land Use DCIA Spreadsheet
      iii. Width – Estimated based on subcatchment shape. Estimation methodology shall be documented.
      A single width shall be calculated for the entire subcatchment. The single width with then be prorated based on sub area acreage for each sub area. DCIA will be prorated based on the area of the DCIA sub area compared to the total subcatchment area. The prorated width for the non-DCIA sub area and pervious sub area will be the same; it will be based on the sum of the non-DCIA plus the pervious area compared to the total subcatchment area.
      It is expected Width is one of the first calibration parameters for peak flow.
      iv. Slope – Computed manually or estimated based on LiDAR. Computation or estimation methodology shall be documented.
      v. Each subcatchment is to be split into area of (1) DCIA, (2) non-DCIA, and (3) pervious area. Within the model, the non-DCIA shall be routed to the pervious area.

   c. Horton Infiltration
      i. For typical urban pervious area (Based on range of values for different soil types, moisture conditions, and vegetation conditions found in Reference A):

HSG Group[a]	Max Infil. Rate (in/hr)	Min Infil. Rate (in/hr)	Decay Rate (1/hr)	Dry Days[b]
A	4.0	1.0	4.0	3.1
B	2.0	0.5	4.0	4.4
C	1.0	0.2	4.0	7.0
D	0.5	0.1	4.0	9.9
Water	0	0	0	0

[a]For HSG listed as A/D, B/D, C/D, the default approach will be to assume the HSG associated with the lower infiltration rate (HSG D).

[b]Use equation 4-12, pg 99, SWMM Reference Manual Volume 1 – Hydrology (Revised), January 2016

ii. Impervious Manning's n – 0.016
iii. Pervious Manning's n – 0.20
iv. Depression Storage for Impervious – 0.05 inches
v. Depression Storage for Pervious – 0.15 inches
vi. Factors for adjusting
    1. Forest – Multiply max and min infiltration rates by 2.
    2. Farmland – Divide max and min infiltration rates by 2.
    3. Other land uses – see reference
vii. Area-weight the Horton Infiltration parameters for each subcatchment based on the area of each soil type within a subcatchment.
viii. It is understood the NRCS/SCS updates the soil mapping at various times. The project teams will identify a date the soils data will be downloaded and that will be the data used for the duration of the project.

9. 1D Hydraulics (References: A, B, D, E, F)
    - Dynamic mode with constant / variable timestep sufficient to model system accurately.
    - Conduit lengthening shall not be used unless prior approval from City on reason.
    - Parameters are default parameters and may need to be adjusted based on calibration data.
    - This list is not intended to be exhaustive.

    a. System to be Modeled
        i. Public
            1. Standard: 18" Pipes and Larger
            2. Process for Exceptions: Provide justification for reason that a pipe 18" and larger does not need to be modeled.
            3. Process for requiring inclusion of pipes less than 18": Necessary when they are the only pipes draining parts of the street or drainage system. For example, a 15" pipe stubbing out to a greenway from the street or a long trunk-line that is less than 18".
        ii. Private
            1. Standard: Not included
            2. Process for requiring inclusion of private pipes:
                a. Stormwater management detention facilities
                b. When necessary to understand the functioning of the public system. For example, the West Towne Mall parking lot drainage system.
        iii. All greenways and major surface drainages
        iv. All stormwater detention facilities (public and private). Private systems may be simplified if serving a single site.
        v. Street surface drainage, but not necessary to the block level unless needed to understand major overflow routes

    b. Loss Coefficients
        i. Entry
            1. Culverts – Select Inlet Type based on the Help File or HEC-RAS Hydraulic Reference Manual

2. Storm Sewer (internal at MHs) = 0.1
3. Storm Drainage Structures (MH) at 45 degree bend = 0.25
4. Storm Drainage Structures (MH) at 90 degree bend = 0.5
5. For culverts and entrances to storm sewer from an open channel or pond, both the energy loss coefficient and the inlet control (culvert code) shall be used.

ii. Exit
1. Culverts –
a. Exit closed conduit to open channel = 0.5
b. Exit closed conduit to lake or pond = 1.0
2. Storm Sewer (internal at MHs) = 0.05
3. Storm Drainage Structures (MH) at 45 degree bend = 0.25
4. Storm Drainage Structures (MH) at 90 degree bend = 0.5

c. Coefficient of Discharge
i. Weirs
1. Sharp Crested – 3.0
2. Roadway embankment – 2.6
3. Flatter overflow – Use engineering judgment

ii. Orifices
1. 0.6

d. Manning's n
i. Pipes
1. Concrete Pipe: 0.013
2. All other n values shall be chosen within generally acceptable ranges.

ii. Channels
1. Use Chow's Open Channel Hydraulics, Reference E

iii. Bank Flow, including developed urban areas
1. Use Chow's Open Channel Hydraulics, Reference E

e. Transect Placement and Modifiers
i. Splitting long open channels
1. Changes in cross section
2. Significant changes in slope and roughness
3. Overflow points

ii. Segment Lengths
iii. Channel Geometry
iv. Provide shapefile where natural channel transects are selected along with XS Identifier

f. Tailwater Conditions:
i. Lake Mendota: one foot over Summer Maximum – 851.10
ii. Lake Wingra:

g. Inlet Clogging Factors
i. Continuous Slopes
1. Street slope < 1% - 25% Clogging
2. Street slope >= 1% - No Clogging

ii. Sags – 50% Clogging

10. 2D Data
a. Surface Roughness – The average Manning's n may vary by land cover / land use. Referencing TR-55, the following roughness shall be used:
i. Impervious areas - 0.1
ii. Turf grass areas - 0.24
iii. Wooded – 0.4
iv. Prairie – 0.15
v. Other – reference TR-55

There is not currently a city-wide impervious area layer. The consultant may choose to delineate the impervious area for the watershed.

Or, the existing data may be utilized. The following assumptions can be made using the existing land use data:

i. For non-residential parcels, impervious and pervious area is available, therefore, that shall be used.
ii. A percent impervious is available for residential parcels. Calculate a composite roughness using the percent impervious area. Remove roofs from the composite roughness calculation – reference the Dane County land use for residential roofs. (roofs will be entered as blocked obstructions)
iii. Average the roughness within the ROW based impervious and pervious area.

b. Blocked Obstructions – enter roofs as blocked obstructions
   i. Non-residential – use City impervious area data for roofs
   ii. Residential – use Dane County roof layer

11. Non-Modeling Data
    a. In the Notes field, include the sources of data

12. Scenarios
    a. Scenarios shall be set up as follows:
       a. 'Children' of the BASE scenario:
          i. EXISTING
             (grandchildren of BASE scenario, children of EXISTING)
             1. EXISTING_002_YR
             2. EXISTING_005_YR
             3. EXISTING_010_YR
             4. EXISTING_025_YR
             5. EXISTING_050_YR
             6. EXISTING_100_YR
             7. EXISTING_500_YR
             8. EXISTING_100YR_LONG_STORM
          ii. PROP_ALT1
             (grandchildren of BASE scenario, children of PROP_ALT1)
             1. PROP_ALT1_002_YR
             2. PROP_ALT1_005_YR
             3. PROP_ALT1_010_YR
             4. PROP_ALT1_025_YR
             5. PROP_ALT1_050_YR
             6. PROP_ALT1_100_YR
             7. PROP_ALT1_500_YR
             8. PROP_ALT1_100YR_LONG_STORM
          iii. PROP_ALT2
             (grandchildren of BASE scenario, children of PROP_ALT2)
             1. PROP_ALT2_002_YR
             2. PROP_ALT2_005_YR
             3. PROP_ALT2_010_YR
             4. PROP_ALT2_025_YR
             5. PROP_ALT2_050_YR
             6. PROP_ALT2_100_YR
             7. PROP_ALT2_500_YR
             8. PROP_ALT2_100YR_LONG_STORM
          iv. PROP_ALT3
             (grandchildren of BASE scenario, children of PROP_ALT3)

             1. PROP_ALT3_002_YR
             2. PROP_ALT3_005_YR
             3. PROP_ALT3_010_YR

Commented [BC1]: Do we know if the scenario manager works for XP-SWMM? Otherwise we can come up with a model naming convention and use global storms.

4. PROP_ALT3_025_YR
5. PROP_ALT3_050_YR
6. PROP_ALT3_100_YR
7. PROP_ALT3_500_YR
8. PROP_ALT3_100YR_LONG_STORM

b. Facility for children of the BASE scenario is defined via database queries. Facility for grandchildren of the BASE scenario are defined by inheritance.
c. Data sets for children of the BASE scenario should be BASE except where needed to define different datasets. Data sets for the grandchildren of the BASE scenario shall be defined by inheritance except for the raingage, which should be set as defined below.
    i. Data set naming convention should match the children of the BASE scenario. For example, if a different junction data set is needed for PROP_ALT2, the junction data set should be called "PROP_ALT2".
    ii. Data set naming convention for raingage sets should be based on the event used in the scenario naming convention, e.g. 002_YR, 005_YR…100YR_LONGSTORM.

REFERENCES

A. Help File
B. Storm Water Management Model version 5.1 User's Manual. (Available at: https://www.epa.gov/water-research/storm-water-management-model-swmm-version-51-users-manual)
C. SWMM reference manual volume I – hydrology (Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NYRA.txt)
D. SWMM reference manual volume volume II – hydraulics (Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100S9AS.PDF?Dockey=P100S9AS.PDF)
E. Chow, Open Channel Hydraulics, 1959
F. HEC-RAS Hydraulic Reference Manual. (Available at: https://www.hec.usace.army.mil/software/hec-ras/documentation/HEC-RAS%205.0%20Reference%20Manual.pdf)

Appendix B – Hydrology Input Parameters per Subbasin

Watershed ID	Total Area (ac)	Directly Connected Impervious Area (ac) (subcatchment 1)	Indirectly Connected Impervious Area (ac) (subcatchment 2) *	Pervious Area (ac) (subcatchment 3)	Width (ft)	Slope (ft/ft)
BM03-A-0315-H-000	2.42	0.20	0.03	2.19	227.28	0.20
ME02-A-0043-A-078	14.82	0.00	0.00	14.82	562.00	0.10
BM03-A-0339-H-006	6.89	3.35	0.00	3.55	383.62	0.11
BM03-A-0339-H-007	2.97	2.05	0.02	0.90	251.68	0.10
ME02-A-0057-H-011	4.14	2.95	0.06	1.13	297.16	0.07
ME02-A-0272-H-000	2.68	0.30	0.01	2.37	239.02	0.14
ME02-A-0272-H-001	1.01	0.22	0.00	0.79	146.58	0.18
ME02-A-0272-H-007	6.79	3.22	0.17	3.39	380.57	0.12
ME02-A-0057-H-004	1.93	0.77	0.00	1.16	203.20	0.15
ME02-A-0057-H-007	1.59	0.35	0.00	1.24	184.17	0.12
ME02-A-0057-H-023	1.95	0.96	0.00	0.98	203.96	0.14
ME02-A-0048-A-026	11.67	0.79	0.31	10.57	499.13	0.10
ME02-A-0067-H-000	13.42	4.57	0.34	8.51	535.21	0.12
ME02-A-0068-H-003	20.99	5.65	0.17	15.16	669.36	0.11
ME02-A-0067-H-004	17.67	5.92	0.06	11.70	614.19	0.07
ME02-A-0043-A-076	2.80	0.81	0.19	1.80	244.38	0.04
ME03-C-0041-A-005	2.84	1.25	0.14	1.45	246.23	0.08
ME02-A-0044-A-009	3.72	2.60	0.05	1.07	281.88	0.07
ME02-A-0275-H-005	3.31	1.91	0.02	1.38	266.15	0.09
ME02-A-0273-H-004	16.55	13.56	0.28	2.71	594.30	0.07
ME02-A-0043-A-054	5.32	1.43	0.95	2.93	336.84	0.12
ME02-A-0044-A-004	1.74	0.60	0.03	1.11	192.77	0.09
BM03-A-0315-H-001	5.10	3.60	0.07	1.43	330.03	0.09
BM03-A-0339-H-000	4.99	3.45	0.14	1.40	326.28	0.06
BM03-A-0339-H-001	1.78	1.30	0.01	0.46	194.99	0.08
BM03-A-0339-H-002	7.90	7.21	0.07	0.62	410.69	0.07
BM03-A-0339-H-003	6.82	6.11	0.06	0.64	381.40	0.05
BM03-A-0339-H-004	1.32	1.09	0.01	0.21	167.80	0.04
BM03-A-0339-H-008	8.26	0.00	8.23	0.03	419.82	0.08
BM03-A-0339-H-009	24.54	16.46	0.17	7.91	723.76	0.07
BM03-A-0339-H-010	1.89	1.47	0.01	0.41	201.03	0.07
BM03-A-0340-H-000	0.89	0.59	0.00	0.30	137.63	0.04
BM03-A-0340-H-001	4.51	1.01	0.00	3.50	310.26	0.09
BM03-A-0340-H-002	7.67	1.61	0.02	6.04	404.70	0.08
ME03-U-0037-Q-001	13.89	1.85	0.58	11.46	544.59	0.12
ME02-A-0053-A-008	3.73	0.05	0.00	3.69	282.30	0.02
ME02-A-0048-A-010	2.42	0.34	0.13	1.95	227.44	0.10
ME02-A-0048-A-000	6.10	0.39	0.16	5.55	360.83	0.17
ME02-A-0049-H-010	4.62	0.35	0.16	4.11	314.14	0.14
ME02-A-0048-A-009	4.66	1.06	0.39	3.21	315.51	0.07
ME02-A-0048-A-013	6.95	0.54	0.24	6.16	385.03	0.11
ME02-A-0043-A-074	7.31	0.83	0.29	6.19	394.92	0.07
ME02-A-0057-H-016	6.08	3.94	0.08	2.06	360.23	0.04
ME02-A-0057-H-006	3.19	1.30	0.00	1.88	260.75	0.12
ME02-A-0042-A-000	1.33	0.62	0.05	0.66	168.67	0.08
ME02-A-0042-A-001	2.58	0.56	0.12	1.90	234.69	0.14
ME02-A-0042-A-002	1.57	0.50	0.04	1.03	182.96	0.13
ME02-A-0042-A-003	0.76	0.34	0.01	0.41	127.03	0.10
ME02-A-0042-A-004	5.34	1.25	0.35	3.73	337.58	0.06
ME02-A-0042-A-005	1.90	0.56	0.13	1.20	201.23	0.06
ME02-A-0042-A-006	2.55	0.62	0.18	1.75	233.08	0.07
ME02-A-0042-A-007	0.55	0.24	0.11	0.20	108.16	0.08
ME02-A-0042-A-008	5.56	1.54	0.60	3.42	344.53	0.13
ME02-A-0042-A-009	1.24	0.52	0.24	0.47	162.59	0.05
ME02-A-0042-A-010	2.88	1.07	0.23	1.59	248.14	0.10
ME02-A-0042-A-011	11.77	4.02	0.30	7.45	501.29	0.13
ME02-A-0042-A-012	6.88	1.87	0.53	4.48	383.26	0.09
ME02-A-0042-A-013	4.29	1.32	0.33	2.64	302.54	0.05
ME02-A-0042-A-014	5.48	1.16	0.43	3.90	342.02	0.09
ME02-A-0042-A-015	2.20	0.15	0.03	2.02	216.56	0.20
ME02-A-0042-A-016	4.19	0.40	0.15	3.64	299.18	0.09
ME02-A-0043-A-000	5.96	2.39	0.21	3.37	356.70	0.07
ME02-A-0043-A-001	0.88	0.28	0.20	0.40	137.17	0.04
ME02-A-0043-A-002	1.86	0.25	0.17	1.44	199.26	0.06
ME02-A-0043-A-003	0.35	0.20	0.04	0.11	86.65	0.04
ME02-A-0043-A-004	3.11	0.57	0.20	2.34	257.65	0.09
ME02-A-0043-A-005	3.72	1.17	0.41	2.13	281.76	0.10
ME02-A-0043-A-006	7.22	1.30	0.43	5.49	392.53	0.09
ME02-A-0043-A-007	0.91	0.44	0.01	0.46	139.34	0.04
ME02-A-0043-A-008	6.75	1.21	0.47	5.07	379.51	0.06
ME02-A-0043-A-009	3.23	0.50	0.21	2.52	262.70	0.07
ME02-A-0043-A-010	2.19	0.40	0.16	1.63	215.99	0.08
ME02-A-0043-A-011	2.83	0.74	0.25	1.84	245.86	0.07
ME02-A-0043-A-012	6.31	1.48	0.47	4.36	366.99	0.10
ME02-A-0043-A-013	5.49	0.35	0.10	5.03	342.24	0.10
ME02-A-0043-A-014	0.43	0.38	0.00	0.05	95.49	0.04
ME02-A-0043-A-015	1.32	0.71	0.03	0.58	167.97	0.07
ME02-A-0043-A-016	0.50	0.25	0.03	0.22	103.03	0.12
ME02-A-0043-A-017	1.06	0.45	0.05	0.56	150.53	0.10
ME02-A-0043-A-018	1.50	0.59	0.08	0.83	178.65	0.07
ME02-A-0043-A-019	1.71	0.55	0.08	1.08	190.87	0.07
ME02-A-0043-A-020	5.95	1.05	0.45	4.44	356.40	0.10
ME02-A-0043-A-021	3.76	0.83	0.23	2.70	283.44	0.10
ME02-A-0043-A-022	3.97	0.78	0.29	2.90	291.12	0.11
ME02-A-0043-A-023	2.84	0.64	0.21	1.99	246.08	0.08
ME02-A-0043-A-024	1.48	0.27	0.12	1.10	177.87	0.11
ME02-A-0043-A-025	5.67	0.74	0.33	4.60	347.94	0.10
ME02-A-0043-A-026	3.80	0.61	0.24	2.95	284.70	0.07
ME02-A-0043-A-027	0.41	0.15	0.03	0.23	93.55	0.13
ME02-A-0043-A-028	0.67	0.15	0.06	0.46	119.81	0.16
ME02-A-0043-A-029	2.28	0.50	0.16	1.62	220.55	0.20
ME02-A-0043-A-030	0.59	0.28	0.02	0.28	112.02	0.10
ME02-A-0043-A-031	9.09	0.30	0.11	8.68	440.59	0.13
ME02-A-0043-A-032	0.15	0.02	0.00	0.13	56.83	0.09
ME02-A-0043-A-033	2.09	0.44	0.12	1.53	211.06	0.10
ME02-A-0043-A-034	1.43	0.54	0.05	0.85	174.82	0.07
ME02-A-0043-A-035	0.75	0.28	0.03	0.44	126.34	0.10
ME02-A-0043-A-036	0.49	0.30	0.01	0.17	101.85	0.05
ME02-A-0043-A-037	5.79	1.80	0.48	3.51	351.48	0.06
ME02-A-0043-A-038	5.81	1.20	0.40	4.22	352.30	0.07
ME02-A-0043-A-039	0.31	0.15	0.00	0.15	80.71	0.08
ME02-A-0043-A-041	5.56	1.55	0.34	3.67	344.41	0.07
ME02-A-0043-A-042	1.53	0.55	0.11	0.87	180.66	0.08
ME02-A-0043-A-043	3.83	1.06	0.28	2.49	285.86	0.11
ME02-A-0043-A-044	4.38	1.04	0.31	3.03	305.67	0.15
ME02-A-0043-A-045	2.34	0.43	0.17	1.74	223.61	0.08
ME02-A-0043-A-046	2.36	0.59	0.18	1.60	224.48	0.08
ME02-A-0043-A-048	1.38	0.49	0.09	0.79	171.44	0.09
ME02-A-0043-A-049	0.35	0.17	0.02	0.16	86.43	0.08
ME02-A-0043-A-050	1.50	0.59	0.08	0.84	179.11	0.05
ME02-A-0043-A-051	3.60	1.03	0.29	2.27	277.07	0.05
ME02-A-0043-A-052	1.51	0.31	0.08	1.12	179.81	0.07
ME02-A-0043-A-053	1.56	0.52	0.13	0.91	182.62	0.15
ME02-A-0043-A-055	1.98	0.45	0.29	1.24	205.49	0.16
ME02-A-0043-A-056	1.54	0.44	0.09	1.00	181.07	0.12
ME02-A-0043-A-057	0.65	0.20	0.04	0.41	117.52	0.07
ME02-A-0043-A-058	20.42	1.93	0.75	17.74	660.23	0.12
ME02-A-0043-A-059	5.78	0.85	0.40	4.53	351.30	0.12
ME02-A-0043-A-060	15.50	3.07	0.97	11.46	575.25	0.10
ME02-A-0043-A-061	4.63	0.77	0.36	3.50	314.45	0.11
ME02-A-0043-A-062	0.99	0.46	0.07	0.46	145.70	0.17
ME02-A-0043-A-063	5.78	2.41	0.39	2.97	351.25	0.09
ME02-A-0043-A-064	5.12	0.83	0.39	3.90	330.73	0.12
ME02-A-0043-A-065	4.51	0.95	0.39	3.17	310.36	0.15

*Note: subcatchment 2 directed to subcatchment 3

Watershed ID	Total Area (ac)	Directly Connected Impervious Area (ac) (subcatchment 1)	Indirectly Connected Impervious Area (ac) (subcatchment 2) *	Pervious Area (ac) (subcatchment 3)	Width (ft)	Slope (ft/ft)
ME02-A-0043-A-066	25.06	0.37	0.14	24.55	731.30	0.14
ME02-A-0043-A-067	4.75	0.53	0.19	4.03	318.41	0.15
ME02-A-0043-A-068	4.39	0.71	0.20	3.48	306.25	0.15
ME02-A-0043-A-069	7.29	1.11	0.33	5.86	394.55	0.09
ME02-A-0043-A-070	7.80	1.23	0.39	6.19	408.04	0.11
ME02-A-0043-A-071	15.40	0.38	0.14	14.88	573.38	0.11
ME02-A-0043-A-072	7.14	1.23	0.39	5.52	390.44	0.08
ME02-A-0043-A-073	2.61	0.49	0.17	1.95	236.20	0.06
ME02-A-0043-A-075	4.72	0.64	0.22	3.86	317.30	0.07
ME02-A-0043-A-077	3.99	0.27	0.12	3.60	291.74	0.14
ME02-A-0043-A-079	9.49	2.64	0.93	5.92	450.12	0.09
ME02-A-0043-A-080	13.06	0.47	0.19	12.39	527.89	0.13
ME02-A-0043-A-081	3.32	0.00	0.00	3.32	266.37	0.10
ME02-A-0043-A-082	11.53	2.99	0.41	8.13	496.15	0.06
ME02-A-0043-A-083	5.97	1.72	0.54	3.71	357.10	0.08
ME02-A-0043-A-084	1.79	0.64	0.14	1.01	195.43	0.07
ME02-A-0043-A-085	7.16	0.00	0.00	7.16	391.02	0.09
ME02-A-0043-A-086	5.06	0.15	0.06	4.86	328.64	0.11
ME02-A-0043-A-087	3.01	0.62	0.16	2.22	253.39	0.12
ME02-A-0043-A-088	0.61	0.28	0.02	0.30	113.66	0.04
ME02-A-0043-A-090	4.52	0.44	0.16	3.91	310.57	0.14
ME02-A-0043-A-091	1.82	0.35	0.07	1.40	196.83	0.09
ME02-A-0043-A-092	6.52	2.49	0.34	3.70	373.19	0.16
ME02-A-0043-A-093	1.12	0.32	0.22	0.58	154.77	0.03
ME02-A-0043-A-094	3.79	0.86	0.21	2.71	284.26	0.18
ME02-A-0043-A-095	1.25	0.22	0.05	0.97	163.29	0.11
ME02-A-0043-A-096	1.03	0.52	0.05	0.46	148.07	0.16
ME02-A-0043-A-097	3.07	1.19	0.24	1.63	255.84	0.14
ME02-A-0043-A-098	1.35	0.43	0.08	0.85	169.77	0.11
ME02-A-0043-A-099	7.41	1.21	0.49	5.70	397.70	0.07
ME02-A-0043-A-100	4.83	2.11	0.16	2.56	321.03	0.05
ME02-A-0044-A-001	7.18	3.56	0.11	3.51	391.54	0.10
ME02-A-0044-A-002	6.76	3.80	0.16	2.80	379.83	0.09
ME02-A-0044-A-003	5.38	1.98	0.15	3.25	338.87	0.09
ME02-A-0044-A-005	4.70	2.94	0.09	1.66	316.57	0.10
ME02-A-0044-A-006	9.13	1.54	0.51	7.08	441.50	0.10
ME02-A-0044-A-008	1.16	0.81	0.01	0.34	157.54	0.05
ME02-A-0044-A-013	1.28	0.74	0.02	0.52	165.24	0.06
ME02-A-0044-A-014	1.18	0.63	0.01	0.55	158.89	0.06
ME02-A-0044-A-015	0.46	0.37	0.01	0.08	99.19	0.03
ME02-A-0044-A-016	1.54	0.72	0.01	0.81	181.42	0.04
ME02-A-0044-A-017	0.34	0.29	0.01	0.04	85.26	0.05
ME02-A-0044-A-018	0.12	0.06	0.00	0.07	51.33	0.05
ME02-A-0044-A-019	3.74	2.11	0.04	1.58	282.46	0.10
ME02-A-0044-A-020	0.87	0.51	0.01	0.35	136.40	0.04
ME02-A-0045-A-000	8.75	1.05	0.33	7.36	432.09	0.13
ME02-A-0045-A-001	7.26	0.53	0.18	6.55	393.52	0.19
ME02-A-0045-A-002	2.58	0.59	0.19	1.80	234.81	0.08
ME02-A-0045-A-003	4.30	1.05	0.35	2.90	302.93	0.11
ME02-A-0045-A-004	2.04	0.64	0.10	1.30	208.76	0.12
ME02-A-0045-A-005	3.94	0.95	0.27	2.72	290.01	0.09
ME02-A-0045-A-006	1.47	0.40	0.11	0.97	177.19	0.07
ME02-A-0045-A-007	4.29	1.50	0.33	2.47	302.77	0.08
ME02-A-0045-A-008	5.35	1.07	0.42	3.86	337.91	0.05
ME02-A-0045-A-009	1.28	0.41	0.12	0.75	165.14	0.09
ME02-A-0045-A-010	0.97	0.33	0.06	0.58	144.23	0.11
ME02-A-0045-A-011	3.34	1.55	0.17	1.61	266.81	0.07
ME02-A-0045-A-012	3.05	0.66	0.28	2.11	255.30	0.09
ME02-A-0045-A-013	7.49	1.51	0.68	5.30	399.83	0.04
ME02-A-0045-A-014	4.58	1.28	0.45	2.86	312.76	0.07
ME02-A-0045-A-015	3.23	1.09	0.31	1.83	262.62	0.06
ME02-A-0045-A-016	3.60	0.97	0.36	2.27	277.30	0.08
ME02-A-0045-A-017	7.79	1.90	0.77	5.12	407.64	0.07
ME02-A-0045-A-018	5.23	1.23	0.53	3.47	334.19	0.06
ME02-A-0045-A-020	3.56	1.20	0.32	2.04	275.62	0.06
ME02-A-0045-A-021	7.29	1.30	0.56	5.43	394.42	0.06
ME02-A-0045-A-022	3.99	0.77	0.35	2.86	291.73	0.05
ME02-A-0045-A-023	4.82	1.68	0.39	2.75	320.91	0.06
ME02-A-0045-A-024	3.07	1.43	0.21	1.42	255.99	0.04
ME02-A-0045-A-025	3.53	1.95	0.15	1.43	274.42	0.05
ME02-A-0045-A-026	0.88	0.41	0.06	0.41	137.20	0.05
ME02-A-0045-A-027	2.28	0.42	0.12	1.74	220.54	0.05
ME02-A-0045-A-028	2.24	1.44	0.08	0.72	218.71	0.05
ME02-A-0045-A-029	1.75	0.35	0.13	1.28	193.54	0.05
ME02-A-0045-A-030	2.11	0.74	0.20	1.18	212.31	0.04
ME02-A-0045-A-031	3.54	0.68	0.28	2.58	275.05	0.08
ME02-A-0045-A-032	3.39	1.03	0.27	2.08	268.83	0.05
ME02-A-0045-A-033	1.28	0.40	0.10	0.78	165.21	0.04
ME02-A-0045-A-034	4.22	1.80	0.29	2.13	300.07	0.07
ME02-A-0045-A-035	1.63	0.41	0.13	1.10	186.80	0.07
ME02-A-0046-H-001	9.86	0.41	0.15	9.30	458.77	0.07
ME02-A-0046-H-002	5.75	0.20	0.07	5.47	350.22	0.07
ME02-A-0046-H-003	8.25	0.85	0.30	7.10	419.67	0.07
ME02-A-0046-H-004	4.77	1.20	0.38	3.19	319.11	0.08
ME02-A-0046-H-005	16.50	8.22	0.62	7.66	593.40	0.09
ME02-A-0046-H-006	7.16	2.23	0.49	4.44	390.97	0.05
ME02-A-0046-H-007	2.11	0.73	0.19	1.18	212.22	0.05
ME02-A-0046-H-008	5.44	1.74	0.55	3.14	340.70	0.05
ME02-A-0047-H-000	1.50	0.38	0.06	1.06	178.79	0.05
ME02-A-0047-H-001	5.80	2.43	0.24	3.14	351.96	0.07
ME02-A-0047-H-002	0.49	0.39	0.00	0.10	102.53	0.06
ME02-A-0047-H-003	1.10	0.85	0.00	0.25	153.11	0.07
ME02-A-0047-H-004	1.30	0.68	0.01	0.60	166.26	0.16
ME02-A-0047-H-005	3.35	1.50	0.02	1.83	267.24	0.07
ME02-A-0047-H-007	3.09	1.26	0.00	1.83	256.91	0.09
ME02-A-0047-H-008	13.11	4.90	0.05	8.16	528.98	0.07
ME02-A-0047-H-009	5.80	2.13	0.00	3.67	351.89	0.07
ME02-A-0047-H-010	5.98	2.38	0.15	3.44	357.13	0.06
ME02-A-0048-A-001	4.19	1.14	0.40	2.65	298.88	0.09
ME02-A-0048-A-002	7.34	2.70	0.63	4.01	395.70	0.07
ME02-A-0048-A-003	7.35	2.18	0.69	4.49	396.06	0.10
ME02-A-0048-A-004	2.26	0.82	0.21	1.23	219.73	0.09
ME02-A-0048-A-005	2.55	1.25	0.20	1.09	233.31	0.08
ME02-A-0048-A-006	5.08	1.35	0.47	3.25	329.14	0.09
ME02-A-0048-A-007	3.61	0.91	0.34	2.37	277.61	0.11
ME02-A-0048-A-008	5.16	1.38	0.51	3.27	332.01	0.08
ME02-A-0048-A-011	3.19	0.80	0.30	2.09	260.78	0.09
ME02-A-0048-A-012	3.17	0.97	0.31	1.89	260.22	0.09
ME02-A-0048-A-015	8.15	1.82	0.78	5.54	416.97	0.07
ME02-A-0048-A-016	3.79	1.24	0.39	2.16	284.57	0.06
ME02-A-0048-A-017	8.72	1.99	0.77	5.96	431.52	0.09
ME02-A-0048-A-018	4.65	1.15	0.43	3.08	315.06	0.11
ME02-A-0048-A-019	5.66	1.63	0.57	3.45	347.60	0.06
ME02-A-0048-A-020	3.71	1.12	0.35	2.23	281.29	0.06
ME02-A-0048-A-021	5.89	2.31	0.38	3.20	354.46	0.07
ME02-A-0048-A-022	3.72	1.45	0.11	2.16	281.63	0.08
ME02-A-0048-A-023	3.36	1.78	0.06	1.53	267.94	0.08
ME02-A-0048-A-024	5.48	3.35	0.03	2.10	342.00	0.07
ME02-A-0048-A-025	1.18	0.83	0.03	0.31	158.54	0.06
ME02-A-0048-A-027	10.14	5.01	0.00	5.13	463.85	0.09
ME02-A-0048-A-028	1.50	0.46	0.12	0.92	179.01	0.05
ME02-A-0048-A-029	7.94	2.80	0.53	4.61	411.75	0.11
ME02-A-0048-A-030	1.14	0.55	0.07	0.53	156.30	0.05
ME02-A-0048-A-031	1.91	0.28	0.09	1.54	202.00	0.09

*Note: subcatchment 2 directed to subcatchment 3

Watershed ID	Total Area (ac)	Directly Connected Impervious Area (ac) (subcatchment 1)	Indirectly Connected Impervious Area (ac) (subcatchment 2) *	Pervious Area (ac) (subcatchment 3)	Width (ft)	Slope (ft/ft)
ME02-A-0048-A-035	1.28	0.13	0.03	1.12	165.06	0.09
ME02-A-0048-A-036	1.14	0.10	0.03	1.01	155.79	0.07
ME02-A-0048-A-037	1.89	0.11	0.03	1.75	200.75	0.09
ME02-A-0048-A-038	9.56	5.47	0.41	3.68	451.64	0.06
ME02-A-0048-A-039	7.84	5.09	0.16	2.59	409.00	0.08
ME02-A-0048-A-040	2.50	0.71	0.19	1.60	231.00	0.11
ME02-A-0048-A-041	6.70	3.23	0.32	3.15	378.08	0.12
ME02-A-0049-H-001	6.74	0.84	0.31	5.58	379.18	0.13
ME02-A-0049-H-002	2.37	0.72	0.21	1.43	224.68	0.11
ME02-A-0049-H-003	2.86	0.81	0.22	1.83	247.02	0.10
ME02-A-0049-H-006	5.26	1.17	0.48	3.61	334.92	0.11
ME02-A-0049-H-007	3.13	0.95	0.30	1.88	258.37	0.09
ME02-A-0049-H-009	6.02	0.52	0.24	5.25	358.34	0.17
ME02-A-0049-H-011	8.18	2.75	0.92	4.51	417.73	0.09
ME02-A-0050-H-002	6.49	4.56	0.05	1.89	372.32	0.08
ME02-A-0050-H-003	2.34	1.74	0.00	0.60	223.33	0.03
ME02-A-0050-H-004	10.25	3.79	0.08	6.38	467.67	0.04
ME02-A-0050-H-007	0.93	0.62	0.00	0.31	140.83	0.07
ME02-A-0050-H-008	0.82	0.63	0.00	0.19	132.34	0.04
ME02-A-0050-H-009	1.13	1.03	0.00	0.10	155.08	0.04
ME02-A-0050-H-010	2.82	2.04	0.00	0.78	245.39	0.05
ME02-A-0051-A-000	9.81	3.76	0.51	5.54	457.67	0.09
ME02-A-0051-A-001	8.15	3.40	0.42	4.33	417.08	0.09
ME02-A-0051-A-002	4.26	2.07	0.02	2.17	301.54	0.06
ME02-A-0051-A-003	12.90	6.76	0.14	6.00	524.78	0.06
ME02-A-0051-A-004	3.17	1.63	0.02	1.53	260.31	0.05
ME02-A-0051-A-005	3.34	2.12	0.04	1.18	266.96	0.03
ME02-A-0051-A-006	8.51	4.00	0.08	4.42	426.10	0.08
ME02-A-0051-A-007	3.73	1.93	0.08	1.73	282.31	0.09
ME02-A-0051-A-008	5.24	3.50	0.07	1.66	334.37	0.03
ME02-A-0051-A-009	2.42	1.16	0.01	1.25	227.29	0.04
ME02-A-0052-H-000	9.27	6.17	0.06	3.04	444.94	0.07
ME02-A-0052-H-001	8.07	5.64	0.12	2.32	415.14	0.05
ME02-A-0053-A-000	2.69	1.04	0.26	1.39	239.55	0.08
ME02-A-0053-A-001	3.85	1.05	0.37	2.43	286.56	0.08
ME02-A-0053-A-002	2.12	0.55	0.19	1.38	212.88	0.11
ME02-A-0053-A-003	2.45	0.50	0.21	1.74	228.68	0.09
ME02-A-0053-A-004	6.49	1.41	0.52	4.56	372.13	0.10
ME02-A-0053-A-005	4.41	1.12	0.41	2.88	306.92	0.07
ME02-A-0053-A-006	8.05	1.33	0.29	6.43	414.61	0.10
ME02-A-0053-A-007	13.42	0.70	0.07	12.65	535.15	0.06
ME02-A-0053-A-009	11.56	2.25	0.05	9.26	496.69	0.03
ME02-A-0053-A-010	4.06	1.48	0.03	2.55	294.49	0.05
ME02-A-0053-A-011	2.82	0.01	0.00	2.81	245.44	0.04
ME02-A-0053-A-012	7.76	2.59	0.05	5.12	406.98	0.04
ME02-A-0053-A-013	5.22	4.05	0.08	1.09	333.91	0.04
ME02-A-0054-H-000	2.43	1.74	0.02	0.67	227.61	0.07
ME02-A-0054-H-001	3.77	3.02	0.03	0.71	283.52	0.06
ME02-A-0054-H-002	6.09	5.05	0.05	0.99	360.55	0.06
ME02-A-0054-H-003	3.57	1.30	0.04	2.23	275.94	0.03
ME02-A-0054-H-004	9.01	2.99	0.09	5.93	438.63	0.04
ME02-A-0054-H-005	1.75	1.23	0.01	0.51	193.41	0.06
ME02-A-0054-H-006	14.84	8.59	0.18	6.08	562.83	0.08
ME02-A-0054-H-007	1.18	0.77	0.00	0.41	158.82	0.05
ME02-A-0054-H-008	0.99	0.70	0.00	0.30	145.69	0.04
ME02-A-0054-H-009	1.00	0.75	0.00	0.25	146.25	0.03
ME02-A-0054-H-015	2.85	1.27	0.03	1.55	286.00	0.07
ME02-A-0054-H-012	2.69	1.02	0.01	1.66	239.50	0.05
ME02-A-0054-H-013	1.18	0.71	0.00	0.47	158.83	0.04
ME02-A-0054-H-014	3.65	2.93	0.03	0.69	279.05	0.04
ME02-A-0057-H-000	17.83	15.87	0.00	1.96	616.97	0.04
ME02-A-0057-H-001	3.86	2.78	0.09	0.99	286.87	0.06
ME02-A-0057-H-002	3.80	2.72	0.08	1.00	284.90	0.06
ME02-A-0057-H-003	2.54	1.30	0.00	1.24	232.79	0.07
ME02-A-0057-H-005	1.50	1.18	0.00	0.32	178.95	0.09
ME02-A-0057-H-008	1.14	0.76	0.00	0.38	156.31	0.05
ME02-A-0057-H-009	2.26	1.29	0.01	0.96	219.69	0.05
ME02-A-0057-H-010	2.76	2.01	0.02	0.73	242.88	0.04
ME02-A-0057-H-012	2.98	2.53	0.03	0.42	252.17	0.04
ME02-A-0057-H-014	2.57	2.06	0.02	0.49	234.41	0.03
ME02-A-0057-H-015	1.24	0.87	0.00	0.37	162.73	0.04
ME02-A-0057-H-017	1.46	0.83	0.01	0.62	176.62	0.09
ME02-A-0057-H-018	12.70	5.77	0.57	6.36	520.60	0.10
ME02-A-0057-H-019	6.15	2.35	0.63	3.17	362.35	0.06
ME02-A-0057-H-020	5.91	2.29	0.50	3.12	355.20	0.06
ME02-A-0057-H-021	2.58	1.48	0.01	1.08	229.87	0.09
ME02-A-0057-H-022	1.59	0.59	0.00	1.00	184.26	0.10
ME02-A-0057-H-024	3.26	2.47	0.00	0.79	263.90	0.06
ME02-A-0057-H-025	3.02	0.00	1.47	1.55	254.06	0.09
ME02-A-0058-H-001	3.29	2.41	0.00	0.88	265.12	0.08
ME02-A-0058-H-002	3.41	2.64	0.00	0.77	269.90	0.08
ME02-A-0060-H-000	4.83	3.59	0.00	1.24	320.95	0.05
ME02-A-0060-H-001	12.41	9.73	0.10	2.58	514.58	0.05
ME02-A-0060-H-002	9.65	5.60	0.17	3.87	453.82	0.08
ME02-A-0060-H-003	8.45	4.94	0.32	3.20	424.69	0.10
ME02-A-0060-H-004	1.73	1.24	0.01	0.47	192.30	0.07
ME02-A-0060-H-005	4.66	3.23	0.07	1.37	315.43	0.05
ME02-A-0060-H-006	6.09	4.29	0.00	1.80	360.65	0.07
ME02-A-0060-H-007	9.78	2.01	0.11	7.65	456.78	0.05
ME02-A-0060-H-008	6.63	3.40	0.03	3.20	376.17	0.09
ME02-A-0060-H-009	2.83	1.30	0.01	1.52	245.91	0.11
ME02-A-0060-H-010	3.58	3.04	0.00	0.54	276.38	0.05
ME02-A-0060-H-011	6.82	0.00	4.35	2.47	381.46	0.10
ME02-A-0061-H-000	17.19	16.56	0.00	0.63	605.70	0.04
ME02-A-0061-H-001	5.66	5.42	0.00	0.23	347.43	0.03
ME02-A-0062-H-001	4.18	4.06	0.00	0.12	298.54	0.03
ME02-A-0062-H-002	8.77	4.72	0.00	4.05	432.65	0.09
ME02-A-0062-H-003	3.83	2.59	0.00	1.24	285.97	0.09
ME02-A-0062-H-004	2.84	2.70	0.00	0.14	246.15	0.03
ME02-A-0062-H-005	4.09	3.99	0.00	0.10	295.52	0.03
ME02-A-0063-H-000	13.76	12.31	0.00	1.45	541.95	0.04
ME02-A-0063-H-001	4.54	4.36	0.00	0.18	311.29	0.02
ME02-A-0063-H-002	6.94	6.44	0.00	0.50	384.89	0.03
ME02-A-0063-H-003	4.38	4.26	0.00	0.12	305.72	0.03
ME02-A-0065-H-000	21.13	16.84	0.17	4.12	671.50	0.06
ME02-A-0065-H-001	5.38	4.16	0.04	1.18	338.92	0.06
ME02-A-0066-H-000	10.18	6.92	0.07	3.19	466.10	0.06
ME02-A-0066-H-001	10.16	8.69	0.09	1.38	465.63	0.03
ME02-A-0066-H-002	6.94	5.66	0.18	1.10	384.78	0.04
ME02-A-0066-H-003	0.96	0.77	0.01	0.18	143.14	0.04
ME02-A-0066-H-004	3.15	2.52	0.03	0.61	259.42	0.03
ME02-A-0066-H-005	5.58	3.88	0.08	1.62	345.17	0.07
ME02-A-0066-H-006	7.82	5.23	0.05	2.54	408.55	0.09
ME02-A-0066-H-007	6.18	4.26	0.09	1.83	363.05	0.08
ME02-A-0067-H-001	5.19	2.74	0.30	2.14	332.79	0.10
ME02-A-0067-H-002	16.87	3.58	0.07	13.22	600.10	0.07
ME02-A-0067-H-003	4.91	2.64	0.03	2.25	323.73	0.08
ME02-A-0067-H-005	1.68	1.31	0.00	0.37	189.41	0.04
ME02-A-0067-H-006	7.44	3.99	0.04	3.40	398.47	0.11
ME02-A-0067-H-007	12.09	5.40	0.05	6.64	508.06	0.04
ME02-A-0067-H-008	1.34	1.12	0.00	0.22	169.18	0.04
ME02-A-0068-H-000	5.08	3.43	0.03	1.62	329.37	0.08
ME02-A-0068-H-001	3.06	1.59	0.00	1.47	255.38	0.16
ME02-A-0068-H-002	14.17	8.64	0.09	5.44	549.97	0.10

*Note: subcatchment 2 directed to subcatchment 3

Watershed ID	Total Area (ac)	Directly Connected Impervious Area (ac) (subcatchment 1)	Indirectly Connected Impervious Area (ac) (subcatchment 2) *	Pervious Area (ac) (subcatchment 3)	Width (ft)	Slope (ft/ft)
ME02-A-0068-H-004	11.23	7.67	0.08	3.49	489.65	0.07
ME02-A-0068-H-005	5.68	3.18	0.10	2.40	348.17	0.13
ME02-A-0270-H-000	7.50	3.12	0.00	4.38	400.18	0.05
ME02-A-0271-H-011	2.68	1.57	0.16	0.95	239.08	0.11
ME02-A-0271-H-000	2.63	1.59	0.02	1.03	236.99	0.06
ME02-A-0271-H-001	0.71	0.52	0.00	0.19	123.15	0.03
ME02-A-0271-H-002	0.41	0.38	0.00	0.03	93.06	0.04
ME02-A-0271-H-003	15.90	2.41	0.13	13.37	582.63	0.07
ME02-A-0271-H-004	3.08	1.14	0.00	1.94	256.45	0.07
ME02-A-0271-H-005	1.25	0.36	0.00	0.89	163.50	0.09
ME02-A-0271-H-006	2.36	0.30	0.00	2.05	224.27	0.06
ME02-A-0271-H-007	2.39	0.93	0.12	1.34	225.76	0.12
ME02-A-0271-H-008	12.12	5.96	0.18	5.97	508.52	0.09
ME02-A-0271-H-009	0.87	0.53	0.07	0.27	136.33	0.09
ME02-A-0271-H-010	0.59	0.35	0.05	0.18	111.89	0.07
ME02-A-0271-H-012	4.08	1.86	0.12	2.10	280.61	0.06
ME02-A-0271-H-013	1.25	0.38	0.05	0.82	163.35	0.14
ME02-A-0271-H-014	5.65	0.74	0.01	4.91	347.38	0.09
ME02-A-0271-H-015	3.87	0.87	0.02	2.98	287.35	0.08
ME02-A-0272-H-002	1.39	0.69	0.00	0.69	172.06	0.06
ME02-A-0272-H-004	16.24	6.00	0.25	9.99	588.83	0.07
ME02-A-0272-H-005	15.67	7.73	0.16	7.78	578.29	0.11
ME02-A-0272-H-006	2.75	1.07	0.03	1.65	242.16	0.12
ME02-A-0272-H-008	8.04	3.47	0.26	4.31	414.28	0.08
ME02-A-0272-H-003	2.81	0.17	0.00	2.64	244.82	0.14
ME02-A-0273-H-001	3.11	0.01	0.00	3.10	257.62	0.06
ME02-A-0273-H-002	3.68	1.74	0.07	1.87	280.30	0.09
ME02-A-0273-H-003	5.95	2.77	0.27	2.91	356.39	0.07
ME02-A-0274-H-000	4.24	1.25	0.39	2.59	300.66	0.09
ME02-A-0274-H-001	3.47	0.70	0.33	2.44	272.00	0.08
ME02-A-0274-H-002	8.56	1.96	0.80	5.80	427.34	0.09
ME02-A-0274-H-003	5.77	1.49	0.55	3.73	350.95	0.08
ME02-A-0274-H-004	7.38	1.90	0.70	4.78	397.02	0.08
ME02-A-0274-H-005	6.82	1.66	0.61	4.54	381.50	0.09
ME02-A-0274-H-006	6.35	0.56	0.35	5.44	368.21	0.12
ME02-A-0274-H-007	5.36	1.20	0.42	3.74	338.17	0.11
ME02-A-0274-H-008	2.47	0.49	0.20	1.78	229.43	0.14
ME02-A-0274-H-010	8.29	2.34	0.23	5.72	420.70	0.09
ME02-A-0274-H-011	3.12	1.36	0.07	1.69	258.20	0.07
ME02-A-0275-H-002	4.91	2.34	0.02	2.55	323.67	0.07
ME02-A-0275-H-003	4.87	2.05	0.02	2.79	321.96	0.08
ME02-A-0275-H-004	10.92	6.19	0.06	4.67	482.82	0.08
ME03-C-0041-A-001	2.63	1.29	0.03	1.31	236.83	0.06
ME03-C-0041-A-002	0.84	0.15	0.04	0.66	134.21	0.03
ME03-C-0041-A-003	6.52	1.02	0.42	5.08	373.02	0.09
ME03-C-0041-A-004	2.44	1.80	0.02	0.62	228.23	0.06
ME03-C-0041-A-006	0.48	0.32	0.00	0.16	101.59	0.04
ME03-C-0041-A-007	0.58	0.26	0.01	0.31	110.86	0.05
ME03-C-0041-A-008	2.50	0.92	0.05	1.53	230.99	0.08
ME03-C-0041-A-009	9.74	3.02	0.62	6.10	455.87	0.09
ME03-C-0041-A-010	1.74	0.44	0.10	1.20	192.45	0.12
ME03-U-0037-Q-002	4.27	0.23	0.07	3.97	302.02	0.16
ME03-U-0295-A-000	3.90	0.41	0.10	3.39	288.41	0.14
ME03-U-0295-A-001	5.98	0.41	0.01	5.56	357.35	0.16
ME03-U-0295-A-002	7.46	1.05	0.43	5.98	399.02	0.11
ME03-U-0295-A-003	4.16	0.97	0.29	2.90	297.92	0.13
ME02-A-0050-H-005	8.96	2.09	0.04	6.83	437.33	0.04
ME02-A-0045-A-019	3.12	0.01	0.00	3.10	257.93	0.12
ME02-A-0046-H-000	15.60	1.08	0.36	14.16	577.00	0.09
ME02-A-0047-H-011	10.82	4.41	0.04	6.36	480.47	0.09
ME02-A-0048-A-032	2.19	0.17	0.05	1.96	216.05	0.08
ME02-A-0057-H-026	3.09	1.40	0.03	1.66	260.95	0.13
ME02-A-0273-H-000	5.50	0.87	0.00	4.63	342.54	0.10
BM03-A-0339-H-005	9.29	5.84	0.06	3.39	445.19	0.08
ME02-A-0274-H-009	1.61	0.41	0.15	1.05	185.49	0.11
ME02-A-0043-A-040	0.84	0.26	0.05	0.53	134.08	0.07
ME03-C-0041-A-000	12.20	2.91	0.36	8.93	510.35	0.12
ME03-U-0037-Q-000	6.52	1.95	0.46	4.10	372.91	0.08
ME02-A-0043-A-047	6.31	3.09	0.38	2.85	367.06	0.06
ME02-A-0058-H-000	10.58	9.82	0.00	0.75	475.10	0.03
ME02-A-0058-H-003	5.70	4.39	0.00	1.31	348.72	0.07
ME02-A-0047-H-006	13.69	3.68	0.00	10.01	540.60	0.09
ME02-A-0054-H-011	7.20	3.20	0.07	3.93	463.00	0.07
BM03-A-0340-H-004	4.55	2.41	0.02	2.12	311.54	0.08
ME02-A-0048-A-034	3.69	0.90	0.20	2.59	280.71	0.07
ME02-A-0048-A-033	4.58	1.08	0.22	3.28	312.59	0.07
ME02-A-0049-H-008	2.47	0.15	0.06	2.26	229.71	0.13
ME02-A-0049-H-000	4.89	0.34	0.12	4.43	322.99	0.11
BM03-A-0340-H-003	3.53	1.05	0.01	2.47	274.48	0.07
BM03-A-0340-H-005	5.02	1.42	0.00	3.60	327.36	0.09
ME02-A-0049-H-004	2.16	0.30	0.08	1.78	214.57	0.10
ME02-A-0049-H-005	2.34	0.43	0.12	1.79	223.56	0.09
BM03-A-0340-H-006	13.85	9.83	0.10	3.92	543.76	0.06
ME02-A-0275-H-000	17.68	6.63	0.07	10.99	614.31	0.10
ME02-A-0275-H-001	7.31	2.04	0.02	5.24	394.89	0.12
ME02-A-0050-H-006	5.91	3.87	0.20	1.83	355.05	0.07
ME02-A-0050-H-000	28.74	14.27	2.13	12.34	783.26	0.04
ME02-A-0050-H-001	15.29	5.58	0.91	8.81	571.37	0.05
ME02-A-0044-A-011	3.46	1.57	0.03	1.86	271.87	0.07
ME02-A-0044-A-010	1.70	0.27	0.05	1.39	190.68	0.16
ME02-A-0044-A-000	3.79	2.50	0.08	1.21	284.60	0.08
ME02-A-0062-H-000	5.27	5.25	0.00	0.03	335.46	0.03
ME02-A-0044-A-007	1.93	1.29	0.03	0.61	203.03	0.05
ME02-A-0044-A-012	0.29	0.22	0.00	0.07	79.15	0.05
ME02-A-0057-H-013	4.25	3.31	0.07	0.88	301.16	0.06
ME02-A-0054-H-010	0.52	0.38	0.00	0.14	105.70	0.03
ME02-A-0043-A-089	13.37	0.95	0.39	12.03	534.19	0.14
ME03-U-0295-A-004	2.66	0.55	0.21	1.89	238.15	0.10
ME02-A-0048-A-014	6.80	0.69	0.33	5.78	381.00	0.11

*Note: subcatchment 2 directed to subcatchment 3

Appendix C – Hydraulic Input Parameters (Links, Nodes)

Junction ID	Ground Elevation	Pipe Crown Elevation	Invert Elevation
302_S_GAMMON_CB1	1042.2	1037.32	1034.32
302_S_GAMMON_CB3	1043.6	1038.02	1035.02
302_S_GAMMON_RD_CB2	1042.2	1037.52	1034.52
ME02-A-0043-A-078	947.78	942.28	937.78
53W1183-001	943.605	942.5	938
BM03-A-0339-H-006	1048.1	1030.1	1028.1
BM03-A-0339-H-007	1049.5	1030.02	1030.02
ME02-A-0057-H-011	1105.36	1085.14	1085.14
ME02-A-0272-H-000	1090	1079.05	1075.05
AE2458-003_001	1091	1077.5	1076
ME02-A-0272-H-001	1105.41	1097.41	1095.41
ME02-A-0272-H-007	1112.85	1095.756	1094.256
AE2459-004_000	1094.381	1089.6	1087.1
ME02-A-0057-H-004	1094.45	1078.5	1077
ME02-A-0057-H-007	1083.88	1075.38	1073.88
AE2659-011	1085	1077.5	1075
ME02-A-0057-H-023	1097.15	1078.65	1077.15
AE2753-014	1048.5	1039.5	1038.5
AE2753-015	1048.2	1039.2	1038.2
ME02-A-0048-A-026	1037.3	1021.3	1017.3
ME02-A-0067-H-000	1025.6	1007.6	1005.6
ME02-A-0068-H-003	1026.1	1007.6	1006.1
AE3052-006	931.6	925.1833	921.6
AE3052-007	930.93	922.8833	917.02
AE3052-010	924.59	916.09	914.59
AE3054-023	992.491	971.171	969.921
ME02-A-0067-H-004	1042.6	1024.6	1022.6
ME02-A-0043-A-076	940	903.1433	901.56
ME03-C-0041-A-005	922.16	903.66	902.16
ME02-A-0044-A-009	889	871.4167	869
AE3354-004	978.64	972.24	968.64
ME02-A-0275-H-005	1009.7	991.7	989.7
AS2359-025	1106.575	1105.06	1102.56
AS2360-006	1107.03	1105.29	1102.79
AS2456-017	1079.655	1077.9	1075.9
AS2456-018	1081.74	1079.36	1077.36
AS2457-001	1073.317	1069.86	1066.86
AS2457-004	1075.223	1071.983	1068.983
AS2457-005	1077.077	1073.57	1070.57
AS2457-015	1076.938	1074.71	1072.21
AS2458-005	1114.948	1101	1099
AS2458-008	1109	1104.37	1102.37
AS2459-003	1098.057	1094.96	1091.46
AS2459-006	1088.358	1085.1	1081.6
AS2459-007	1095.358	1092.48	1088.98
AS2459-013	1095.751	1092.7	1089.2
AS2459-019	1106.438	1103.95	1101.45
AS2459-020	1105.655	1103.11	1100.61
AS2459-022	1105.498	1102.73	1101.23
AS2460-001	1154.414	1151.51	1149.51
AS2460-003	1126.442	1116.64	1114.64
AS2460-005	1109.857	1105.45	1102.95
AS2461-020	1167.409	1164.75	1162.75
AS2461-021	1166.012	1163.13	1161.13
AS2555-003	1062.828	1060.2	1058.2
AS2555-007	1068.597	1063.75	1061.75
AS2555-008	1073.177	1065.51	1063.51
AS2555-009	1079.496	1076.5	1074.75
AS2555-021	1061.062	1059	1057
AS2557-001	1052.913	1048.96	1042.46
AS2557-003	1065.579	1060.6	1054.6
AS2557-004	1068.997	1062.14	1056.14
AS2557-008	1069.707	1066.05	1063.05
AS2558-002	1068.368	1066.37	1061.87
AS2558-003	1065.802	1063.649	1059.149
AS2558-004	1067.566	1063.78	1058.28
AS2653-001	1045.968	1044.04	1041.54
AS2654-004	1046.875	1043.34	1040.84
AS2654-008	1045.591	1043.8	1041.3
AS2655-002	1040.404	1037.94	1033.94
AS2655-003	1043.096	1040.71	1037.21
AS2655-012	1055.1	1052.91	1050.41
AS2655-016	1059.985	1057.27	1055.27
AS2655-019	1047.604	1045.51	1042.01
AS2656-007	1040.69	1037.6	1035.6
AS2658-009	1075.19	1073.2	1070.7
ME02-A-0273-H-004	1090.82	1088.1	1084.6
AS2659-008	1078.055	1074.488	1072.988
AS2659-010	1080.578	1077.7	1075.2
AS2659-017	1078.18	1074.6	1072.1
AS2659-019	1076.488	1073.837	1071.337
AS2659-020	1078.612	1074.446	1072.946
AS2660-003	1082.965	1080.17	1078.17
AS2660-006	1083.03	1080	1078
AS2660-007	1083.679	1080.35	1078.35
AS2660-011	1081.96	1079.74	1077.24
AS2660-013	1084.314	1081.2	1079.2
AS2660-027	1091.998	1089.4	1086.4
AS2660-029	1082.591	1080.02	1077.52
AS2752-009	1046.441	1043.27	1040.52
AS2752-010	1048.714	1046.27	1044.77
AS2752-011	1044.424	1041.15	1038.4
AS2753-002	1040.704	1038.75	1036
AS2753-004	1040.467	1039.4	1036.9
AS2753-007	1045.755	1043.63	1042.13
AS2754-001	1043.963	1025.27	1022.27
AS2754-003	1046.865	1043.08	1040.08
AS2754-005	1046.427	1040.23	1037.23
AS2754-006	1045.617	1038.4867	1035.32
AS2754-007	1041.643	1036.9467	1033.78
AS2754-012	1041.066	1026.37	1023.37
AS2755-007	1036.415	1036.25	1032.25
AS2755-013	1038.171	1027.48	1024.48
AS2756-008	1037.808	1034.25	1031.25
AS2756-041	1039.142	1036.45	1031.95
AS2756-056	1039.934	1037.13	1032.63
AS2756-063	1050	1034.89	1030.39
AS2757-056	1048.038	1046.25	1044.75
AS2851-002	1043.53	1039.59	1038.09
AS2851-003	1054.563	1050.91	1049.41
AS2852-020	1018.046	1014.76	1012.76
AS2852-021	1019.878	1014.85	1012.85
AS2852-022	1022.222	1017.67	1015.67
AS2852-024	1028.722	1024.9	1023.15
AS2853-004	1026.736	1023.8	1022.3
AS2853-009	1035.471	1032.11	1030.86
AS2853-010	1038.069	1034.77	1033.52
AS2853-015	1041.483	1038.81	1037.56
AS2854-001	1026.061	1020.14	1018.64
AS2854-008	1028.378	1026.25	1023.25
AS2854-010	1028.551	1021.7	1020.2
AS2854-014	1037.534	1024.17	1021.17
AS2854-016	1033.75	1032.72	1030.72
AS2854-018	1032.842	1030.38	1028.38

Junction ID	Ground Elevation	Pipe Crown Elevation	Invert Elevation
AS2854-019	1030.997	1028.6	1026.6
AS2856-009	1041.343	1036.83	1033.83
AS2856-012	1039.663	1037.77	1035.77
AS2856-017	1040.524	1038.64	1037.39
AS2856-019	1041.223	1039.07	1037.82
AS2857-015	1036.464	1035.15	1031.15
AS2857-015_001	1034.573	1033.46	1029.46
AS2857-020	1050	1032.57	1028.57
AS2857-021	1035.345	1032.74	1028.74
AS2858-005	1038.012	1032.8	1027.8
AS2858-018	1040.185	1038.23	1035.23
AS2858-020	1036.719	1033.17	1029.17
AS2858-021	1035.669	1032.96	1028.96
AS2858-027	1038.97	1036.95	1033.45
AS2858-029	1036.128	1033.93	1029.93
AS2858-029-001	1035.073	1033.634	1029.634
AS2858-029-002	1034.063	1033.081	1029.081
AS2859-005	1031.823	1027.31	1021.81
AS2860-001	1025.433	1021.95	1015.95
AS2860-003	1027.852	1023.45	1018.95
AS2860-011	1023.752	1021.27	1017.77
AS2860-020	1024.407	1023.56	1020.06
AS2860-029	1022.986	1021.46	1017.96
AS2952-023	977.478	963.38	959.88
AS2952-025	970.824	968.15	964.65
AS2952-026	970.195	968.47	965.97
AS2952-027	973.718	963.3033	959.72
AS2953-001	965.056	959.48	955.98
AS2953-002	984.634	980.68	977.68
AS2953-003	1007.957	1002.67	999.17
AS2955-001	1009.518	1005.2	1001.2
AS2956-006	1036.388	1029.9	1027.4
AS2956-009	1024.626	1019.58	1016.58
AS2956-010	1015.988	1010.78	1007.78
AS2956-011	1033.913	1032.69	1029.69
AS2956-014	1009.887	1004.57	1002.07
AS2956-015	1009.375	1006.3	1003.3
AS2956-019	1013.754	1008.68	1005.68
AS2956-025	1022.508	1020.86	1017.86
AS2956-030	1035.061	1031.62	1028.62
AS2956-031	1035.704	1031.22	1028.22
AS2956-032	1036.004	1031.12	1028.12
AS2956-033	1035.346	1028.38	1025.38
AS2956-034	1034.094	1027.66	1024.66
AS2956-035	1032.676	1027.12	1024.12
AS2956-036	1026.339	1022.9	1019.9
AS2957-005	1036.311	1033.86	1031.86
AS2958-007	1059.721	1056.5	1055
AS2958-008	1045.538	1043.1	1040.6
AS2958-010	1044.75	1042.35	1039.85
AS2958-013	1042.591	1040.29	1037.29
AS2958-014	1042.105	1039.43	1037.43
AS2960-003	1032.989	1030.39	1027.39
AS2960-017	1036.221	1032.19	1029.19
AS3050-002	986.892	980.6	979.1
AS3050-010	977.503	974	972
AS3053-001	946.923	942.623	941.373
AS3053-002	948.055	944.305	943.055
AS3053-003	937.1	936.1	934.1
AS3053-014	956.652	955.46	951.96
AS3054-003	972.189	969.85	968.6
AS3054-010	991.317	988.85	987.6
AS3054-012	986.025	981.85	980.6
AS3055-002	1011.857	1009.67	1006.17
AS3055-003	1017.477	1015.12	1012.12
AS3055-004	1020.28	1016.82	1013.82
AS3055-005	1023.525	1019.92	1016.92
AS3055-006	1023.814	1019.08	1017.08
AS3055-009	1010.153	1007.63	1004.13
AS3055-010	1025.188	1022.96	1020.96
AS3055-012	1012.785	1010.429	1007.429
AS3055-013	1014.091	1011.985	1008.985
AS3149-004	917.188	913.99	911.99
AS3149-009	917.034	910.83	908.83
AS3150-001	911.836	908.26	905.76
AS3150-004	906.461	903.7	901.2
AS3150-008	907.349	906.8	904.3
AS3150-009	905.361	904.4	901.9
AS3150-012	902.208	901.1	898.6
AS3150-013	900.096	898.6	896.1
AS3150-016	899.554	897.1	895.6
AS3150-019	901.868	897.75	895.25
AS3150-022-000	912.703	908.73	906.73
AS3150-026	948.169	944.31	942.81
AS3150-027	970.493	966.3	964.8
AS3150-039	907.75	905.31	903.31
AS3150-041	909.337	906.9	905.15
AS3150-044	917.159	914.32	912.57
AS3150-047	925.187	921.42	919.67
AS3150-048	928.878	923.03	921.28
AS3151-001	901.121	898.1	896.6
AS3151-005	899.246	896.35	894.85
AS3151-008	907.335	905.1	903.1
AS3151-009	904.579	901.6	899.6
AS3151-042	901.664	900.07	898.32
AS3151-050	900.741	898.35	896.85
AS3151-054	898.978	896.5	895
AS3152-001	953.488	950.6	948.6
AS3152-003	975.673	973.6	971.6
AS3152-008	922.967	919.6	917.6
AS3153-009	982.65	980.6	978.6
AS3153-021	984.627	982.67	980.67
AS3153-023	986.023	983.95	982.7
AS3153-025	996.954	993.67	992.42
AS3153-028	1001.313	998.62	997.62
AS3154-007	1007.118	1003.79	1001.79
AS3155-001	1033.865	1028.22	1025.72
AS3155-003	1039.245	1036.6	1034.1
AS3246-032	906.584	899.68	897.68
AS3246-035	906.78	900.54	898.54
AS3246-036	909.661	905.73	903.73
AS3247-003	882.616	877.66	875.66
AS3247-004	905.918	892.67	890.67
AS3247-007	912.961	908.8	907.8
AS3247-009	912.228	908.6	906.6
AS3247-013	906.613	901.1	899.1
AS3247-026	898.521	891.85	889.85
AS3247-028	903.974	899.47	897.47
AS3248-001	897.353	892.1	890.1
AS3248-010	886.84	879.6	877.6
AS3248-011	879.726	872.7	870.7
AS3250-002	911.571	908.23	906.73
AS3250-003	910.621	909.21	907.71
AS3250-013	898.911	892.6	886.6

Junction ID	Ground Elevation	Pipe Crown Elevation	Invert Elevation
AS3250-013-001	896.909	894.6	888.6
AS3250-017	898.919	892.6	889.6
AS3250-018	898.488	892.35	886.35
AS3250-021	899.163	897.27	894.27
AS3250-026	900.157	895.2	894.2
AS3250-028	903.954	899.53	898.53
ME02-A-0043-A-054	926.59	910.6	906.59
AS3250-034	897.373	890	884
AS3251-024	906.139	903.73	900.73
AS3251-028	903.709	901.81	898.81
AS3251-032	909.513	908.1	904.1
AS3251-033	905.819	904.95	900.95
AS3251-044	904.67	902.61	898.61
AS3252-005	948.521	945.21	943.71
AS3252-008	949.666	945.15	943.4
AS3252-009	951.901	947.55	945.8
AS3252-019	972.693	971.4	969.9
AS3252-020	972.419	971.4	969.4
AS3252-021	971.783	970.9	968.9
AS3252-027	976.426	969.3	967.3
AS3253-006	973.005	971.6	970.1
AS3253-011	973.096	970.7	969.2
AS3253-012	972.53	969.35	967.6
AS3253-013	971.484	967.38	965.63
AS3256-010	1038.672	1036.95	1035.45
AS3256-013	1022.279	1018.96	1017.46
AS3346-005	859.123	855.272	854.022
AS3346-011	857.472	856.14	853.14
AS3346-012	855.424	854.95	851.95
AS3347-001	872.109	868.06	866.06
AS3347-002	863.25	859.46	856.96
AS3347-003	859.038	857.55	855.05
AS3347-004	857.541	854.8	853.3
AS3347-021	866.345	862	860
AS3347-025	857.445	856.83	853.83
AS3347-027	863.304	861.48	859.48
AS3347-028	864.722	863.15	861.65
AS3347-036	879.509	867.4	865.4
AS3347-042	884.458	870.75	868.75
AS3348-002	876.447	866.94	864.94
AS3348-004	868.578	865.9	863.4
AS3348-006	865.388	858.2	855.2
AS3348-007	868.383	861.1	858.6
AS3348-008	871.529	866.4	864.4
AS3348-009	869.273	863.6	861.6
AS3348-018	862.064	858.1	852.1
AS3348-028	868.375	863.35	857.35
AS3348-035	873.648	869.31	867.31
AS3348-041	872.259	868.4	866.4
AS3348-042	872.661	868.23	866.23
AS3348-043	872.505	867.83	865.83
AS3348-045	863.915	861.6	855.6
AS3348-050	876.877	875.62	874.12
AS3348-056	888.887	886.36	885.11
AS3348-059	891.048	890.25	889
AS3348-063	867.413	864.18	861.68
AS3348-095	867.757	863.94	859.94
AS3348-100	869.732	866.39	864.39
AS3349-005	875.09	871.9	865.9
AS3349-008	876.695	871.3	869.8
AS3349-011	874.799	869.5	868
AS3349-014	871.868	868.1	866.6
AS3349-015	873.328	867.5	866
AS3349-018	873.33	867.6	866.6
AS3349-019	870.181	866.6	865.1
AS3349-025	869.633	866.1	864.6
AS3349-026	870.243	866.26	864.76
AS3349-027	870.051	866.6	864.6
AS3349-048	890.202	879.259	875.259
AS3349-049	890.351	885.37	883.62
AS3349-050	889.864	886.75	885
AS3349-056	875.098	874.4767	872.06
AS3349-057	876.356	874.85	872.85
AS3350-003	879.096	875.1	874.1
AS3350-006	897.998	895.65	893.15
AS3350-014	899.245	897.853	896.353
AS3350-015	898.683	897.85	895.35
AS3350-015-001	899.028	896.85	895.35
AS3350-022	901.737	899.1	897.6
AS3350-025	919.611	916.7	915.2
AS3350-031	898.102	889.6	883.6
AS3350-035	936.448	932.29	931.29
AS3350-040	899.073	891.48	887.98
AS3350-041	897.894	890.83	887.33
AS3350-042	897.55	890.09	886.59
AS3350-043	896.549	888.9433	886.11
AS3352-013	961.253	958.85	957.6
AS3352-018	968.176	964.55	963.3
AS3352-020	969.846	967.6	965.6
AS3352-028	976.715	970.19	968.19
AS3352-036	974.009	970.42	968.92
AS3352-039	974.732	971.55	970.05
AS3352-042	975.023	972.07	970.57
AS3352-044	974.785	972	970.75
AS3352-048	975.085	973.28	972.03
AS3353-003	966.687	966.25	965
AS3353-006	966.264	964.85	963.35
AS3353-007	965.998	964.7	963.2
AS3353-008	965.42	965.06	963.56
AS3353-015	967.27	966.02	964.52
AS3353-018	970.048	967.1	965.6
AS3353-028	968.905	967.8	966.3
AS3353-029	968.97	966.45	964.7
AS3353-033	968.725	967.75	966.5
AS3353-034	969.371	967.16	965.91
AS3353-040	969.095	967.1	965.6
AS3353-058	972.768	969.83	968.83
AS3354-003	974.95	972.82	968.82
AS3354-010	974.71	972.34	970.84
AS3354-023	976.742	974.84	972.84
AS3355-002	983.278	980.27	976.27
AS3355-002-000	984.844	981.11	977.11
AS3356-023	988.501	988.501	984.501
AS3356-028	990.155	987.05	985.3
AS3356-031	986.757	984.64	982.39
AS3356-032	987.68	984.76	981.26
AS3356-033	986.758	984.26	980.26
AS3356-038	989.811	987.55	984.05
AS3356-043	998.824	988.64	986.89
AS3357-007	993.661	991.48	987.98
AS3357-008	1002.503	1000.65	998.9
AS3447-004	895.837	892.445	890.945
AS3447-005	860.419	856.709	855.459
AS3447-008	856.112	852.137	850.137

Junction ID	Ground Elevation	Pipe Crown Elevation	Invert Elevation
AS3449-006	911.335	905.85	904.1
AS3449-008	903.794	901.6	899.6
AS3449-023	905.192	898.27	895.77
AS3449-027	912.761	899.31	896.81
AS3449-032	912.28	899.62	897.62
AS3449-035	925.936	922.21	920.21
AS3450-002	900.79	893.58	890.08
AS3450-003	901.482	895.1	892.1
AS3450-004	900.773	897.12	894.12
AS3450-016	918.067	912.87	910.87
AS3450-021	912.988	905.59	902.84
AS3450-022	914.975	910.98	908.48
AS3450-025	918.528	916.15	913.65
ME02-A-0044-A-004	947	924.25	922
AS3450-036	925.327	919.2	916.7
AS3450-055	899.852	892.61	889.11
AS3450-057	925.578	923.25	921
AS3452-002	972.857	971.07	970.07
AS3452-005	974.433	971.33	970.33
AS3452-006	979.746	976.6	975.6
AS3457-008	997.107	991.1	988.1
AS3457-012	993.856	991.55	989.05
AS3457-016	996.471	991.09	988.09
AS3457-017	996.891	990.66	988.16
AS3457-018	993.571	991.68	989.18
AS3458-022	996.502	993.2	991.45
AS3458-023	1004.652	1000.9	999.4
BELTLINE_UNDERPASS_N	1045.5	1045.5	1035.5
BELTLINE_UNDERPASS_S	1042	1042	1032
BIOFILTER_US_JCT	890	870.05	866.05
BM03-A-0315-H-001	1045.63	1028.02	1025.63
BM03-A-0339-H-000	1035.018	1025.018	1025.018
BM03-A-0339-H-001	1038.984	1028.984	1028.984
BM03-A-0339-H-002	1047.469	1037.469	1037.469
BM03-A-0339-H-003	1069.431	1059.431	1059.431
BM03-A-0339-H-004	1033.855	1023.855	1023.855
Surface_JCT9	1041.686	1031.686	1031.686
BM03-A-0339-H-008	1051	1041	1041
BM03-A-0339-H-009	1044.162	1034.162	1034.162
BM03-A-0339-H-010	1044.653	1034.653	1034.653
BM03-A-0340-H-000	1033.095	1023.095	1023.095
BM03-A-0340-H-001	1034.443	1024.443	1024.443
BM03-A-0340-H-002	1042.964	1032.964	1032.964
CB2853-007	1026.717	1024.36	1022.86
CB2854-036	1027.233	1025.03	1022.03
CB2854-037	1030.309	1028.03	1025.03
CB3150-023	917.416	913.88	912.38
CB3150-024	927.597	923.61	922.11
CB3150-037	907.19	904.83	902.83
CB3247-024	895.131	888.33	886.33
CB3348-074	865.929	859.07	857.07
CB3348-081	866.315	859.53	857.53
CB3348-088	867.007	860.89	858.89
CB3348-091	867.59	861.71	859.71
CB3348-096	868.121	861.2	857.2
CB3348-097	868.315	861.58	857.58
CB3349-028	871.803	862.37	858.37
CB3349-030	879.169	872.61	869.11
CB3349-041	891.691	885.51	882.51
CB3449-017	901.246	897.66	894.66
ID*633	1010.2	1000	1000
ME03-U-0037-Q-001	924.5	906	904.5
DT3053-016	948.557	939.807	938.557
DT3152-009	940	901.73	895.73
DT3346-010	858.309	857.309	854.309
DT3447-003	899.901	896.392	894.892
Surface_JCT5	1063.5	1043.5	1043.5
GAMMON_CB111	1040.083	1035.09	1032.78
GAMMON_CB143	1074.178	1072.28	1059.15
GAMMON_CB144	1073.889	1060.68	1058.18
GAMMON_IN112	1040.344	1034.78	1032.78
GAMMON_IN84	1074.208	1071.91	1069.91
GAMMON_IN85	1074.198	1069	1058.66
GAMMON_IN88	1079.107	1060.7	1059.11
GAMMON_MH101	1041.271	1035.95	1031.95
GAMMON_MH104	1040.53	1035.22	1033.22
GAMMON_MH105	1042.857	1039.34	1038.09
GAMMON_MH110	1041.818	1037.59	1036.09
GAMMON_MH120	1046.143	1042.35	1038.35
GAMMON_MH125	1046.77	1040.94	1039.44
GAMMON_MH149	1073.192	1067.38	1065.38
GAMMON_MH150	1070.549	1064.2	1053.17
GAMMON_MH151	1064.192	1052.94	1048.94
GAMMON_MH90	1074.303	1059.57	1055.57
GAMMON_MH91	1070.223	1057.68	1053.68
GAMMON_MH93	1048.816	1044.3	1040.3
ID*660	1008	998	998
ID*661	1007.9	997.9	997.9
ID*662	1005.1	995.1	995.1
GR-3251-039	919.37	910.39	904.39
ME02-A-0053-A-008	1042.99	1036.1567	1032.99
GR2854-015	1040.04	1023.04	1020.04
BM03-A-0315-H-000	1025.93	1021.93	1015.93
GR2953-004	1008.53	1004.31	1000.81
ME02-A-0048-A-010	1020.11	1008.53	1008.53
GR3053-010	962.127	951.7867	947.37
ME02-A-0048-A-000	963.11	952.3967	947.98
GR3151-018	914.17	898.27	894.17
HAWSER_HS-2	971.446	968.93	967.51
HAWSER_HS3	978.356	975	967.93
HAWSER_HS4	988.297	985.11	983.11
HAWSER_HS5	995.635	992.74	991.74
HAWSER_HS6	998.143	994.97	993.97
HD2854-032-001	1029.3	1020.69	1016.62
ME02-A-0049-H-010	980.6	973.7667	970.6
HD2953-008	1022.36	1014.9	1012.36
ME02-A-0048-A-009	1033.16	1015.69	1013.16
HD3053-021_2	962.19	948.3867	943.97
ME02-A-0048-A-013	965.28	949.9067	945.28
ME02-A-0043-A-074	920	891.4	891.4
HD3261-040	911.247	910.6	904.6
IN2358-001	1109.193	1106	1104
IN2358-025	1110.135	1106.55	1104.8
IN2359-010	1103.617	1102.02	1099.77
IN2359-011	1105.072	1101.64	1099.39
IN2359-017	1106.42	1104.34	1102.09
IN2359-019	1121.314	1118.49	1116.74
IN2359-023	1127.975	1124.95	1123.45
IN2360-009	1107.228	1106.47	1103.97
IN2455-011	1081.823	1080.1	1078.6
IN2456-019	1081.961	1079.56	1077.56
IN2458-002	1071.625	1070.73	1066.73
IN2458-002-001	1081	1076	1072
IN2458-009	1109.251	1105.36	1103.36

Junction ID	Ground Elevation	Pipe Crown Elevation	Invert Elevation
IN2459-002	1108.415	1105.96	1104.46
IN2459-014	1105.191	1101.82	1098.82
IN2459-027	1106.246	1103.19	1101.69
IN2459-029	1107.467	1104.24	1102.74
IN2555-013	1079.015	1076.65	1074.9
IN2556-008	1078.665	1076.88	1075.38
IN2557-002	1059.435	1055	1049
IN2557-005	1052.055	1046.81	1042.81
IN2560-001	1109.514	1107.85	1106.6
IN2560-003	1116.268	1114.29	1113.04
IN2653-009	1047.087	1045.58	1044.58
IN2654-009	1046.997	1043.3367	1040.92
IN2655-018	1048.976	1046.084	1043.584
IN2655-020	1045.692	1043.779	1040.279
IN2655-023	1039.976	1034.732	1033.232
IN2655-024	1039.663	1034.942	1032.942
IN2655-025	1045.022	1036.156	1034.906
IN2656-004	1040.987	1038.237	1036.987
IN2656-022	1048.292	1045.067	1043.567
IN2656-027	1039.577	1036.013	1034.013
IN2657-008	1045.343	1037.25	1033.75
IN2659-001	1080.399	1076.899	1075.399
IN2659-002	1080.354	1076.854	1075.354
IN2660-015	1083.801	1082.55	1080.55
IN2660-018	1081.55	1079.5	1077
IN2660-021	1085.589	1083.8	1082.3
IN2660-022	1086.623	1084.8	1083.3
IN2660-026	1092.09	1089.6	1087.1
IN2660-028	1103.774	1100.75	1099.5
IN2660-031	1092.585	1089.5	1087
ME02-A-0057-H-016	1090.71	1081.8767	1080.71
IN2753-001	1037.804	1037.35	1034.6
IN2753-011	1046.009	1043.605	1042.605
IN2753-013	1046.655	1044.856	1043.856
IN2755-018	1034.912	1031.75	1029.75
IN2755-019	1034.619	1032.5	1030
IN2756-060	1034.569	1031.25	1029.25
IN2756-061	1034.982	1031.5	1029.5
IN2757-055	1048.537	1045	1043.5
IN2759-002	1080.225	1077.725	1076.225
IN2759-003	1079.865	1077.365	1075.865
IN2759-004	1077.634	1075.4	1073.9
IN2759-012	1077.187	1075.99	1074.49
ME02-A-0057-H-006	1087.76	1077.76	1077.76
IN2760-001	1048.028	1046.68	1045.18
IN2760-002	1059.053	1057.56	1056.06
IN2852-016	1015.284	1013.4	1010.4
IN2852-028	1015.247	1012.97	1009.97
IN2853-008	1026.375	1023.96	1022.46
IN2853-011	1038.631	1035.91	1034.66
IN2853-018	1042.418	1039.83	1038.83
IN2854-023	1029.942	1028.78	1027.28
IN2854-033	1025.374	1019.28	1017.53
IN2856-008	1043.024	1041.31	1039.81
IN2856-010	1043.182	1040.84	1039.34
IN2857-012	1050	1032.381	1030.381
IN2857-014	1038.333	1032.896	1030.396
IN2859-001	1031.448	1030.369	1025.369
IN2859-003	1031.363	1028.25	1022.75
IN2860-006	1033.96	1032.18	1030.68
IN2860-007	1037.542	1035.88	1034.38
IN2860-013	1024.886	1021.946	1015.946
IN2860-021	1026.597	1024.375	1018.875
IN2860-034	1028.652	1022.992	1021.492
IN2952-003	974.866	973.8	972.3
IN2952-004	974.11	969.6667	966.5
IN2952-005	974.35	966.1667	963
IN2952-011	977.206	974.35	972.85
IN2952-015	978.433	977.7	975.2
IN2952-020	978.499	977.5	975
IN2955-006	1013.564	1012.35	1010.85
IN2955-010	1007.14	1006.02	1004.02
ID*771	1009.388	1003.5	1001
IN2956-002	1033.728	1032.08	1030.58
IN2956-023	1033.301	1031.9	1029.9
IN2957-008	1042.645	1041.7267	1040.56
IN2957-009	1042.654	1041.3667	1040.2
IN2957-010	1043.164	1042.15	1040.15
IN2957-012	1036.651	1034.9	1033.4
IN2958-024	1045.011	1040.73	1038.73
IN2958-025	1045.501	1040.62	1038.62
IN2958-026	1043.055	1040.01	1038.01
IN2958-030	1044.001	1042.767	1040.267
IN3050-001	985.836	982.06	980.81
IN3050-009	935.596	930.85	928.85
IN3052-001	921.206	919.34	917.34
IN3052-002	926.485	925.38	923.38
IN3053-028	946.862	945.35	944.1
IN3053-029	947.104	943.352	942.102
IN3054-004	975.741	974.1	972.85
IN3054-005	976.743	973.78	972.53
IN3054-020	968.991	967.85	966.6
IN3149-003	916.468	914.5	913
IN3149-011	974.841	971.83	970.58
IN3150-003	933.663	930	928
IN3151-034	900.451	899.53	897.53
IN3151-035	900.79	899.61	897.61
IN3151-038	900.666	899.33	897.83
IN3151-040	901.293	899.97	898.22
IN3151-041	901.593	900.07	898.57
IN3151-043	902.245	900.7	899.2
IN3152-019	902.452	900.0353	898.452
IN3153-015	986.148	984.29	982.54
IN3153-017	986.192	984.54	983.04
IN3153-020	984.648	982.79	981.04
IN3154-003	1004.798	999.96	997.96
IN3154-005	1006.307	1004.231	1002.231
IN3154-008	1006.431	1003.897	1002.397
IN3246-028	895.24	888.01	886.01
IN3246-031	905.55	899.68	897.68
IN3246-033	906.228	900.26	898.26
IN3246-034	906.32	899.44	897.44
IN3246-041	905.54	901.2	899.2
IN3246-048	905.944	900.68	898.68
IN3247-023	905.205	899.84	897.84
IN3247-025	894.841	890.98	888.98
IN3250-001	910.946	907.7	906.2
IN3250-027	901.987	900.04	897.04
IN3250-032	897.197	891.6	889.6
IN3251-011	933.859	932.37	930.87
IN3251-013	933.619	930.89	929.39
IN3251-014	912.197	908.85	907.1
IN3251-015	912.514	910.28	908.78
IN3251-018	909.162	906.85	905.1

Junction ID	Ground Elevation	Pipe Crown Elevation	Invert Elevation
IN3251-020	907.165	905.32	902.32
IN3252-006	948.705	944.55	942.8
IN3252-011	960.299	958.08	956.58
IN3252-014	957.976	955.89	954.39
IN3252-015	953.817	951.87	950.37
IN3252-028	965.992	964.9	963.4
IN3252-029	967.92	962	960.5
IN3252-030	959.8	957.06	955.56
IN3254-001	997.166	994.86	992.86
IN3254-002	993.84	991.04	989.04
IN3254-003	977.482	974.18	971.68
IN3255-003	1038.661	1037.07	1035.57
IN3347-022	860.367	854.298	852.298
IN3347-035	879.063	867.29	865.29
IN3348-052	888.827	885.646	884.146
IN3348-055	888.847	886.29	885.04
IN3348-064	866.25	859.382	856.382
IN3348-109	866.366	857.55	854.55
IN3349-051	888.826	887.07	885.32
IN3349-062	889.806	881.44	879.44
IN3349-064	890.239	888	886
IN3349-065	896.105	893.36	891.61
IN3349-066	889.97	887.9	886.15
IN3349-067	890.371	888.12	886.37
IN3349-068	890.992	889.25	887.5
IN3350-016	898.334	896.742	895.242
IN3350-018	918.511	915.85	914.35
IN3350-021	935.548	932.082	930.582
IN3350-029	917.48	916.17	914.92
IN3350-030	918.461	917.52	916.52
IN3350-046	897.293	894.33	892.58
IN3350-047	897.162	894.38	892.88
IN3352-002	975.807	973.17	971.92
IN3352-003	976.49	971.05	969.8
IN3352-005	966.576	966.005	964.755
IN3352-034	975.901	969.69	968.19
IN3353-054	972.848	971.42	970.17
IN3356-025	990.625	987.47	985.97
IN3356-026	990.052	987.2	985.7
IN3356-027	989.758	987.029	985.529
IN3356-030	986.383	984.76	982.76
IN3356-044	998.614	994.35	992.6
IN3357-012	1002.494	1000.85	999.35
IN3358-002	1013.018	1010.08	1008.58
IN3358-003	1013.319	1011.56	1010.06
IN3358-004	1016.574	1014.88	1013.38
IN3447-016	883.475	882.65	881.15
IN3447-017	883.639	881.3	879.8
IN3447-018	855.948	851.593	850.926
IN3447-019	855.519	851.49	850.49
IN3447-021	884.093	882.136	879.136
IN3450-011	917.586	916.56	915.06
IN3450-038	911.423	902.75	900
IN3450-054	900.659	898.4	896.9
IN3453-001	970.268	966.81	965.81
IN3453-002	970.515	967.5	966.5
IN3453-003	970.637	968.45	967.45
IN3457-010	998.602	994.85	992.85
IN3457-013	992.938	991.1	989.1
IN3457-014	992.975	991.56	989.56
IN3457-020	992.787	991.56	989.56
IN3547-001	886.257	882.91	881.41
IN3547-002	885.12	883.43	881.93
JCT-142	1083.39	1057	1054
JCT-144	1059.537	1055.09	1052.09
JCT-146	1056.867	1051.945	1048.945
JCT-154	1050.507	1045.47	1041.96
JCT-158	1052.289	1043.492	1039.492
JCT-160	1051.517	1042.772	1038.772
JCT-162	1051.451	1041.5	1037.5
JCT-172	1061.25	1057.33	1055.77
JCT-174	1056.827	1046.881	1044.881
JCT-176	1056.102	1046.248	1043.209
JCT-178	1055.225	1046.876	1043.876
JCT-180	1055.198	1047.307	1044.307
JCT-182	1055.324	1047.974	1044.974
JCT-184	1054.696	1048.938	1045.938
JCT-186	1054.75	1048.57	1045.07
JCT-188	1054.549	1047.941	1044.441
JCT-200	1053.358	1051.628	1048.628
JCT-202	1053.353	1048.987	1045.987
JCT-204	1053.699	1052.511	1051.011
JCT-206	1051.835	1049.05	1047.55
JCT-208	1052.311	1048.838	1046.588
JCT-210	1051.693	1048.54	1045.54
JCT-212	1051.723	1048.013	1045.013
JCT-214	1052.2	1047.368	1044.368
JCT-216	1052.194	1046.88	1043.86
JCT-220	1051.917	1050.05	1048.3
JCT-222	1052.853	1049.374	1047.124
JCT-224	1051.659	1049.008	1046.008
JCT-226	1050.313	1046.55	1043.55
JCT-228	1051.148	1045.229	1042.229
JCT-230	1050.164	1044.038	1041.038
JCT-232	1047.25	1043.003	1040.003
JCT-234	1048.053	1041.291	1038.291
JCT-236	1049.2	1039.466	1036.454
JCT-238	1050.23	1038.864	1035.364
JCT-240	1045.453	1043.581	1042.081
JCT-242	1045.838	1041.999	1040.249
JCT-246	1042.771	1040.178	1038.428
JCT-248	1042.093	1039.403	1037.653
JCT-250	1047.045	1039.23	1037.23
JCT-256	1052.815	1049.939	1046.939
JCT-258	1052.066	1042.443	1035.943
JCT_1_7050_WATTS_RD	1090.5	1088.36	1085.36
JCT_6624_SEYBOLD_RD	1031.6	1024.43	1024.43
KETTLE_POND_S-1_	923	923	918
KETTLE_POND_S-2_	923.562	919.97	918.47
KETTLE_POND_S6_	912.567	911.2	906
KETTLE_POND_S7	915.3	915.3	910.3
MASTHEAD_MH1	993.328	989.46	987.21
MASTHEAD_MH2	993.954	990.29	988.04
MASTHEAD_MH3	993.962	992.35	988.35
MASTHEAD_MH4	993.932	992.53	990.28
MASTHEAD_MH5	995.507	991.78	989.53
ME02-A-0042-A-000	878.548	868.548	868.548
ME02-A-0042-A-001	889.044	879.044	879.044
ME02-A-0042-A-002	904.305	894.305	894.305
ME02-A-0042-A-003	913.574	903.574	903.574
ME02-A-0042-A-004	922.924	912.924	912.924
ME02-A-0042-A-005	921.422	911.422	911.422
ME02-A-0042-A-006	923.777	913.777	913.777
ME02-A-0042-A-007	877.784	867.784	867.784

Junction ID	Ground Elevation	Pipe Crown Elevation	Invert Elevation
ME02-A-0042-A-008	879.349	869.349	869.349
ME02-A-0042-A-009	882.266	872.266	872.266
ME02-A-0042-A-010	882.96	872.96	872.96
ME02-A-0042-A-011	901	891	891
ME02-A-0042-A-012	905.312	895.312	895.312
ME02-A-0042-A-013	933.925	923.925	923.925
ME02-A-0042-A-014	909.244	899.244	899.244
ME02-A-0042-A-015	928.5	918.5	918.5
ME02-A-0042-A-016	936	917.5	916
ME02-A-0043-A-000	866.381	856.381	856.381
ME02-A-0043-A-001	881.525	871.525	871.525
ME02-A-0043-A-002	889.896	869.896	869.896
ME02-A-0043-A-003	882.844	872.844	872.844
ME02-A-0043-A-004	946.72	936.72	936.72
ME02-A-0043-A-005	880.37	870.37	870.37
ME02-A-0043-A-006	906.849	896.849	896.849
ME02-A-0043-A-007	876.899	866.899	866.899
ME02-A-0043-A-008	961.287	951.287	951.287
ME02-A-0043-A-009	978.822	968.822	968.822
ME02-A-0043-A-010	907.563	897.563	897.563
ME02-A-0043-A-011	875.5	865.5	865.5
ME02-A-0043-A-012	921.016	911.016	911.016
ME02-A-0043-A-013	924	904	904
ME02-A-0043-A-014	936.055	926.055	926.055
ME02-A-0043-A-015	914.998	904.998	904.998
ME02-A-0043-A-016	910.892	900.892	900.892
ME02-A-0043-A-017	901.439	891.439	891.439
ME02-A-0043-A-018	889.349	879.349	879.349
ME02-A-0043-A-019	881.436	871.436	871.436
ME02-A-0043-A-020	905.731	895.731	895.731
ME02-A-0043-A-021	880.06	870.06	870.06
ME02-A-0043-A-022	900.701	890.701	890.701
ME02-A-0043-A-023	934.474	924.474	924.474
ME02-A-0043-A-024	898.191	888.191	888.191
ME02-A-0043-A-025	898.939	888.939	888.939
ME02-A-0043-A-026	948.744	938.744	938.744
ME02-A-0043-A-027	886.672	876.672	876.672
ME02-A-0043-A-028	874.664	864.664	864.664
ME02-A-0043-A-029	876.229	866.229	866.229
ME02-A-0043-A-030	870.234	860.234	860.234
ME02-A-0043-A-031	871.5	852.4167	851.5
ME02-A-0043-A-032	907.167	897.167	897.167
ME02-A-0043-A-033	914.984	904.984	904.984
ME02-A-0043-A-034	913.794	903.794	903.794
ME02-A-0043-A-035	922.925	912.925	912.925
ME02-A-0043-A-036	908.445	898.445	898.445
ME02-A-0043-A-037	996.151	986.151	986.151
ME02-A-0043-A-038	906.595	896.595	896.595
ME02-A-0043-A-039	908.965	898.965	898.965
ME02-A-0043-A-041	918.739	898.739	898.739
ME02-A-0043-A-042	920.863	900.863	900.863
ME02-A-0043-A-043	917.155	907.155	907.155
ME02-A-0043-A-044	933.125	923.125	923.125
ME02-A-0043-A-045	976.194	966.194	966.194
ME02-A-0043-A-046	969.98	959.98	959.98
ME02-A-0043-A-048	963.308	953.308	953.308
ME02-A-0043-A-049	985.403	975.403	975.403
ME02-A-0043-A-050	1006.278	996.278	996.278
ME02-A-0043-A-051	993.852	983.852	983.852
ME02-A-0043-A-052	908.688	898.688	898.688
ME02-A-0043-A-053	920.326	910.326	910.326
ME02-A-0043-A-055	922.01	912.01	912.01
ME02-A-0043-A-056	921.785	911.785	911.785
ME02-A-0043-A-057	921.137	911.137	911.137
ME02-A-0043-A-058	930.863	920.863	920.863
ME02-A-0043-A-059	942.145	932.145	932.145
ME02-A-0043-A-060	926.782	916.782	916.782
ME02-A-0043-A-061	925.15	915.15	915.15
ME02-A-0043-A-062	937.565	927.565	927.565
ME02-A-0043-A-063	985.436	975.436	975.436
ME02-A-0043-A-064	995.865	985.865	985.865
ME02-A-0043-A-065	1013.149	1003.149	1003.149
ME02-A-0043-A-066	953.8	933.8	933.8
ME02-A-0043-A-067	927.375	917.375	917.375
ME02-A-0043-A-068	917.335	907.335	907.335
ME02-A-0043-A-069	915.717	905.717	905.717
ME02-A-0043-A-070	914.373	904.373	904.373
ME02-A-0043-A-071	948	938	938
ME02-A-0043-A-072	921.803	901.803	901.803
ME02-A-0043-A-073	920.634	900.634	900.634
ME02-A-0043-A-075	912.026	902.026	902.026
ME02-A-0043-A-077	939.5	929.5	929.5
ME02-A-0043-A-079	956.881	946.881	946.881
ME02-A-0043-A-080	929.815	914.815	914.815
ME02-A-0043-A-081	928.7	918.7	918.7
ME02-A-0043-A-082	996.946	986.946	986.946
ME02-A-0043-A-083	1007.964	997.964	997.964
ME02-A-0043-A-084	919.786	899.786	899.786
ME02-A-0043-A-085	918.672	914.672	914.672
ME02-A-0043-A-086	925.592	910.592	910.592
ME02-A-0043-A-087	914.444	904.444	904.444
ME02-A-0043-A-088	918.864	898.864	898.864
ME02-A-0043-A-090	914.875	904.875	904.875
ME02-A-0043-A-091	884.585	874.585	874.585
ME02-A-0043-A-092	906.999	896.999	896.999
ME02-A-0043-A-093	879.305	869.305	869.305
ME02-A-0043-A-094	889.083	879.083	879.083
ME02-A-0043-A-095	885.885	875.885	875.885
ME02-A-0043-A-096	908.705	898.705	898.705
ME02-A-0043-A-097	911.341	901.341	901.341
ME02-A-0043-A-098	929.785	919.785	919.785
ME02-A-0043-A-099	944.875	934.875	934.875
ME02-A-0043-A-100	1011.016	1001.016	1001.016
Surface_JCT2	900.93	890.93	890.93
ME02-A-0044-A-001	911.464	901.464	901.464
ME02-A-0044-A-002	928.789	918.789	918.789
ME02-A-0044-A-003	952.981	942.981	942.981
ME02-A-0044-A-005	934.386	924.386	924.386
ME02-A-0044-A-006	927.586	917.586	917.586
ME02-A-0044-A-008	909.582	899.582	899.582
ME02-A-0044-A-013	926.547	916.547	916.547
ME02-A-0044-A-014	898.772	888.772	888.772
ME02-A-0044-A-015	899.976	889.976	889.976
ME02-A-0044-A-016	910.535	900.535	900.535
ME02-A-0044-A-017	902.029	892.029	892.029
ME02-A-0044-A-018	913.153	903.153	903.153
ME02-A-0044-A-019	927.45	917.45	917.45
ME02-A-0044-A-020	907.218	897.218	897.218
ME02-A-0045-A-000	924.039	909.039	909.039
ME02-A-0045-A-001	949.665	926.885	926.885
ME02-A-0045-A-002	945.688	935.688	935.688
ME02-A-0045-A-003	970.203	960.203	960.203
ME02-A-0045-A-004	958.281	948.281	948.281
ME02-A-0045-A-005	970.837	960.837	960.837

Junction ID	Ground Elevation	Pipe Crown Elevation	Invert Elevation
ME02-A-0045-A-006	980.893	970.893	970.893
ME02-A-0045-A-007	983.13	973.13	973.13
ME02-A-0045-A-008	978.777	968.777	968.777
ME02-A-0045-A-009	982.545	972.545	972.545
ME02-A-0045-A-010	982.319	972.319	972.319
ME02-A-0045-A-011	978.722	968.722	968.722
ME02-A-0045-A-012	977.317	967.317	967.317
ME02-A-0045-A-013	978.816	968.816	968.816
ME02-A-0045-A-014	980.482	970.482	970.482
ME02-A-0045-A-015	982.777	972.777	972.777
ME02-A-0045-A-016	982.591	972.591	972.591
ME02-A-0045-A-017	992.837	982.837	982.837
ME02-A-0045-A-018	982.739	972.739	972.739
ME02-A-0045-A-020	998.867	988.867	988.867
ME02-A-0045-A-021	975.493	965.493	965.493
ME02-A-0045-A-022	977.223	967.223	967.223
ME02-A-0045-A-023	982.492	972.492	972.492
ME02-A-0045-A-024	979.686	969.686	969.686
ME02-A-0045-A-025	983.233	973.233	973.233
ME02-A-0045-A-026	986.245	976.245	976.245
ME02-A-0045-A-027	983.972	973.972	973.972
ME02-A-0045-A-028	989.614	979.614	979.614
ME02-A-0045-A-029	984.732	974.732	974.732
ME02-A-0045-A-030	984.658	974.658	974.658
ME02-A-0045-A-031	977.51	967.51	967.51
ME02-A-0045-A-032	985.252	975.252	975.252
ME02-A-0045-A-033	985.805	975.805	975.805
ME02-A-0045-A-034	983.947	973.947	973.947
ME02-A-0045-A-035	976.576	966.576	966.576
ME02-A-0046-H-001	996.2	976.2	976.2
ME02-A-0046-H-002	1003.7	993.7	993.7
ME02-A-0046-H-003	1007.394	996.5	996.5
ME02-A-0046-H-004	1014.239	1004.239	1004.239
ME02-A-0046-H-005	1016.672	1006.672	1006.672
ME02-A-0046-H-006	986.976	976.976	976.976
ME02-A-0046-H-007	991.198	981.198	981.198
ME02-A-0046-H-008	993.423	983.423	983.423
ME02-A-0047-H-000	992.261	982.261	982.261
ME02-A-0047-H-001	994.433	984.433	984.433
ME02-A-0047-H-002	999.754	989.754	989.754
ME02-A-0047-H-003	1008.778	998.778	998.778
ME02-A-0047-H-004	1032.438	1022.438	1022.438
ME02-A-0047-H-005	1049.244	1039.244	1039.244
ME02-A-0047-H-007	996.225	986.225	986.225
ME02-A-0047-H-008	999.824	989.824	989.824
ME02-A-0047-H-009	1012.331	1002.331	1002.331
ME02-A-0047-H-010	996.398	986.398	986.398
ME02-A-0048-A-001	963.916	953.916	953.916
ME02-A-0048-A-002	1052.262	1042.262	1042.262
ME02-A-0048-A-003	992.219	982.219	982.219
ME02-A-0048-A-004	963.599	953.599	953.599
ME02-A-0048-A-005	961.802	951.802	951.802
ME02-A-0048-A-006	1052.457	1042.457	1042.457
ME02-A-0048-A-007	1047.857	1037.857	1037.857
ME02-A-0048-A-008	1036.513	1026.513	1026.513
ME02-A-0048-A-011	975.336	965.336	965.336
ME02-A-0048-A-012	994.281	984.281	984.281
ME02-A-0048-A-015	986.752	976.752	976.752
ME02-A-0048-A-016	1006.267	996.267	996.267
Surface_JCT1	1005.054	995.054	995.054
ME02-A-0048-A-017	997.704	987.704	987.704
ME02-A-0048-A-018	980.797	970.797	970.797
ME02-A-0048-A-019	1005.216	995.216	995.216
ME02-A-0048-A-020	1010.326	1000.326	1000.326
ME02-A-0048-A-021	1031.455	1021.455	1021.455
ME02-A-0048-A-022	1012.708	1002.708	1002.708
ME02-A-0048-A-023	1009.662	999.662	999.662
ME02-A-0048-A-024	1013.233	1003.233	1003.233
ME02-A-0048-A-025	1002.842	992.842	992.842
ME02-A-0048-A-027	1017.403	1007.403	1007.403
ME02-A-0048-A-028	1037.044	1027.044	1027.044
ME02-A-0048-A-029	1000.397	990.397	990.397
ME02-A-0048-A-030	1038.336	1028.336	1028.336
ME02-A-0048-A-031	1001.288	990.89	986.288
ME02-A-0048-A-035	1043.3	1023.3	1023.3
ME02-A-0048-A-036	1048	1028	1028
ME02-A-0048-A-037	1049	1029	1029
ME02-A-0048-A-038	1040.735	1030.735	1030.735
ME02-A-0048-A-039	1043.581	1033.581	1033.581
ME02-A-0048-A-040	1039.959	1029.959	1029.959
ME02-A-0048-A-041	1041.686	1031.686	1031.686
ME02-A-0049-H-001	1016.619	1006.619	1006.619
ME02-A-0049-H-002	1043.894	1033.894	1033.894
ME02-A-0049-H-003	988.67	978.67	978.67
ME02-A-0049-H-006	986.985	976.985	976.985
ME02-A-0049-H-007	1022.579	1012.579	1012.579
ME02-A-0049-H-009	1003.188	988.188	988.188
ME02-A-0049-H-011	984.943	974.943	974.943
WTP_Structure	1033.6	1027.1	1025.6
ME02-A-0050-H-002	1050	1038.354	1038.354
ME02-A-0050-H-003	1050	1034.524	1034.524
ME02-A-0050-H-004	1055.641	1045.641	1045.641
ME02-A-0050-H-007	1050.56	1040.56	1040.56
ME02-A-0050-H-008	1065.453	1045.453	1045.453
ME02-A-0050-H-009	1054.591	1044.591	1044.591
ME02-A-0050-H-010	1052.018	1042.018	1042.018
ME02-A-0051-A-000	1072.931	1062.931	1062.931
ME02-A-0051-A-001	1059.647	1049.647	1049.647
ME02-A-0051-A-002	1057.017	1047.017	1047.017
ME02-A-0051-A-003	1063.453	1043.453	1043.453
ME02-A-0051-A-004	1056.252	1046.252	1046.252
ME02-A-0051-A-005	1071.25	1051.25	1051.25
ME02-A-0051-A-006	1055.958	1045.958	1045.958
ME02-A-0051-A-007	1061.851	1051.851	1051.851
ME02-A-0051-A-008	1058.112	1048.112	1048.112
ME02-A-0051-A-009	1055.771	1045.771	1045.771
ME02-A-0052-H-000	1051.038	1041.038	1041.038
ME02-A-0052-H-001	1054.26	1044.26	1044.26
ME02-A-0053-A-000	1059.679	1049.679	1049.679
ME02-A-0053-A-001	1066.337	1056.337	1056.337
ME02-A-0053-A-002	1060.33	1050.33	1050.33
ME02-A-0053-A-003	1059.407	1049.407	1049.407
ME02-A-0053-A-004	1067.787	1057.787	1057.787
ME02-A-0053-A-005	1056.356	1046.356	1046.356
ME02-A-0053-A-006	1057.662	1047.662	1047.662
ME02-A-0053-A-007	1046.9	1038.4	1036.9
ME02-A-0053-A-009	1047.7	1037.7	1037.7
ME02-A-0053-A-010	1049.9	1039.9	1039.9
ME02-A-0053-A-011	1052.3	1042.3	1042.3
ME02-A-0053-A-012	1053.151	1043.151	1043.151
ME02-A-0053-A-013	1067.566	1047.566	1047.566
ME02-A-0054-H-000	1091.123	1081.123	1081.123
ME02-A-0054-H-001	1088.622	1078.622	1078.622
ME02-A-0054-H-002	1078.083	1068.083	1068.083

Junction ID	Ground Elevation	Pipe Crown Elevation	Invert Elevation
ME02-A-0054-H-003	1071.041	1061.041	1061.041
ME02-A-0054-H-004	1070.888	1060.888	1060.888
ME02-A-0054-H-005	1064.877	1054.877	1054.877
ME02-A-0054-H-006	1056.771	1046.771	1046.771
ME02-A-0054-H-007	1058.718	1048.718	1048.718
ME02-A-0054-H-008	1052.72	1042.72	1042.72
ME02-A-0054-H-009	1049.709	1039.709	1039.709
ME02-A-0054-H-015	1050	1039.899	1039.899
ME02-A-0054-H-012	1054.85	1044.85	1044.85
ME02-A-0054-H-013	1050.901	1040.901	1040.901
ME02-A-0054-H-014	1050	1036.957	1036.957
ME02-A-0057-H-000	1067.333	1052.333	1052.333
ME02-A-0057-H-001	1058.666	1048.666	1048.666
ME02-A-0057-H-002	1073.509	1063.509	1063.509
ME02-A-0057-H-003	1083.448	1073.448	1073.448
ME02-A-0057-H-005	1085.394	1075.394	1075.394
ME02-A-0057-H-008	1088.066	1078.066	1078.066
ME02-A-0057-H-009	1090.482	1080.482	1080.482
ME02-A-0057-H-010	1090.468	1080.468	1080.468
ME02-A-0057-H-012	1092.847	1082.847	1082.847
ME02-A-0057-H-014	1091.844	1081.844	1081.844
ME02-A-0057-H-015	1093.808	1083.808	1083.808
ME02-A-0057-H-017	1093.933	1083.933	1083.933
ME02-A-0057-H-018	1102.732	1092.732	1092.732
ME02-A-0057-H-019	1139.892	1129.892	1129.892
ME02-A-0057-H-020	1135.638	1125.638	1125.638
ME02-A-0057-H-021	1097.28	1087.28	1087.28
ME02-A-0057-H-022	1084.384	1074.384	1074.384
ME02-A-0057-H-024	1056.656	1046.656	1046.656
ME02-A-0057-H-025	1107	1097	1097
ME02-A-0058-H-001	1068.441	1053.441	1053.441
ME02-A-0058-H-002	1068.588	1053.588	1053.588
ME02-A-0060-H-000	1079.513	1069.513	1069.513
ME02-A-0060-H-001	1082.882	1072.882	1072.882
ME02-A-0060-H-002	1089.005	1079.005	1079.005
ME02-A-0060-H-003	1086.75	1076.75	1076.75
ME02-A-0060-H-004	1092.209	1082.209	1082.209
ME02-A-0060-H-005	1085.484	1065.484	1065.484
ME02-A-0060-H-006	1086.592	1066.592	1066.592
ME02-A-0060-H-007	1086	1066	1066
Surface_JCT4	1092.96	1082.96	1082.96
ME02-A-0060-H-008	1086.975	1071.625	1071.625
ME02-A-0060-H-009	1104.36	1084.36	1084.36
ME02-A-0060-H-010	1078.636	1068.636	1068.636
ME02-A-0060-H-011	1089.696	1079.696	1079.696
ME02-A-0061-H-000	1066.723	1051.723	1051.723
ME02-A-0061-H-001	1067.071	1052.071	1052.071
ME02-A-0062-H-001	1068.134	1053.134	1053.134
ME02-A-0062-H-002	1072.238	1062.238	1062.238
ME02-A-0062-H-003	1067.703	1057.703	1057.703
ME02-A-0062-H-004	1068.53	1053.53	1053.53
ME02-A-0062-H-005	1068.768	1053.768	1053.768
ME02-A-0063-H-000	1067.028	1052.028	1052.028
ME02-A-0063-H-001	1060.48	1050.48	1050.48
ME02-A-0063-H-002	1060.858	1045.858	1045.858
ME02-A-0063-H-003	1065.615	1050.3	1050.3
ME02-A-0065-H-000	1050	1034.289	1034.289
ME02-A-0065-H-001	1045.34	1035.34	1035.34
ME02-A-0066-H-000	1050	1036.754	1036.754
ME02-A-0066-H-001	1050	1038.784	1038.784
ME02-A-0066-H-002	1052.813	1042.813	1042.813
ME02-A-0066-H-003	1051.776	1041.776	1041.776
ME02-A-0066-H-004	1052.224	1042.224	1042.224
ME02-A-0066-H-005	1052.753	1042.753	1042.753
ME02-A-0066-H-006	1054.23	1044.23	1044.23
ME02-A-0066-H-007	1069.23	1059.23	1059.23
ME02-A-0067-H-001	1020.008	1010.008	1010.008
ME02-A-0067-H-002	1022.013	1012.013	1012.013
ME02-A-0067-H-003	1027.225	1017.225	1017.225
ME02-A-0067-H-005	1034.749	1024.749	1024.749
ME02-A-0067-H-006	1047.9	1027.9	1027.9
ME02-A-0067-H-007	1050.45	1040.45	1040.45
ME02-A-0067-H-008	1019.202	1009.202	1009.202
ME02-A-0068-H-000	1024.47	1014.47	1014.47
ME02-A-0068-H-001	1051.269	1041.269	1041.269
ME02-A-0068-H-002	1043.395	1033.395	1033.395
ME02-A-0068-H-004	1046.81	1036.81	1036.81
ME02-A-0068-H-005	1063	1043	1043
ME02-A-0270-H-000	1123.56	1103.56	1103.56
Box_Inlet	1112.98	1105.935	1102.98
ME02-A-0271-H-011	1155.07	1135.07	1135.07
ME02-A-0271-H-000	1105.242	1095.242	1095.242
ME02-A-0271-H-001	1115.191	1105.191	1105.191
ME02-A-0271-H-002	1115.276	1105.276	1105.276
ME02-A-0271-H-003	1118.675	1108.675	1108.675
ME02-A-0271-H-004	1113.617	1103.617	1103.617
ME02-A-0271-H-005	1131.42	1121.42	1121.42
ME02-A-0271-H-006	1138.51	1128.51	1128.51
ME02-A-0271-H-007	1116.358	1106.358	1106.358
ME02-A-0271-H-008	1138.017	1128.017	1128.017
ME02-A-0271-H-009	1164.549	1154.549	1154.549
ME02-A-0271-H-010	1175.879	1165.879	1165.879
ME02-A-0271-H-012	1177.473	1167.473	1167.473
ME02-A-0271-H-013	1151.1	1131.1	1131.1
ME02-A-0271-H-014	1117.335	1107.335	1107.335
ME02-A-0271-H-015	1116.731	1106.731	1106.731
ME02-A-0272-H-002	1119.451	1109.451	1109.451
ME02-A-0272-H-004	1094.579	1084.76	1074.579
ME02-A-0272-H-005	1100.921	1091.921	1088.921
ME02-A-0272-H-006	1107.868	1097.868	1097.868
ME02-A-0272-H-008	1119.367	1109.367	1109.367
ME02-A-0272-H-003	1096.456	1089.456	1086.456
ME02-A-0273-H-001	1100.52	1080.52	1080.52
ME02-A-0273-H-002	1102.274	1092.274	1092.274
ME02-A-0273-H-003	1126.371	1116.371	1116.371
ME02-A-0274-H-000	1027.926	1017.926	1017.926
ME02-A-0274-H-001	1027.083	1017.083	1017.083
ME02-A-0274-H-002	1031.443	1021.443	1021.443
ME02-A-0274-H-003	1045.849	1035.849	1035.849
ME02-A-0274-H-004	1060.755	1050.755	1050.755
ME02-A-0274-H-005	1064.736	1054.736	1054.736
ME02-A-0274-H-006	1068.8	1048.8	1048.8
ME02-A-0274-H-007	1038.634	1028.634	1028.634
ME02-A-0274-H-008	1032.231	1022.231	1022.231
ME02-A-0274-H-010	1025.337	1015.337	1015.337
ME02-A-0274-H-011	1038.24	1028.24	1028.24
ME02-A-0275-H-002	1008.917	998.917	998.917
ME02-A-0275-H-003	1002.864	992.864	992.864
ME02-A-0275-H-004	1026.986	1016.986	1016.986
ME03-C-0041-A-001	866.382	856.382	856.382
ME03-C-0041-A-002	868.5	858.5	858.5
ME03-C-0041-A-003	876.91	858.41	856.91
ME03-C-0041-A-004	904.968	894.968	894.968
ME03-C-0041-A-006	915.006	905.006	905.006

Junction ID	Ground Elevation	Pipe Crown Elevation	Invert Elevation
ME03-C-0041-A-007	916.694	906.694	906.694
ME03-C-0041-A-008	915.018	905.018	905.018
ME03-C-0041-A-009	919.638	909.638	909.638
ME03-C-0041-A-010	870.088	860.088	860.088
KETTLE_POND_Road	933.331	923.331	923.331
ME03-U-0037-Q-002	922.602	902.602	902.602
ME03-U-0295-A-000	892.761	882.761	882.761
ME03-U-0295-A-001	893.887	883.887	883.887
ME03-U-0295-A-002	893.941	883.941	883.941
SURFACE_JCT6	865.878	855.378	855.378
ME03-U-0295-A-003	865.946	855.946	855.946
MEM_HS_DITCH_JCT-100	1054	1044	1044
MEM_HS_DITCH_JCT-101	1051.7	1041.7	1041.7
MEM_HS_DITCH_JCT-102	1048	1038	1038
ME02-A-0050-H-005	1050	1034.5	1032
MHS-CB3	1047.967	1040.051	1037.051
MHS-CB6	1036.511	1035.53	1032.53
MHS_CB1	1047.356	1044.64	1042.64
MHS_CB2	1047.227	1043.05	1041.05
MHS_CB4	1045.333	1038.84	1035.84
MHS_ENDWALL	1052.483	1035.483	1032.483
MI3052-008	919.34	919.34	917.34
MI3151-030	897.237	895.8	894.3
MI3151-032	897.484	896.26	894.76
MI3248-016	874.769	870.394	868.394
MI3252-039	956.319	953.532	952.032
MI3347-026	857.78	852.666	850.666
MI3350-001-000	881.017	879.1	873.1
MI3350-001-002	888.605	888.025	882.025
MI3350-007	898.258	887.6	881.6
MI3353-062	973.074	971	970
MI3355-003	982.221	977.732	973.732
MI3355-022	978.02	972.7667	969.6
MI3449-033	911.05	899.679	897.679
ME02-A-0045-A-019	972.6	963.56	960.06
MSH_GRNW_S_HILL_763	977.84	962.59	957.84
NAUTILUS_S1	1005.7	996.7	995.7
ND3151-023	902.296	898.747	894.372
ND3151-023-001	901.828	899.242	894.492
ND3151-023-002	902.124	899.819	894.679
ND3151-023-003	902.632	900.371	894.871
OWEN_RT_POND_JCT_737	966.716	957	953
OWEN_RT_POND_JCT_740	966.749	957.233	956.4
OWEN_RT_POND_JCT_741	963.84	956.333	955.5
OWEN_RT_POND_JCT_742	962.048	959.3	958.3
OWEN_RT_POND_JCT_744	964.932	954.503	950
OWEN_RT_POND_JCT_746	960.846	959	958
OWEN_RT_POND_JCT_748	948.448	945.02	940.52
OWEN_RT_POND_JCT_749	959.556	956	955
ME02-A-0046-H-000	979.3	973.3	969.3
ME02-A-0047-H-011	992.06	984.93	981.93
PL2753-005	1042.3	1040.8	1038.3
ME02-A-0048-A-032	1044	1025.5	1024
PL3246-039	911.154	906.005	904.005
ME02-A-0057-H-026	1107.7	1090.2	1087.7
PVT_EXACT_LN1	1042.027	1034.6	1031.6
PVT_EXACT_LN2	1047.139	1039.6	1036.6
PVT_EXACT_LN3	1045.86	1041.6	1038.6
ME02-A-0273-H-000	1102.15	1088.06	1082.15
PVT_N_BROOKLYN_DR	1131.91	1128.91	1126.91
RD_JCT-413	889.032	879.032	879.032
BM03-A-0339-H-005	1045.638	1035.638	1035.638
ROAD_JCT-146	1069.787	1059.787	1059.787
ROAD_JCT-158	1050	1035.843	1035.843
ROAD_JCT-164	1050	1039.583	1039.583
ME02-A-0274-H-009	1027.995	1017.995	1017.995
ROAD_JCT-269	984.246	974.246	974.246
ROAD_JCT-280	959.451	949.451	949.451
ROAD_JCT-303	916.578	906.578	906.578
ME02-A-0043-A-040	944.089	934.089	934.089
ROAD_JCT-359	873.499	863.499	863.499
ME03-C-0041-A-000	868.947	858.947	858.947
ROAD_JCT-367	879.718	869.718	869.718
ME03-U-0037-Q-000	935.013	925.013	925.013
ME02-A-0043-A-047	877.895	867.895	867.895
RR_STORAGE-02	932	913.5	912
RR_STORAGE-03	926.3	916.3	916.3
RR_UNDERPASS_JCT-DS	1007.5	894.5	887.5
S-4-PB11399	1003	1002.5	998.5
S-4-PB11399B	1003	1001.1	997.1
S-9_PN11399	1006	1004.211	1000
SS3247-020	905.42	894.13	892.13
SS3348-070	866.663	859.26	856.26
SS3348-073	866.038	859.06	857.06
ST3053-018	950.372	946.298	945.298
ME02-A-0058-H-000	1059.065	1049.065	1049.065
TE2958-023	1053.416	1049.5	1048
TE3353-056	970.004	968.858	967.608
TP2557-006	1052.997	1048.96	1042.201
TP2854-027	1025.66	1021.6	1017.6
TP3150-014-000	899.546	896.1	889.2
TP3150-014-001	900.8	897.17	891.17
TP3150-014-002	900.5	895.8	889.8
TP3150-014-003	900.048	895.5	889.5
TP3151-011	898.7	898.32	894.32
TP3151-036	902.165	899.68	895.68
TP3152-020	903.302	901.155	895.155
TP3152-020-001	903.658	901.486	895.486
TP3250-030	898.696	894.2	885.6
TP3250-033	897.602	891.5	885.5
TP3346-009	858.619	856.485	853.485
TP3347-015	854.6	850.6	844.6
TP3347-016	854.6	850.6	844.6
TP3348-017	863.62	861.1	855.1
TP3348-026	867.794	863.3	857.3
TP3348-027	867.548	862.6	856.6
TP3349-003	873.588	870.771	864.771
TP3349-004	871.478	867.061	861.061
TP3349-055	876.518	876.518	870.518
TP3350-033	918.084	915.254	913.754
ME02-A-0058-H-003	1067.897	1052.897	1052.897
TRANS_JCT-122	1065.457	1050.457	1050.457
TRANS_JCT-126	1046.393	1032.893	1031.393
TRANS_JCT-141	1011.769	1000.8	996.769
TRANS_JCT-143	997.04	984.99	979.36
TRANS_JCT-146	983.189	971.23	960.619
TRANS_JCT-148	974.663	959.19	954.203
TRANS_JCT-156	928.878	916	913.878
TRANS_JCT-160	912.218	894.16	892.218
TRANS_JCT-161	911.952	891.952	891.952
TRANS_JCT-163	910.116	894.094	890.116
TRANS_JCT-164	910.737	895.106	890.737
TRANS_JCT-168	977.544	967.28	962.544
TRANS_JCT-170	976.182	963.62	961.182

Junction ID	Ground Elevation	Pipe Crown Elevation	Invert Elevation
TRANS_JCT-171	975.822	965.97	960.822
TRANS_JCT-173	973.958	960.36	953.958
TRANS_JCT-175	967.103	957.28	947.103
TRANS_JCT-179	942.631	939.64	919.851
TRANS_JCT-181	1021.057	1009.057	1006.057
TRANS_JCT-182	1013.725	998.725	998.725
TRANS_JCT-184	993.213	978.213	978.213
TRANS_JCT-185	987.689	972.689	972.689
TRANS_JCT-199	1094	1084	1084
TRANS_JCT-200	1093	1083	1083
TRANS_JCT-201	1057.974	1047.974	1047.974
TRANS_JCT-204	1110	1100	1100
TRANS_JCT-205	1109	1099	1099
TRANS_JCT-206	1054	1044	1044
TRANS_JCT-207	1055	1045	1045
ID*1509	995.96	988.96	985.96
ID*1510	993.77	986.77	983.77
ME02-A-0047-H-006	1006.553	987.553	986.553
ID*1512	1052.553	1046.29	1042.79
ID*1513	1052.916	1047.17	1043.62
ID*1514	1053.446	1049.3	1045.8
ID*1515	1053.079	1049.89	1047.68
WEST_TOWNE_MALL_ST10	1057.905	1055.8	1052.36
WEST_TOWNE_MALL_ST11	1053.675	1051.553	1049.953
WEST_TOWNE_MALL_ST12	1053.621	1052.05	1049.55
WEST_TOWNE_MALL_ST9	1059.065	1056.55	1055.05
WEST_TOWN_MALL_EX100	1049.981	1044.12	1040.12
WEST_TOWN_MALL_EX106	1053.66	1051.05	1049.3
WT_FORBAY_COLLAR	1033.968	1032.2067	1029.04
YELLOWSTONE_1	1016.936	1015	1012
YELLOWSTONE_11	1015.653	1013.26	1012.26
YELLOWSTONE_12	1019.82	1016.82	1015.82
YELLOWSTONE_13	1028.854	1025.81	1024.81
YELLOWSTONE_YS2	1017.24	1015.41	1012.91
YELLOWSTONE_YS3	1017.68	1015.74	1013.24
YELLOWSTONE_YS4	1021.557	1018.61	1016.36
YELLOWSTONE_YS5	1036.152	1032.68	1031.18
YELLOWSTONE_YS6	1051.305	1048.01	1046.76
YELLOWSTONE_YS7	1062.93	1059.95	1058.95
YELLOWSTONE_YS8	1065.174	1062.31	1061.31
Surface_JCT7	1023.2	1013.2	1013.2
LKMED-001_	860.37	851.62	850.37
LKMED-002	861.07	854.07	851.07
LKMED-003	854.6	850.6	844.6
LKMED-005	860.95	853.95	850.95
LKMED-006	855	846.5	845
OFALL_SPRING_CT-STM	860.23	852.23	850.23
OFALL_SPRING_CT-SURF	865.5	855.5	855.5
ME02-A-0054-H-011	1043.5	1038.5	1035.5
BM03-A-0340-H-004	1060.86	1045.86	1045.86
GARNER_RET_POND	990.77	973.9367	970.77
ME02-A-0048-A-034	1017.5	998.5	996
ME02-A-0048-A-033	1012	1005.5	992
ME02-A-0049-H-008	971.4	957.233	956.4
ME02-A-0049-H-000	972.5	959	957.5
BM03-A-0340-H-003	1057.139	1047.139	1047.139
BM03-A-0340-H-005	1056.6	1044.6	1041.6
RR_UNDERPASS_JCT-US	908	895	888
ME02-A-0049-H-004	968	965.6	953
ME02-A-0049-H-005	976	966	956
BM03-A-0340-H-006	1031.48	1021.48	1021.48
Surface_JCT8	1046.33	1036.33	1036.33
ME02-A-0275-H-000	1000.96	991	985.96
ME02-A-0275-H-001	998.77	988.82	983.77
UW_RSCH_PARK_E_POND3	991.93	986.55	981.93
ME02-A-0050-H-006	1054.6	1037.63	1029.6
ME02-A-0050-H-000	1051.67	1033.1	1026.6
ME02-A-0050-H-001	1049.1	1034.53	1024.1
ME02-A-0044-A-011	889	869	869
ME02-A-0044-A-010	889	869	869
ME02-A-0044-A-000	907.218	897.218	897.218
ME02-A-0062-H-000	1068.134	1054.75	1054.75
ME02-A-0044-A-007	902.029	892.029	892.029
ME02-A-0044-A-012	899.976	889.976	889.976
ME02-A-0057-H-013	1102.274	1092.274	1092.274
ME02-A-0054-H-010	1050	1039.899	1039.899
ME02-A-0043-A-089	940	899.001	899.001
ME03-U-0295-A-004	920	899.901	899.901
Gam_Surface	1099	1079.107	1079.107
Node1375	1062	1042.857	1042.857
AE_3053-019	977.46	950.96	947.46
ME02-A-0048-A-014	995.3	975.3	975.3
WTP_N_Outlet	1031.6	1028.49	1025.49
Bord_P_Outflow	912.6	897.148	891.348

Junction ID	2D Connection Type
302_S_GAMMON_CB1	Sealed
302_S_GAMMON_CB3	Sealed
302_S_GAMMON_RD_CB2	Sealed
ME02-A-0043-A-078	2D Invert
53W1183-001	Sealed
BM03-A-0339-H-006	2D Invert
BM03-A-0339-H-007	2D Invert
ME02-A-0057-H-011	2D Invert
ME02-A-0272-H-000	2D Invert
AE2458-003_001	Sealed
ME02-A-0272-H-001	2D Invert
ME02-A-0272-H-007	2D Invert
AE2459-004_000	Sealed
ME02-A-0057-H-004	2D Invert
ME02-A-0057-H-007	2D Invert
AE2659-011	2D Invert
ME02-A-0057-H-023	2D Invert
AE2753-014	Sealed
AE2753-015	Sealed
ME02-A-0048-A-026	2D Invert
ME02-A-0067-H-000	2D Invert
ME02-A-0068-H-003	2D Invert
AE3052-006	2D Invert
AE3052-007	2D Invert
AE3052-010	2D Invert
AE3054-023	2D Invert
ME02-A-0067-H-004	2D Invert
ME02-A-0043-A-076	2D Invert
ME03-C-0041-A-005	2D Invert
ME02-A-0044-A-009	2D Invert
AE3354-004	2D Invert
ME02-A-0275-H-005	2D Invert
AS2359-025	Sealed
AS2360-006	Sealed
AS2456-017	Sealed
AS2456-018	Sealed
AS2457-001	Sealed
AS2457-004	Sealed
AS2457-005	Sealed
AS2457-015	Sealed
AS2458-005	Sealed
AS2458-008	Sealed
AS2459-003	Sealed
AS2459-006	Sealed
AS2459-007	Sealed
AS2459-013	Sealed
AS2459-019	Sealed
AS2459-020	Sealed
AS2459-022	Sealed
AS2460-001	Sealed
AS2460-003	Sealed
AS2460-005	Sealed
AS2461-020	Sealed
AS2461-021	Sealed
AS2555-003	Sealed
AS2555-007	Sealed
AS2555-008	Sealed
AS2555-009	Sealed
AS2555-021	Sealed
AS2557-001	Sealed
AS2557-003	Sealed
AS2557-004	Sealed
AS2557-008	Sealed
AS2558-002	Sealed
AS2558-003	Sealed
AS2558-004	Sealed
AS2653-001	Sealed
AS2654-004	Sealed
AS2654-008	Sealed
AS2655-002	Sealed
AS2655-003	Sealed
AS2655-012	Sealed
AS2655-016	Sealed
AS2655-019	Sealed
AS2656-007	Sealed
AS2658-009	Sealed
ME02-A-0273-H-004	2D Invert
AS2659-008	Sealed
AS2659-010	Sealed
AS2659-017	Sealed
AS2659-019	Sealed
AS2659-020	Sealed
AS2660-003	Sealed
AS2660-006	Sealed
AS2660-007	Sealed
AS2660-011	Sealed
AS2660-013	Sealed
AS2660-027	Sealed
AS2660-029	Sealed
AS2752-009	Sealed
AS2752-010	Sealed
AS2752-011	Sealed
AS2753-002	Sealed
AS2753-004	Sealed
AS2753-007	Sealed
AS2754-001	Sealed
AS2754-003	Sealed
AS2754-005	Sealed
AS2754-006	Sealed
AS2754-007	Sealed
AS2754-012	Sealed
AS2755-007	Sealed
AS2755-013	Sealed
AS2756-008	Sealed
AS2756-041	Sealed
AS2756-056	Sealed
AS2756-063	Sealed
AS2757-056	Sealed
AS2851-002	Sealed
AS2851-003	Sealed
AS2852-020	Sealed
AS2852-021	Sealed
AS2852-022	Sealed
AS2852-024	Sealed
AS2853-004	Sealed
AS2853-009	Sealed
AS2853-010	Sealed
AS2853-015	Sealed
AS2854-001	Sealed
AS2854-008	Sealed
AS2854-010	Sealed
AS2854-014	Sealed
AS2854-016	Sealed
AS2854-018	Sealed

Junction ID	2D Connection Type
AS2854-019	Sealed
AS2856-009	Sealed
AS2856-012	Sealed
AS2856-017	Sealed
AS2856-019	Sealed
AS2857-015	Sealed
AS2857-015_001	Sealed
AS2857-020	Sealed
AS2857-021	Sealed
AS2858-005	Sealed
AS2858-018	Sealed
AS2858-020	Sealed
AS2858-021	Sealed
AS2858-027	Sealed
AS2858-029	Sealed
AS2858-029-001	Sealed
AS2858-029-002	Sealed
AS2859-005	Sealed
AS2860-001	Sealed
AS2860-003	Sealed
AS2860-011	Sealed
AS2860-020	Sealed
AS2860-029	Sealed
AS2952-023	Sealed
AS2952-025	Sealed
AS2952-026	Sealed
AS2952-027	Sealed
AS2953-001	Sealed
AS2953-002	Sealed
AS2953-003	Sealed
AS2955-001	Sealed
AS2956-006	Sealed
AS2956-009	Sealed
AS2956-010	Sealed
AS2956-011	Sealed
AS2956-014	Sealed
AS2956-015	Sealed
AS2956-019	Sealed
AS2956-025	Sealed
AS2956-030	Sealed
AS2956-031	Sealed
AS2956-032	Sealed
AS2956-033	Sealed
AS2956-034	Sealed
AS2956-035	Sealed
AS2956-036	Sealed
AS2957-005	Sealed
AS2958-007	Sealed
AS2958-008	Sealed
AS2958-010	Sealed
AS2958-013	Sealed
AS2958-014	Sealed
AS2960-003	Sealed
AS2960-017	Sealed
AS3050-002	Sealed
AS3050-010	Sealed
AS3053-001	Sealed
AS3053-002	Sealed
AS3053-003	Sealed
AS3053-014	Sealed
AS3054-003	Sealed
AS3054-010	Sealed
AS3054-012	Sealed
AS3055-002	Sealed
AS3055-003	Sealed
AS3055-004	Sealed
AS3055-005	Sealed
AS3055-006	Sealed
AS3055-009	Sealed
AS3055-010	Sealed
AS3055-012	Sealed
AS3055-013	Sealed
AS3149-004	Sealed
AS3149-009	Sealed
AS3150-001	Sealed
AS3150-004	Sealed
AS3150-008	Sealed
AS3150-009	Sealed
AS3150-012	Sealed
AS3150-013	Sealed
AS3150-016	Sealed
AS3150-019	Sealed
AS3150-022-000	Sealed
AS3150-026	Sealed
AS3150-027	Sealed
AS3150-039	Sealed
AS3150-041	Sealed
AS3150-044	Sealed
AS3150-047	Sealed
AS3150-048	Sealed
AS3151-001	Sealed
AS3151-005	Sealed
AS3151-008	Sealed
AS3151-009	Sealed
AS3151-042	Sealed
AS3151-050	Sealed
AS3151-054	Sealed
AS3152-001	Sealed
AS3152-003	Sealed
AS3152-008	Sealed
AS3153-009	Sealed
AS3153-021	Sealed
AS3153-023	Sealed
AS3153-025	Sealed
AS3153-028	Sealed
AS3154-007	Sealed
AS3155-001	Sealed
AS3155-003	Sealed
AS3246-032	Sealed
AS3246-035	Sealed
AS3246-036	Sealed
AS3247-003	Sealed
AS3247-004	Sealed
AS3247-007	Sealed
AS3247-009	Sealed
AS3247-013	Sealed
AS3247-026	Sealed
AS3247-028	Sealed
AS3248-001	Sealed
AS3248-010	Sealed
AS3248-011	Sealed
AS3250-002	Sealed
AS3250-003	Sealed
AS3250-013	Sealed

Junction ID	2D Connection Type
AS3250-013-001	Sealed
AS3250-017	Sealed
AS3250-018	Sealed
AS3250-021	Sealed
AS3250-026	Sealed
AS3250-028	Sealed
ME02-A-0043-A-054	2D Invert
AS3250-034	Sealed
AS3251-024	Sealed
AS3251-028	Sealed
AS3251-032	Sealed
AS3251-033	Sealed
AS3251-044	Sealed
AS3252-005	Sealed
AS3252-008	Sealed
AS3252-009	Sealed
AS3252-019	Sealed
AS3252-020	Sealed
AS3252-021	Sealed
AS3252-027	Sealed
AS3253-006	Sealed
AS3253-011	Sealed
AS3253-012	Sealed
AS3253-013	Sealed
AS3256-010	Sealed
AS3256-013	Sealed
AS3346-005	Sealed
AS3346-011	Sealed
AS3346-012	Sealed
AS3347-001	Sealed
AS3347-002	Sealed
AS3347-003	Sealed
AS3347-004	Sealed
AS3347-021	Sealed
AS3347-025	Sealed
AS3347-027	Sealed
AS3347-028	Sealed
AS3347-036	Sealed
AS3347-042	Sealed
AS3348-002	Sealed
AS3348-004	Sealed
AS3348-006	Sealed
AS3348-007	Sealed
AS3348-008	Sealed
AS3348-009	Sealed
AS3348-018	Sealed
AS3348-028	Sealed
AS3348-035	Sealed
AS3348-041	Sealed
AS3348-042	Sealed
AS3348-043	Sealed
AS3348-045	Sealed
AS3348-050	Sealed
AS3348-056	Sealed
AS3348-059	Sealed
AS3348-063	Sealed
AS3348-095	Sealed
AS3348-100	Sealed
AS3349-005	Sealed
AS3349-008	Sealed
AS3349-011	Sealed
AS3349-014	Sealed
AS3349-015	Sealed
AS3349-018	Sealed
AS3349-019	Sealed
AS3349-025	Sealed
AS3349-026	Sealed
AS3349-027	Sealed
AS3349-048	Sealed
AS3349-049	Sealed
AS3349-050	Sealed
AS3349-056	Sealed
AS3349-057	Sealed
AS3350-003	Sealed
AS3350-006	Sealed
AS3350-014	Sealed
AS3350-015	Sealed
AS3350-015-001	Sealed
AS3350-022	Sealed
AS3350-025	Sealed
AS3350-031	Sealed
AS3350-035	Sealed
AS3350-040	Sealed
AS3350-041	Sealed
AS3350-042	Sealed
AS3350-043	Sealed
AS3352-013	Sealed
AS3352-018	Sealed
AS3352-020	Sealed
AS3352-028	Sealed
AS3352-036	Sealed
AS3352-039	Sealed
AS3352-042	Sealed
AS3352-044	Sealed
AS3352-048	Sealed
AS3353-003	Sealed
AS3353-006	Sealed
AS3353-007	Sealed
AS3353-008	Sealed
AS3353-015	Sealed
AS3353-018	Sealed
AS3353-028	Sealed
AS3353-029	Sealed
AS3353-033	Sealed
AS3353-034	Sealed
AS3353-040	Sealed
AS3353-058	Sealed
AS3354-003	Sealed
AS3354-010	Sealed
AS3354-023	Sealed
AS3355-002	Sealed
AS3355-002-000	Sealed
AS3356-023	Sealed
AS3356-028	Sealed
AS3356-031	Sealed
AS3356-032	Sealed
AS3356-033	Sealed
AS3356-038	Sealed
AS3356-043	Sealed
AS3357-007	Sealed
AS3357-008	Sealed
AS3447-004	Sealed
AS3447-005	Sealed
AS3447-008	Sealed

Junction ID	2D Connection Type
AS3449-006	Sealed
AS3449-008	Sealed
AS3449-023	Sealed
AS3449-027	Sealed
AS3449-032	Sealed
AS3449-035	Sealed
AS3450-002	Sealed
AS3450-003	Sealed
AS3450-004	Sealed
AS3450-016	Sealed
AS3450-021	Sealed
AS3450-022	Sealed
AS3450-025	Sealed
ME02-A-0044-A-004	2D Invert
AS3450-036	Sealed
AS3450-055	Sealed
AS3450-057	Sealed
AS3452-002	Sealed
AS3452-005	Sealed
AS3452-006	Sealed
AS3457-008	Sealed
AS3457-012	Sealed
AS3457-016	Sealed
AS3457-017	Sealed
AS3457-018	Sealed
AS3458-022	Sealed
AS3458-023	Sealed
BELTLINE_UNDERPASS_N	2D Invert
BELTLINE_UNDERPASS_S	2D Invert
BIOFILTER_US_JCT	Sealed
BM03-A-0315-H-001	2D Invert
BM03-A-0339-H-000	2D Invert
BM03-A-0339-H-001	2D Invert
BM03-A-0339-H-002	2D Invert
BM03-A-0339-H-003	2D Invert
BM03-A-0339-H-004	2D Invert
Surface_JCT9	2D Invert
BM03-A-0339-H-008	2D Invert
BM03-A-0339-H-009	2D Invert
BM03-A-0339-H-010	2D Invert
BM03-A-0340-H-000	2D Invert
BM03-A-0340-H-001	2D Invert
BM03-A-0340-H-002	2D Invert
CB2853-007	Sealed
CB2854-036	Sealed
CB2854-037	Sealed
CB3150-023	Sealed
CB3150-024	Sealed
CB3150-037	Sealed
CB3247-024	Sealed
CB3348-074	Sealed
CB3348-081	Sealed
CB3348-088	Sealed
CB3348-091	Sealed
CB3348-096	Sealed
CB3348-097	Sealed
CB3349-028	Sealed
CB3349-030	Sealed
CB3349-041	Sealed
CB3449-017	Sealed
ID*633	Sealed
ME03-U-0037-Q-001	2D Invert
DT3053-016	2D Invert
DT3152-009	2D Invert
DT3346-010	Sealed
DT3447-003	Sealed
Surface_JCT5	2D Invert
GAMMON_CB111	Sealed
GAMMON_CB143	Sealed
GAMMON_CB144	Sealed
GAMMON_IN112	Sealed
GAMMON_IN84	Sealed
GAMMON_IN85	Sealed
GAMMON_IN88	Sealed
GAMMON_MH101	Sealed
GAMMON_MH104	Sealed
GAMMON_MH105	Sealed
GAMMON_MH110	Sealed
GAMMON_MH120	Sealed
GAMMON_MH125	Sealed
GAMMON_MH149	Sealed
GAMMON_MH150	Sealed
GAMMON_MH151	Sealed
GAMMON_MH90	Sealed
GAMMON_MH91	Sealed
GAMMON_MH93	Sealed
ID*660	Sealed
ID*661	Sealed
ID*662	Sealed
GR-3251-039	2D Invert
ME02-A-0053-A-008	2D Invert
GR2854-015	2D Invert
BM03-A-0315-H-000	2D Invert
GR2953-004	Sealed
ME02-A-0048-A-010	2D Invert
GR3053-010	2D Invert
ME02-A-0048-A-000	2D Invert
GR3151-018	2D Invert
HAWSER_HS-2	Sealed
HAWSER_HS3	Sealed
HAWSER_HS4	Sealed
HAWSER_HS5	Sealed
HAWSER_HS6	Sealed
HD2854-032-001	2D Invert
ME02-A-0049-H-010	2D Invert
HD2953-008	2D Invert
ME02-A-0048-A-009	2D Invert
HD3053-021_2	2D Invert
ME02-A-0048-A-013	2D Invert
ME02-A-0043-A-074	2D Invert
HD3261-040	Sealed
IN2358-001	Sealed
IN2358-025	Sealed
IN2359-010	Sealed
IN2359-011	Sealed
IN2359-017	Sealed
IN2359-019	Sealed
IN2359-023	Sealed
IN2360-009	Sealed
IN2455-011	Sealed
IN2456-019	Sealed
IN2458-002	Sealed
IN2458-002-001	Sealed
IN2458-009	Sealed

Junction ID	2D Connection Type
IN2459-002	Sealed
IN2459-014	Sealed
IN2459-027	Sealed
IN2459-029	Sealed
IN2555-013	Sealed
IN2556-008	Sealed
IN2557-002	Sealed
IN2557-005	Sealed
IN2560-001	Sealed
IN2560-003	Sealed
IN2653-009	Sealed
IN2654-009	Sealed
IN2655-018	Sealed
IN2655-020	Sealed
IN2655-023	Sealed
IN2655-024	Sealed
IN2655-025	Sealed
IN2656-004	Sealed
IN2656-022	Sealed
IN2656-027	Sealed
IN2657-008	Sealed
IN2659-001	Sealed
IN2659-002	Sealed
IN2660-015	Sealed
IN2660-018	Sealed
IN2660-021	Sealed
IN2660-022	Sealed
IN2660-026	Sealed
IN2660-028	Sealed
IN2660-031	Sealed
ME02-A-0057-H-016	2D Invert
IN2753-001	Sealed
IN2753-011	Sealed
IN2753-013	Sealed
IN2755-018	Sealed
IN2755-019	Sealed
IN2756-060	Sealed
IN2756-061	Sealed
IN2757-055	Sealed
IN2759-002	Sealed
IN2759-003	Sealed
IN2759-004	Sealed
IN2759-012	Sealed
ME02-A-0057-H-006	2D Invert
IN2760-001	Sealed
IN2760-002	Sealed
IN2852-016	Sealed
IN2852-028	Sealed
IN2853-008	Sealed
IN2853-011	Sealed
IN2853-018	Sealed
IN2854-023	Sealed
IN2854-033	Sealed
IN2856-008	Sealed
IN2856-010	Sealed
IN2857-012	Sealed
IN2857-014	Sealed
IN2859-001	Sealed
IN2859-003	Sealed
IN2860-006	Sealed
IN2860-007	Sealed
IN2860-013	Sealed
IN2860-021	Sealed
IN2860-034	Sealed
IN2952-003	Sealed
IN2952-004	Sealed
IN2952-005	Sealed
IN2952-011	Sealed
IN2952-015	Sealed
IN2952-020	Sealed
IN2955-006	Sealed
IN2955-010	Sealed
ID*771	Sealed
IN2956-002	Sealed
IN2956-023	Sealed
IN2957-008	Sealed
IN2957-009	Sealed
IN2957-010	Sealed
IN2957-012	Sealed
IN2958-024	Sealed
IN2958-025	Sealed
IN2958-026	Sealed
IN2958-030	Sealed
IN3050-001	Sealed
IN3050-009	Sealed
IN3052-001	Sealed
IN3052-002	Sealed
IN3053-028	Sealed
IN3053-029	Sealed
IN3054-004	Sealed
IN3054-005	Sealed
IN3054-020	Sealed
IN3149-003	Sealed
IN3149-011	Sealed
IN3150-003	Sealed
IN3151-034	Sealed
IN3151-035	Sealed
IN3151-038	Sealed
IN3151-040	Sealed
IN3151-041	Sealed
IN3151-043	Sealed
IN3152-019	Sealed
IN3153-015	Sealed
IN3153-017	Sealed
IN3153-020	Sealed
IN3154-003	Sealed
IN3154-005	Sealed
IN3154-008	Sealed
IN3246-028	Sealed
IN3246-031	Sealed
IN3246-033	Sealed
IN3246-034	Sealed
IN3246-041	Sealed
IN3246-048	Sealed
IN3247-023	Sealed
IN3247-025	Sealed
IN3250-001	Sealed
IN3250-027	Sealed
IN3250-032	Sealed
IN3251-011	Sealed
IN3251-013	Sealed
IN3251-014	Sealed
IN3251-015	Sealed
IN3251-018	Sealed

Junction ID	2D Connection Type
IN3251-020	Sealed
IN3252-006	Sealed
IN3252-011	Sealed
IN3252-014	Sealed
IN3252-015	Sealed
IN3252-028	Sealed
IN3252-029	Sealed
IN3252-030	Sealed
IN3254-001	Sealed
IN3254-002	Sealed
IN3254-003	Sealed
IN3255-003	Sealed
IN3347-022	Sealed
IN3347-035	Sealed
IN3348-052	Sealed
IN3348-055	Sealed
IN3348-064	Sealed
IN3348-109	Sealed
IN3349-051	Sealed
IN3349-062	Sealed
IN3349-064	Sealed
IN3349-065	Sealed
IN3349-066	Sealed
IN3349-067	Sealed
IN3349-068	Sealed
IN3350-016	Sealed
IN3350-018	Sealed
IN3350-021	Sealed
IN3350-029	Sealed
IN3350-030	Sealed
IN3350-046	Sealed
IN3350-047	Sealed
IN3352-002	Sealed
IN3352-003	Sealed
IN3352-005	Sealed
IN3352-034	Sealed
IN3353-054	Sealed
IN3356-025	Sealed
IN3356-026	Sealed
IN3356-027	Sealed
IN3356-030	Sealed
IN3356-044	Sealed
IN3357-012	Sealed
IN3358-002	Sealed
IN3358-003	Sealed
IN3358-004	Sealed
IN3447-016	Sealed
IN3447-017	Sealed
IN3447-018	Sealed
IN3447-019	Sealed
IN3447-021	Sealed
IN3450-011	Sealed
IN3450-038	Sealed
IN3450-054	Sealed
IN3453-001	Sealed
IN3453-002	Sealed
IN3453-003	Sealed
IN3457-010	Sealed
IN3457-013	Sealed
IN3457-014	Sealed
IN3457-020	Sealed
IN3547-001	Sealed
IN3547-002	Sealed
JCT-142	Sealed
JCT-144	Sealed
JCT-146	Sealed
JCT-154	Sealed
JCT-158	Sealed
JCT-160	Sealed
JCT-162	Sealed
JCT-172	Sealed
JCT-174	Sealed
JCT-176	Sealed
JCT-178	Sealed
JCT-180	Sealed
JCT-182	Sealed
JCT-184	Sealed
JCT-186	Sealed
JCT-188	Sealed
JCT-200	Sealed
JCT-202	Sealed
JCT-204	Sealed
JCT-206	Sealed
JCT-208	Sealed
JCT-210	Sealed
JCT-212	Sealed
JCT-214	Sealed
JCT-216	Sealed
JCT-220	Sealed
JCT-222	Sealed
JCT-224	Sealed
JCT-226	Sealed
JCT-228	Sealed
JCT-230	Sealed
JCT-232	Sealed
JCT-234	Sealed
JCT-236	Sealed
JCT-238	Sealed
JCT-240	Sealed
JCT-242	Sealed
JCT-246	Sealed
JCT-248	Sealed
JCT-250	Sealed
JCT-256	Sealed
JCT-258	Sealed
JCT_1_7050_WATTS_RD	Sealed
JCT_6624_SEYBOLD_RD	Sealed
KETTLE_POND_S-1_	Sealed
KETTLE_POND_S-2_	Sealed
KETTLE_POND_S6_	Sealed
KETTLE_POND_S7	Sealed
MASTHEAD_MH1	Sealed
MASTHEAD_MH2	Sealed
MASTHEAD_MH3	Sealed
MASTHEAD_MH4	Sealed
MASTHEAD_MH5	Sealed
ME02-A-0042-A-000	2D Invert
ME02-A-0042-A-001	2D Invert
ME02-A-0042-A-002	2D Invert
ME02-A-0042-A-003	2D Invert
ME02-A-0042-A-004	2D Invert
ME02-A-0042-A-005	2D Invert
ME02-A-0042-A-006	2D Invert
ME02-A-0042-A-007	2D Invert

Junction ID	2D Connection Type
ME02-A-0042-A-008	2D Invert
ME02-A-0042-A-009	2D Invert
ME02-A-0042-A-010	2D Invert
ME02-A-0042-A-011	2D Invert
ME02-A-0042-A-012	2D Invert
ME02-A-0042-A-013	2D Invert
ME02-A-0042-A-014	2D Invert
ME02-A-0042-A-015	2D Invert
ME02-A-0042-A-016	2D Invert
ME02-A-0043-A-000	2D Invert
ME02-A-0043-A-001	2D Invert
ME02-A-0043-A-002	2D Invert
ME02-A-0043-A-003	2D Invert
ME02-A-0043-A-004	2D Invert
ME02-A-0043-A-005	2D Invert
ME02-A-0043-A-006	2D Invert
ME02-A-0043-A-007	2D Invert
ME02-A-0043-A-008	2D Invert
ME02-A-0043-A-009	2D Invert
ME02-A-0043-A-010	2D Invert
ME02-A-0043-A-011	2D Invert
ME02-A-0043-A-012	2D Invert
ME02-A-0043-A-013	2D Invert
ME02-A-0043-A-014	2D Invert
ME02-A-0043-A-015	2D Invert
ME02-A-0043-A-016	2D Invert
ME02-A-0043-A-017	2D Invert
ME02-A-0043-A-018	2D Invert
ME02-A-0043-A-019	2D Invert
ME02-A-0043-A-020	2D Invert
ME02-A-0043-A-021	2D Invert
ME02-A-0043-A-022	2D Invert
ME02-A-0043-A-023	2D Invert
ME02-A-0043-A-024	2D Invert
ME02-A-0043-A-025	2D Invert
ME02-A-0043-A-026	2D Invert
ME02-A-0043-A-027	2D Invert
ME02-A-0043-A-028	2D Invert
ME02-A-0043-A-029	2D Invert
ME02-A-0043-A-030	2D Invert
ME02-A-0043-A-031	Sealed
ME02-A-0043-A-032	2D Invert
ME02-A-0043-A-033	2D Invert
ME02-A-0043-A-034	2D Invert
ME02-A-0043-A-035	2D Invert
ME02-A-0043-A-036	2D Invert
ME02-A-0043-A-037	2D Invert
ME02-A-0043-A-038	2D Invert
ME02-A-0043-A-039	2D Invert
ME02-A-0043-A-041	2D Invert
ME02-A-0043-A-042	2D Invert
ME02-A-0043-A-043	2D Invert
ME02-A-0043-A-044	2D Invert
ME02-A-0043-A-045	2D Invert
ME02-A-0043-A-046	2D Invert
ME02-A-0043-A-048	2D Invert
ME02-A-0043-A-049	2D Invert
ME02-A-0043-A-050	2D Invert
ME02-A-0043-A-051	2D Invert
ME02-A-0043-A-052	2D Invert
ME02-A-0043-A-053	2D Invert
ME02-A-0043-A-055	2D Invert
ME02-A-0043-A-056	2D Invert
ME02-A-0043-A-057	2D Invert
ME02-A-0043-A-058	2D Invert
ME02-A-0043-A-059	2D Invert
ME02-A-0043-A-060	2D Invert
ME02-A-0043-A-061	2D Invert
ME02-A-0043-A-062	2D Invert
ME02-A-0043-A-063	2D Invert
ME02-A-0043-A-064	2D Invert
ME02-A-0043-A-065	2D Invert
ME02-A-0043-A-066	2D Invert
ME02-A-0043-A-067	2D Invert
ME02-A-0043-A-068	2D Invert
ME02-A-0043-A-069	2D Invert
ME02-A-0043-A-070	2D Invert
ME02-A-0043-A-071	2D Invert
ME02-A-0043-A-072	2D Invert
ME02-A-0043-A-073	2D Invert
ME02-A-0043-A-075	2D Invert
ME02-A-0043-A-077	2D Invert
ME02-A-0043-A-079	2D Invert
ME02-A-0043-A-080	2D Invert
ME02-A-0043-A-081	2D Invert
ME02-A-0043-A-082	2D Invert
ME02-A-0043-A-083	2D Invert
ME02-A-0043-A-084	2D Invert
ME02-A-0043-A-085	2D Invert
ME02-A-0043-A-086	2D Invert
ME02-A-0043-A-087	2D Invert
ME02-A-0043-A-088	2D Invert
ME02-A-0043-A-090	2D Invert
ME02-A-0043-A-091	2D Invert
ME02-A-0043-A-092	2D Invert
ME02-A-0043-A-093	2D Invert
ME02-A-0043-A-094	2D Invert
ME02-A-0043-A-095	2D Invert
ME02-A-0043-A-096	2D Invert
ME02-A-0043-A-097	2D Invert
ME02-A-0043-A-098	2D Invert
ME02-A-0043-A-099	2D Invert
ME02-A-0043-A-100	2D Invert
Surface_JCT2	2D Invert
ME02-A-0044-A-001	2D Invert
ME02-A-0044-A-002	2D Invert
ME02-A-0044-A-003	2D Invert
ME02-A-0044-A-005	2D Invert
ME02-A-0044-A-006	2D Invert
ME02-A-0044-A-008	2D Invert
ME02-A-0044-A-013	2D Invert
ME02-A-0044-A-014	2D Invert
ME02-A-0044-A-015	2D Invert
ME02-A-0044-A-016	2D Invert
ME02-A-0044-A-017	2D Invert
ME02-A-0044-A-018	2D Invert
ME02-A-0044-A-019	2D Invert
ME02-A-0044-A-020	2D Invert
ME02-A-0045-A-000	2D Invert
ME02-A-0045-A-001	2D Invert
ME02-A-0045-A-002	2D Invert
ME02-A-0045-A-003	2D Invert
ME02-A-0045-A-004	2D Invert
ME02-A-0045-A-005	2D Invert

Junction ID	2D Connection Type
ME02-A-0045-A-006	2D Invert
ME02-A-0045-A-007	2D Invert
ME02-A-0045-A-008	2D Invert
ME02-A-0045-A-009	2D Invert
ME02-A-0045-A-010	2D Invert
ME02-A-0045-A-011	2D Invert
ME02-A-0045-A-012	2D Invert
ME02-A-0045-A-013	2D Invert
ME02-A-0045-A-014	2D Invert
ME02-A-0045-A-015	2D Invert
ME02-A-0045-A-016	2D Invert
ME02-A-0045-A-017	2D Invert
ME02-A-0045-A-018	2D Invert
ME02-A-0045-A-020	2D Invert
ME02-A-0045-A-021	2D Invert
ME02-A-0045-A-022	2D Invert
ME02-A-0045-A-023	2D Invert
ME02-A-0045-A-024	2D Invert
ME02-A-0045-A-025	2D Invert
ME02-A-0045-A-026	2D Invert
ME02-A-0045-A-027	2D Invert
ME02-A-0045-A-028	2D Invert
ME02-A-0045-A-029	2D Invert
ME02-A-0045-A-030	2D Invert
ME02-A-0045-A-031	2D Invert
ME02-A-0045-A-032	2D Invert
ME02-A-0045-A-033	2D Invert
ME02-A-0045-A-034	2D Invert
ME02-A-0045-A-035	2D Invert
ME02-A-0046-H-001	2D Invert
ME02-A-0046-H-002	2D Invert
ME02-A-0046-H-003	2D Invert
ME02-A-0046-H-004	2D Invert
ME02-A-0046-H-005	2D Invert
ME02-A-0046-H-006	2D Invert
ME02-A-0046-H-007	2D Invert
ME02-A-0046-H-008	2D Invert
ME02-A-0047-H-000	2D Invert
ME02-A-0047-H-001	2D Invert
ME02-A-0047-H-002	2D Invert
ME02-A-0047-H-003	2D Invert
ME02-A-0047-H-004	2D Invert
ME02-A-0047-H-005	2D Invert
ME02-A-0047-H-007	2D Invert
ME02-A-0047-H-008	2D Invert
ME02-A-0047-H-009	2D Invert
ME02-A-0047-H-010	2D Invert
ME02-A-0048-A-001	2D Invert
ME02-A-0048-A-002	2D Invert
ME02-A-0048-A-003	2D Invert
ME02-A-0048-A-004	2D Invert
ME02-A-0048-A-005	2D Invert
ME02-A-0048-A-006	2D Invert
ME02-A-0048-A-007	2D Invert
ME02-A-0048-A-008	2D Invert
ME02-A-0048-A-011	2D Invert
ME02-A-0048-A-012	2D Invert
ME02-A-0048-A-015	2D Invert
ME02-A-0048-A-016	2D Invert
Surface_JCT1	2D Invert
ME02-A-0048-A-017	2D Invert
ME02-A-0048-A-018	2D Invert
ME02-A-0048-A-019	2D Invert
ME02-A-0048-A-020	2D Invert
ME02-A-0048-A-021	2D Invert
ME02-A-0048-A-022	2D Invert
ME02-A-0048-A-023	2D Invert
ME02-A-0048-A-024	2D Invert
ME02-A-0048-A-025	2D Invert
ME02-A-0048-A-027	2D Invert
ME02-A-0048-A-028	2D Invert
ME02-A-0048-A-029	2D Invert
ME02-A-0048-A-030	2D Invert
ME02-A-0048-A-031	2D Invert
ME02-A-0048-A-035	2D Invert
ME02-A-0048-A-036	2D Invert
ME02-A-0048-A-037	2D Invert
ME02-A-0048-A-038	2D Invert
ME02-A-0048-A-039	2D Invert
ME02-A-0048-A-040	2D Invert
ME02-A-0048-A-041	2D Invert
ME02-A-0049-H-001	2D Invert
ME02-A-0049-H-002	2D Invert
ME02-A-0049-H-003	2D Invert
ME02-A-0049-H-006	2D Invert
ME02-A-0049-H-007	2D Invert
ME02-A-0049-H-009	2D Invert
ME02-A-0049-H-011	2D Invert
WTP_Structure	2D Spill L
ME02-A-0050-H-002	2D Invert
ME02-A-0050-H-003	2D Invert
ME02-A-0050-H-004	2D Invert
ME02-A-0050-H-007	2D Invert
ME02-A-0050-H-008	2D Invert
ME02-A-0050-H-009	2D Invert
ME02-A-0050-H-010	2D Invert
ME02-A-0051-A-000	2D Invert
ME02-A-0051-A-001	2D Invert
ME02-A-0051-A-002	2D Invert
ME02-A-0051-A-003	2D Invert
ME02-A-0051-A-004	2D Invert
ME02-A-0051-A-005	2D Invert
ME02-A-0051-A-006	2D Invert
ME02-A-0051-A-007	2D Invert
ME02-A-0051-A-008	2D Invert
ME02-A-0051-A-009	2D Invert
ME02-A-0052-H-000	2D Invert
ME02-A-0052-H-001	2D Invert
ME02-A-0053-A-000	2D Invert
ME02-A-0053-A-001	2D Invert
ME02-A-0053-A-002	2D Invert
ME02-A-0053-A-003	2D Invert
ME02-A-0053-A-004	2D Invert
ME02-A-0053-A-005	2D Invert
ME02-A-0053-A-006	2D Invert
ME02-A-0053-A-007	2D Invert
ME02-A-0053-A-009	2D Invert
ME02-A-0053-A-010	2D Invert
ME02-A-0053-A-011	2D Invert
ME02-A-0053-A-012	2D Invert
ME02-A-0053-A-013	2D Invert
ME02-A-0054-H-000	2D Invert
ME02-A-0054-H-001	2D Invert
ME02-A-0054-H-002	2D Invert

Junction ID	2D Connection Type
ME02-A-0054-H-003	2D Invert
ME02-A-0054-H-004	2D Invert
ME02-A-0054-H-005	2D Invert
ME02-A-0054-H-006	2D Invert
ME02-A-0054-H-007	2D Invert
ME02-A-0054-H-008	2D Invert
ME02-A-0054-H-009	2D Invert
ME02-A-0054-H-015	2D Invert
ME02-A-0054-H-012	2D Invert
ME02-A-0054-H-013	2D Invert
ME02-A-0054-H-014	2D Invert
ME02-A-0057-H-000	2D Invert
ME02-A-0057-H-001	2D Invert
ME02-A-0057-H-002	2D Invert
ME02-A-0057-H-003	2D Invert
ME02-A-0057-H-005	2D Invert
ME02-A-0057-H-008	2D Invert
ME02-A-0057-H-009	2D Invert
ME02-A-0057-H-010	2D Invert
ME02-A-0057-H-012	2D Invert
ME02-A-0057-H-014	2D Invert
ME02-A-0057-H-015	2D Invert
ME02-A-0057-H-017	2D Invert
ME02-A-0057-H-018	2D Invert
ME02-A-0057-H-019	2D Invert
ME02-A-0057-H-020	2D Invert
ME02-A-0057-H-021	2D Invert
ME02-A-0057-H-022	2D Invert
ME02-A-0057-H-024	2D Invert
ME02-A-0057-H-025	2D Invert
ME02-A-0058-H-001	2D Invert
ME02-A-0058-H-002	2D Invert
ME02-A-0060-H-000	2D Invert
ME02-A-0060-H-001	2D Invert
ME02-A-0060-H-002	2D Invert
ME02-A-0060-H-003	2D Invert
ME02-A-0060-H-004	2D Invert
ME02-A-0060-H-005	2D Invert
ME02-A-0060-H-006	2D Invert
ME02-A-0060-H-007	2D Invert
Surface_JCT4	2D Invert
ME02-A-0060-H-008	2D Invert
ME02-A-0060-H-009	2D Invert
ME02-A-0060-H-010	2D Invert
ME02-A-0060-H-011	2D Invert
ME02-A-0061-H-000	2D Invert
ME02-A-0061-H-001	2D Invert
ME02-A-0062-H-001	2D Invert
ME02-A-0062-H-002	2D Invert
ME02-A-0062-H-003	2D Invert
ME02-A-0062-H-004	2D Invert
ME02-A-0062-H-005	2D Invert
ME02-A-0063-H-000	2D Invert
ME02-A-0063-H-001	2D Invert
ME02-A-0063-H-002	2D Invert
ME02-A-0063-H-003	2D Invert
ME02-A-0065-H-000	2D Invert
ME02-A-0065-H-001	2D Invert
ME02-A-0066-H-000	2D Invert
ME02-A-0066-H-001	2D Invert
ME02-A-0066-H-002	2D Invert
ME02-A-0066-H-003	2D Invert
ME02-A-0066-H-004	2D Invert
ME02-A-0066-H-005	2D Invert
ME02-A-0066-H-006	2D Invert
ME02-A-0066-H-007	2D Invert
ME02-A-0067-H-001	2D Invert
ME02-A-0067-H-002	2D Invert
ME02-A-0067-H-003	2D Invert
ME02-A-0067-H-005	2D Invert
ME02-A-0067-H-006	2D Invert
ME02-A-0067-H-007	2D Invert
ME02-A-0067-H-008	2D Invert
ME02-A-0068-H-000	2D Invert
ME02-A-0068-H-001	2D Invert
ME02-A-0068-H-002	2D Invert
ME02-A-0068-H-004	2D Invert
ME02-A-0068-H-005	2D Invert
ME02-A-0270-H-000	2D Invert
Box_Inlet	Sealed
ME02-A-0271-H-011	2D Invert
ME02-A-0271-H-000	2D Invert
ME02-A-0271-H-001	2D Invert
ME02-A-0271-H-002	2D Invert
ME02-A-0271-H-003	2D Invert
ME02-A-0271-H-004	2D Invert
ME02-A-0271-H-005	2D Invert
ME02-A-0271-H-006	2D Invert
ME02-A-0271-H-007	2D Invert
ME02-A-0271-H-008	2D Invert
ME02-A-0271-H-009	2D Invert
ME02-A-0271-H-010	2D Invert
ME02-A-0271-H-012	2D Invert
ME02-A-0271-H-013	2D Invert
ME02-A-0271-H-014	2D Invert
ME02-A-0271-H-015	2D Invert
ME02-A-0272-H-002	2D Invert
ME02-A-0272-H-004	2D Invert
ME02-A-0272-H-005	2D Invert
ME02-A-0272-H-006	2D Invert
ME02-A-0272-H-008	2D Invert
ME02-A-0272-H-003	2D Invert
ME02-A-0273-H-001	2D Invert
ME02-A-0273-H-002	2D Invert
ME02-A-0273-H-003	2D Invert
ME02-A-0274-H-000	2D Invert
ME02-A-0274-H-001	2D Invert
ME02-A-0274-H-002	2D Invert
ME02-A-0274-H-003	2D Invert
ME02-A-0274-H-004	2D Invert
ME02-A-0274-H-005	2D Invert
ME02-A-0274-H-006	2D Invert
ME02-A-0274-H-007	2D Invert
ME02-A-0274-H-008	2D Invert
ME02-A-0274-H-010	2D Invert
ME02-A-0274-H-011	2D Invert
ME02-A-0275-H-002	2D Invert
ME02-A-0275-H-003	2D Invert
ME02-A-0275-H-004	2D Invert
ME03-C-0041-A-001	2D Invert
ME03-C-0041-A-002	2D Invert
ME03-C-0041-A-003	2D Invert
ME03-C-0041-A-004	2D Invert
ME03-C-0041-A-006	2D Invert

Junction ID	2D Connection Type
ME03-C-0041-A-007	2D Invert
ME03-C-0041-A-008	2D Invert
ME03-C-0041-A-009	2D Invert
ME03-C-0041-A-010	2D Invert
KETTLE_POND_Road	Sealed
ME03-U-0037-Q-002	2D Invert
ME03-U-0295-A-000	2D Invert
ME03-U-0295-A-001	2D Invert
ME03-U-0295-A-002	2D Invert
SURFACE_JCT6	2D Invert
ME03-U-0295-A-003	2D Invert
MEM_HS_DITCH_JCT-100	2D Invert
MEM_HS_DITCH_JCT-101	2D Invert
MEM_HS_DITCH_JCT-102	2D Invert
ME02-A-0050-H-005	2D Invert
MHS-CB3	Sealed
MHS-CB6	Sealed
MHS_CB1	Sealed
MHS_CB2	Sealed
MHS_CB4	Sealed
MHS_ENDWALL	2D Invert
MI3052-008	Sealed
MI3151-030	Sealed
MI3151-032	Sealed
MI3248-016	Sealed
MI3252-039	Sealed
MI3347-026	Sealed
MI3350-001-000	Sealed
MI3350-001-002	Sealed
MI3350-007	Sealed
MI3353-062	Sealed
MI3355-003	Sealed
MI3355-022	Sealed
MI3449-033	Sealed
ME02-A-0045-A-019	2D Invert
MSH_GRNW_S_HILL_763	2D Invert
NAUTILUS_S1	2D Invert
ND3151-023	Sealed
ND3151-023-001	Sealed
ND3151-023-002	Sealed
ND3151-023-003	Sealed
OWEN_RT_POND_JCT_737	Sealed
OWEN_RT_POND_JCT_740	Sealed
OWEN_RT_POND_JCT_741	Sealed
OWEN_RT_POND_JCT_742	Sealed
OWEN_RT_POND_JCT_744	Sealed
OWEN_RT_POND_JCT_746	Sealed
OWEN_RT_POND_JCT_748	Sealed
OWEN_RT_POND_JCT_749	Sealed
ME02-A-0046-H-000	Sealed
ME02-A-0047-H-011	Sealed
PL2753-005	Sealed
ME02-A-0048-A-032	2D Invert
PL3246-039	Sealed
ME02-A-0057-H-026	2D Invert
PVT_EXACT_LN1	Sealed
PVT_EXACT_LN2	Sealed
PVT_EXACT_LN3	Sealed
ME02-A-0273-H-000	2D Invert
PVT_N_BROOKLYN_DR	Sealed
RD_JCT-413	2D Invert
BM03-A-0339-H-005	2D Invert
ROAD_JCT-146	2D Invert
ROAD_JCT-158	2D Invert
ROAD_JCT-164	2D Invert
ME02-A-0274-H-009	2D Invert
ROAD_JCT-269	2D Invert
ROAD_JCT-280	2D Invert
ROAD_JCT-303	2D Invert
ME02-A-0043-A-040	2D Invert
ROAD_JCT-359	2D Invert
ME03-C-0041-A-000	2D Invert
ROAD_JCT-367	2D Invert
ME03-U-0037-Q-000	2D Invert
ME02-A-0043-A-047	2D Invert
RR_STORAGE-02	2D Invert
RR_STORAGE-03	Sealed
RR_UNDERPASS_JCT-DS	2D Invert
S-4-PB11399	2D Invert
S-4-PB11399B	2D Invert
S-9_PN11399	Sealed
SS3247-020	Sealed
SS3348-070	Sealed
SS3348-073	Sealed
ST3053-018	Sealed
ME02-A-0058-H-000	2D Invert
TE2958-023	Sealed
TE3353-056	Sealed
TP2557-006	Sealed
TP2854-027	Sealed
TP3150-014-000	Sealed
TP3150-014-001	Sealed
TP3150-014-002	Sealed
TP3150-014-003	Sealed
TP3151-011	Sealed
TP3151-036	Sealed
TP3152-020	Sealed
TP3152-020-001	Sealed
TP3250-030	Sealed
TP3250-033	Sealed
TP3346-009	Sealed
TP3347-015	Sealed
TP3347-016	Sealed
TP3348-017	Sealed
TP3348-026	Sealed
TP3348-027	Sealed
TP3349-003	Sealed
TP3349-004	Sealed
TP3349-055	Sealed
TP3350-033	Sealed
ME02-A-0058-H-003	2D Invert
TRANS_JCT-122	Sealed
TRANS_JCT-126	2D Invert
TRANS_JCT-141	2D Invert
TRANS_JCT-143	2D Invert
TRANS_JCT-146	2D Invert
TRANS_JCT-148	2D Invert
TRANS_JCT-156	2D Invert
TRANS_JCT-160	2D Invert
TRANS_JCT-161	Sealed
TRANS_JCT-163	2D Invert
TRANS_JCT-164	2D Invert
TRANS_JCT-168	2D Invert
TRANS_JCT-170	2D Invert

Junction ID	2D Connection Type
TRANS_JCT-171	2D Invert
TRANS_JCT-173	2D Invert
TRANS_JCT-175	2D Invert
TRANS_JCT-179	2D Invert
TRANS_JCT-181	2D Invert
TRANS_JCT-182	2D Invert
TRANS_JCT-184	2D Invert
TRANS_JCT-185	2D Invert
TRANS_JCT-199	Sealed
TRANS_JCT-200	Sealed
TRANS_JCT-201	Sealed
TRANS_JCT-204	Sealed
TRANS_JCT-205	Sealed
TRANS_JCT-206	Sealed
TRANS_JCT-207	Sealed
ID*1509	Sealed
ID*1510	Sealed
ME02-A-0047-H-006	2D Invert
ID*1512	Sealed
ID*1513	Sealed
ID*1514	Sealed
ID*1515	Sealed
WEST_TOWNE_MALL_ST10	Sealed
WEST_TOWNE_MALL_ST11	Sealed
WEST_TOWNE_MALL_ST12	Sealed
WEST_TOWNE_MALL_ST9	Sealed
WEST_TOWN_MALL_EX100	Sealed
WEST_TOWN_MALL_EX106	Sealed
WT_FORBAY_COLLAR	Sealed
YELLOWSTONE_1	Sealed
YELLOWSTONE_11	Sealed
YELLOWSTONE_12	Sealed
YELLOWSTONE_13	Sealed
YELLOWSTONE_YS2	Sealed
YELLOWSTONE_YS3	Sealed
YELLOWSTONE_YS4	Sealed
YELLOWSTONE_YS5	Sealed
YELLOWSTONE_YS6	Sealed
YELLOWSTONE_YS7	Sealed
YELLOWSTONE_YS8	Sealed
Surface_JCT7	2D Invert
LKMED-001_	Sealed
LKMED-002	Sealed
LKMED-003	Sealed
LKMED-005	Sealed
LKMED-006	Sealed
OFALL_SPRING_CT-STM	Sealed
OFALL_SPRING_CT-SURF	Sealed
ME02-A-0054-H-011	Sealed
BM03-A-0340-H-004	Sealed
GARNER_RET_POND	2D Invert
ME02-A-0048-A-034	2D Invert
ME02-A-0048-A-033	2D Invert
ME02-A-0049-H-008	2D Invert
ME02-A-0049-H-000	2D Invert
BM03-A-0340-H-003	Sealed
BM03-A-0340-H-005	Sealed
RR_UNDERPASS_JCT-US	2D Invert
ME02-A-0049-H-004	2D Invert
ME02-A-0049-H-005	2D Invert
BM03-A-0340-H-006	2D Invert
Surface_JCT8	Sealed
ME02-A-0275-H-000	2D Invert
ME02-A-0275-H-001	2D Invert
UW_RSCH_PARK_E_POND3	2D Invert
ME02-A-0050-H-006	Sealed
ME02-A-0050-H-000	2D Invert
ME02-A-0050-H-001	2D Invert
ME02-A-0044-A-011	2D Invert
ME02-A-0044-A-010	2D Invert
ME02-A-0044-A-000	2D Invert
ME02-A-0062-H-000	2D Invert
ME02-A-0044-A-007	2D Invert
ME02-A-0044-A-012	2D Invert
ME02-A-0057-H-013	2D Invert
ME02-A-0054-H-010	2D Invert
ME02-A-0043-A-089	2D Invert
ME03-U-0295-A-004	2D Invert
Gam_Surface	2D Invert
Node1375	2D Invert
AE_3053-019	2D Invert
ME02-A-0048-A-014	No Ponding
WTP_N_Outlet	Sealed
Bord_P_Outflow	2D Invert

Conduit ID	Length (ft)	Conduit Shape	Flow Area (sf)	Manning's n Value	Span (ft)	Depth (ft)
302_S_GAMMON_CB1_EX	18	Circular	7.0686	0.012	3	3
302_S_GAMMON_CB2_CB1	50	Circular	7.0686	0.01	3	3
302_S_GAMMON_CB3_CB2	126	Circular	7.0686	0.01	3	3
302_S_GAMMON_CB4_CB3	102	Circular	7.0686	0.01	3	3
ID*1566	114	Circular	12.5664	0.013	4	4
ID*1567	82.009	Circular	1.7671	0.013	1.5	1.5
ID*1568	67	Circular	1.7671	0.013	1.5	1.5
ID*1569	85.929	Circular	1.7671	0.013	1.5	1.5
ID*1570	53.587	Circular	0.7854	0.013	1	1
ID*1571	564.617	Circular	7.0686	0.013	3	3
ID*1574	28.808	Circular	3.1416	0.013	2	2
ID*1575	38.282	Circular	1.7671	0.013	1.5	1.5
ID*1576	59.24	H Ellipse	16.6	0.012	5.6667	3.5833
ID*1578	25.051	H Ellipse	3.3	0.024	2.5	1.5833
ID*1579	60.024	Circular	1.7671	0.013	1.5	1.5
ID*1580	7	Circular	0.7854	0.013	1	1
ID*1581	40	Circular	7.0686	0.013	3	3
ID*1582	20	Circular	7.0686	0.013	3	3
ID*1583	17	Circular	3.1416	0.013	2	2
ID*1584	45.04	Circular	4.9087	0.013	2.5	2.5
ID*1585	47.927	Circular	4.9087	0.013	2.5	2.5
ID*1586	379.104	Circular	3.1416	0.013	2	2
ID*1587	235.133	Circular	3.1416	0.013	2	2
ID*1588	283.507	Circular	7.0686	0.013	3	3
ID*1589	157.153	Circular	7.0686	0.013	3	3
ID*1590	117.521	Circular	7.0686	0.013	3	3
ID*1591	33.269	Circular	4.9087	0.013	2.5	2.5
ID*1592	155.688	Circular	3.1416	0.013	2	2
ID*1593	265.683	Circular	3.1416	0.013	2	2
ID*1594	227	Circular	9.6211	0.013	3.5	3.5
ID*1595	242	Circular	9.6211	0.013	3.5	3.5
ID*1596	194.238	Circular	9.6211	0.013	3.5	3.5
ID*1597	143.569	Circular	4.9087	0.013	2.5	2.5
ID*1598	177.736	Circular	4.9087	0.013	2.5	2.5
ID*1599	81.388	Circular	1.7671	0.013	1.5	1.5
ID*1600	340.2	Circular	3.1416	0.013	2	2
ID*1601	294.948	Circular	3.1416	0.013	2	2
ID*1602	178.605	Circular	4.9087	0.013	2.5	2.5
ID*1603	267.329	Circular	3.1416	0.013	2	2
ID*1604	352.469	Circular	3.1416	0.013	2	2
ID*1605	101.75	Circular	3.1416	0.013	2	2
ID*1606	533.143	Circular	3.1416	0.013	2	2
ID*1607	253.023	Circular	3.1416	0.013	2	2
ID*1608	293.488	Circular	2.4053	0.013	1.75	1.75
ID*1609	121.483	Circular	3.1416	0.013	2	2
ID*1610	44.134	Circular	33.1831	0.013	6.5	6.5
ID*1611	279.424	Circular	28.2743	0.013	6	6
ID*1612	389.762	Circular	28.2743	0.013	6	6
ID*1613	33.428	Circular	7.0686	0.013	3	3
ID*1614	283.868	Circular	15.9043	0.013	4.5	4.5
ID*1615	90.597	Circular	15.9043	0.013	4.5	4.5
ID*1616	634.3	Circular	23.7583	0.013	5.5	5.5
ID*1617	73.003	Circular	4.9087	0.013	2.5	2.5
ID*1618	49	H Ellipse	7.4	0.012	3.75	2.4167
ID*1619	162.817	Circular	4.9087	0.013	2.5	2.5
ID*1620	98.27	Circular	12.5664	0.013	4	4
ID*1621	231.467	Circular	9.6211	0.013	3.5	3.5
ID*1622	285.279	Circular	4.9087	0.013	2.5	2.5
ID*1623	288.622	Circular	3.1416	0.013	2	2
ID*1624	122.321	Circular	9.6211	0.013	3.5	3.5
ID*1625	71.649	Circular	4.9087	0.013	2.5	2.5
ID*1626	12	Circular	9.6211	0.013	3.5	3.5
ID*1627	56	Circular	1.7671	0.013	1.5	1.5
ID*1628	47.648	Circular	1.7671	0.013	1.5	1.5
ID*1629	39.668	Circular	4.9087	0.013	2.5	2.5
ID*1630	218.01	Circular	4.9087	0.013	2.5	2.5
ID*1631	182.266	Circular	4.9087	0.013	2.5	2.5
ID*1632	71.521	Circular	1.7671	0.013	1.5	1.5
ID*1633	42.814	Circular	3.1416	0.013	2	2
ID*1634	47.806	Circular	3.1416	0.013	2	2
ID*1635	58.343	Circular	3.1416	0.013	2	2
ID*1636	85.073	Circular	4.9087	0.013	2.5	2.5
ID*1637	272.289	Circular	3.1416	0.013	2	2
ID*1638	605.747	Circular	7.0686	0.013	3	3
ID*1639	91.267	Circular	4.9087	0.013	2.5	2.5
ID*1640	118.667	Circular	1.7671	0.013	1.5	1.5
ID*1641	329.583	Circular	5.9396	0.013	2.75	2.75
ID*1642	426.27	Circular	5.9396	0.013	2.75	2.75
ID*1643	391.631	Circular	4.9087	0.013	2.5	2.5
ID*1644	232.518	Circular	1.7671	0.013	1.5	1.5
ID*1645	542	Circular	7.0686	0.013	3	3
ID*1646	516.216	Circular	7.0686	0.013	3	3
ID*1647	313.493	H Ellipse	7.4	0.012	3.75	2.4167
ID*1648	334.106	H Ellipse	12.9	0.012	5	3.1667
ID*1649	158.191	H Ellipse	12.9	0.012	5	3.1667
ID*1650	566.577	Circular	7.0686	0.013	3	3
ID*1651	134.414	Circular	12.5664	0.013	4	4
ID*1652	550.527	Circular	7.0686	0.013	3	3
ID*1653	85.591	Circular	7.0686	0.013	3	3
ID*1654	297.441	Circular	15.9043	0.013	4.5	4.5
ID*1655	131.447	Circular	15.9043	0.013	4.5	4.5
ID*1656	60.038	Circular	15.9043	0.013	4.5	4.5
ID*1657	40.004	Circular	1.7671	0.013	1.5	1.5
ID*1658	296.033	Circular	1.7671	0.013	1.5	1.5
ID*1659	260.029	Circular	1.7671	0.013	1.5	1.5
ID*1660	35	Circular	4.9087	0.013	2.5	2.5
ID*1661	158.536	Circular	7.0686	0.013	3	3
ID*1662	71	Circular	3.1416	0.013	2	2
ID*1663	92.011	Circular	3.1416	0.013	2	2
ID*1664	146.88	Circular	3.1416	0.013	2	2
ID*1665	320.037	Circular	2.4053	0.013	1.75	1.75
ID*1666	205.024	Circular	1.7671	0.013	1.5	1.5
ID*1667	214.025	Circular	1.2272	0.013	1.25	1.25
ID*1668	70.79	Circular	1.2272	0.013	1.25	1.25
ID*1669	282.048	Circular	1.2272	0.013	1.25	1.25
ID*1670	37.428	Circular	1.7671	0.013	1.5	1.5
ID*1671	231.787	Circular	7.0686	0.013	3	3
ID*1672	455.731	Circular	1.7671	0.013	1.5	1.5
ID*1673	469.158	Circular	7.0686	0.013	3	3
ID*1674	155.997	Circular	3.1416	0.013	2	2
ID*1675	358.629	Circular	3.1416	0.013	2	2
ID*1676	139.917	Circular	3.1416	0.013	2	2
ID*1677	203.096	Circular	7.0686	0.013	3	3
ID*1678	245.528	Circular	3.1416	0.013	2	2
ID*1679	154.126	Circular	1.2272	0.013	1.25	1.25
ID*1680	110.228	Circular	1.2272	0.013	1.25	1.25
ID*1681	424	Circular	12.5664	0.013	4	4
ID*1682	448.033	Circular	12.5664	0.013	4	4
ID*1683	90.544	Circular	12.5664	0.013	4	4
ID*1684	272.341	Circular	19.635	0.013	5	5
ID*1685	263.65	Circular	7.0686	0.013	3	3
ID*1686	237.055	Circular	12.5664	0.013	4	4
ID*1687	226.745	H Ellipse	16.6	0.012	5.6667	3.5833
ID*1688	432.877	Circular	9.6211	0.013	3.5	3.5

Conduit ID	Length (ft)	Conduit Shape	Flow Area (sf)	Manning's n Value	Span (ft)	Depth (ft)
ID*1689	462.57	Circular	12.5664	0.013	4	4
ID*1690	60.8	Circular	12.5664	0.013	4	4
ID*1691	191	Circular	23.7583	0.013	5.5	5.5
ID*1692	22.265	Circular	28.2743	0.013	6	6
ID*1693	79.238	Circular	15.9043	0.013	4.5	4.5
ID*1694	112.115	Circular	9.6211	0.013	3.5	3.5
ID*1695	276.344	Circular	9.6211	0.013	3.5	3.5
ID*1696	68.089	Circular	9.6211	0.013	3.5	3.5
ID*1697	97.011	H Ellipse	12.9	0.012	5	3.1667
ID*1698	185.498	Circular	9.6211	0.013	3.5	3.5
ID*1699	59.007	Circular	4.9087	0.013	2.5	2.5
ID*1700	151.565	H Ellipse	16.6	0.012	5.6667	3.5833
ID*1701	236.553	Circular	9.6211	0.013	3.5	3.5
ID*1702	380.799	Circular	7.0686	0.013	3	3
ID*1703	382.794	Circular	7.0686	0.013	3	3
ID*1704	55	Circular	12.5664	0.013	4	4
ID*1705	220.627	Circular	4.9087	0.013	2.5	2.5
ID*1706	222.186	Circular	7.0686	0.013	3	3
ID*1707	88.328	Circular	7.0686	0.013	3	3
ID*1708	45.914	Circular	7.0686	0.013	3	3
ID*1709	47	H Ellipse	5.1	0.013	3.1667	2
ID*1710	36.951	Circular	4.9087	0.013	2.5	2.5
ID*1711	399.767	Circular	7.0686	0.013	3	3
ID*1712	124.537	Circular	7.0686	0.013	3	3
ID*1713	104.004	Circular	7.0686	0.013	3	3
ID*1714	26.001	Circular	7.0686	0.013	3	3
ID*1715	79.869	Circular	7.0686	0.013	3	3
ID*1716	141.006	Circular	7.0686	0.013	3	3
ID*1717	107.004	Circular	7.0686	0.013	3	3
ID*1718	167.696	Circular	7.0686	0.013	3	3
ID*1719	55.002	Circular	4.9087	0.013	2.5	2.5
ID*1720	453.267	Circular	3.1416	0.013	2	2
ID*1721	174.562	Circular	1.7671	0.013	1.5	1.5
ID*1722	36.433	Circular	4.9087	0.013	2.5	2.5
ID*1723	399.855	Circular	4.9087	0.013	2.5	2.5
ID*1724	410.696	Circular	7.0686	0.013	3	3
ID*1725	41.862	Circular	3.1416	0.013	2	2
ID*1726	411.527	Circular	4.9087	0.013	2.5	2.5
ID*1727	70	Circular	7.0686	0.013	3	3
ID*1728	45.002	Circular	1.7671	0.013	1.5	1.5
ID*1729	395.036	Circular	3.1416	0.024	2	2
ID*1730	103.956	Circular	1.2272	0.013	1.25	1.25
ID*1731	57.509	Circular	1.2272	0.024	1.25	1.25
ID*1732	10	Circular	1.2272	0.013	1.25	1.25
ID*1733	114.096	Circular	3.1416	0.024	2	2
ID*1734	276.284	Circular	9.6211	0.013	3.5	3.5
ID*1735	42	Circular	1.2272	0.013	1.25	1.25
ID*1736	68.131	Circular	1.2272	0.013	1.25	1.25
ID*1737	47.572	Circular	1.2272	0.013	1.25	1.25
ID*1738	256.507	Circular	9.6211	0.013	3.5	3.5
ID*1739	136.965	Circular	7.0686	0.013	3	3
ID*1740	99.839	Circular	7.0686	0.013	3	3
ID*1741	155.185	Circular	7.0686	0.013	3	3
ID*1742	53.655	H Ellipse	3.3	0.012	2.5	1.5833
ID*1743	163.861	Circular	9.6211	0.013	3.5	3.5
ID*1744	71.044	Circular	3.1416	0.013	2	2
ID*1745	55.007	Circular	7.0686	0.013	3	3
ID*1746	68.007	Circular	7.0686	0.013	3	3
ID*1747	247.681	Circular	3.1416	0.013	2	2
ID*1748	180	Circular	3.1416	0.013	2	2
ID*1749	110.557	Circular	4.9087	0.013	2.5	2.5
ID*1750	164.821	Circular	4.9087	0.024	2.5	2.5
ID*1751	41.276	Circular	4.9087	0.013	2.5	2.5
ID*1752	111.94	Circular	4.9087	0.013	2.5	2.5
ID*1753	198.292	Circular	4.9087	0.013	2.5	2.5
ID*1754	33.005	Circular	4.9087	0.013	2.5	2.5
ID*1755	120.17	Circular	1.7671	0.013	1.5	1.5
ID*1756	96.918	H Ellipse	5.1	0.012	3.1667	2
ID*1757	86.394	Circular	3.1416	0.013	2	2
ID*1758	186.022	Circular	1.7671	0.013	1.5	1.5
ID*1759	215.026	Circular	1.7671	0.013	1.5	1.5
ID*1760	46.001	Circular	3.1416	0.013	2	2
ID*1761	79.003	Circular	2.4053	0.013	1.75	1.75
ID*1762	315.012	Circular	2.4053	0.013	1.75	1.75
ID*1763	270.01	Circular	2.4053	0.013	1.75	1.75
ID*1764	71.003	Circular	2.4053	0.013	1.75	1.75
ID*1765	40.509	Circular	1.7671	0.013	1.5	1.5
ID*1766	43.107	Circular	1.7671	0.013	1.5	1.5
ID*1767	82.723	Circular	3.1416	0.013	2	2
ID*1768	97.487	Circular	3.1416	0.013	2	2
ID*1769	18	Circular	2.4053	0.013	1.75	1.75
ID*1770	50.217	Circular	1.7671	0.013	1.5	1.5
ID*1771	48	Circular	1.7671	0.013	1.5	1.5
ID*1772	325.76	Circular	3.1416	0.013	2	2
ID*1773	339.667	Circular	3.1416	0.013	2	2
ID*1774	314.144	Circular	3.1416	0.013	2	2
ID*1775	147.256	Circular	3.1416	0.013	2	2
ID*1776	62.601	Circular	3.1416	0.013	2	2
ID*1777	29.943	Circular	1.2272	0.013	1.25	1.25
ID*1778	330.103	Circular	1.2272	0.013	1.25	1.25
ID*1779	335.038	Circular	0.7854	0.013	1	1
ID*1780	332.308	Circular	3.1416	0.013	2	2
ID*1781	445.98	Circular	4.9087	0.013	2.5	2.5
ID*1782	256.611	Circular	4.9087	0.013	2.5	2.5
ID*1783	59.887	Circular	3.1416	0.013	2	2
ID*1784	18	Circular	3.1416	0.013	2	2
ID*1785	84.011	Circular	3.1416	0.013	2	2
ID*1786	222.313	Circular	3.1416	0.014	2	2
ID*1787	152.281	Circular	3.1416	0.013	2	2
ID*1788	80.356	Circular	0.7854	0.013	1	1
ID*1789	140.998	Circular	3.1416	0.013	2	2
ID*1790	27.823	Circular	3.1416	0.013	2	2
ID*1791	37.004	Circular	3.1416	0.013	2	2
ID*1792	284.032	Circular	3.1416	0.013	2	2
ID*1793	174.801	Circular	3.1416	0.013	2	2
ID*1794	141.513	Circular	3.1416	0.013	2	2
ID*1795	136.361	Circular	3.1416	0.013	2	2
ID*1796	22.08	Circular	1.7671	0.013	1.5	1.5
ID*1797	194.994	Circular	1.7671	0.013	1.5	1.5
ID*1798	229	Rectangle	84	0.012	14	6
ID*1799	16	Circular	7.0686	0.013	3	3
ID*1800	48.099	Rectangle	84	0.012	14	6
ID*1801	107.127	Rectangle	102	0.012	17	6
ID*1802	24.802	Circular	7.0686	0.013	3	3
ID*1803	128.319	Circular	0.7854	0.013	1	1
ID*1804	71.049	Circular	0.7854	0.013	1	1
ID*1805	153.376	Circular	0.7854	0.013	1	1
ID*1806	202.9	Rectangle	102	0.012	17	6
ID*1807	75.185	Circular	7.0686	0.013	3	3
ID*1808	128.972	Circular	7.0686	0.013	3	3
ID*1809	126	Circular	12.5664	0.013	4	4
ID*1810	45.392	Circular	12.5664	0.013	4	4
ID*1811	272	Circular	12.5664	0.013	4	4
ID*1812	33.189	Circular	1.7671	0.013	1.5	1.5

Conduit ID	Length (ft)	Conduit Shape	Flow Area (sf)	Manning's n Value	Span (ft)	Depth (ft)
ID*1813	34.509	Circular	2.4053	0.014	1.75	1.75
ID*1814	54.133	Circular	2.4053	0.014	1.75	1.75
ID*1815	60.501	Circular	1.7671	0.014	1.5	1.5
ID*1816	69.735	Circular	3.1416	0.014	2	2
ID*1817	368.472	Circular	3.1416	0.014	2	2
ID*1818	230.465	Circular	2.4053	0.014	1.75	1.75
ID*1819	76.025	Circular	1.7671	0.014	1.5	1.5
ID*1820	76.146	Circular	1.7671	0.013	1.5	1.5
ID*1821	162.864	Circular	2.4053	0.013	1.75	1.75
ID*1822	329.919	Circular	2.4053	0.014	1.75	1.75
ID*1823	319.441	Circular	1.7671	0.013	1.5	1.5
ID*1824	401.844	Circular	1.7671	0.013	1.5	1.5
AS3346-005_LKMED-001	251.673	Circular	1.2272	0.013	1.25	1.25
ID*1826	197.548	Rectangle	12	0.013	4	3
AS3346-012_LKMED-002	242.822	Rectangle	12	0.013	4	3
ID*1828	209.561	Circular	3.1416	0.014	2	2
ID*1829	197.588	Circular	4.9087	0.014	2.5	2.5
ID*1830	128.536	Circular	4.9087	0.014	2.5	2.5
ID*1831	238.848	Circular	1.7671	0.013	1.5	1.5
ID*1832	59.176	Rectangle	4	0.013	2	2
ID*1833	59.392	Rectangle	12	0.013	4	3
ID*1834	60.213	Rectangle	4	0.013	2	2
ID*1835	32.098	Circular	1.7671	0.013	1.5	1.5
ID*1836	22	Circular	3.1416	0.013	2	2
ID*1837	102.012	Circular	3.1416	0.013	2	2
ID*1838	184.009	Circular	3.1416	0.013	2	2
ID*1839	43.286	Circular	4.9087	0.013	2.5	2.5
ID*1840	108.7	Circular	7.0686	0.013	3	3
ID*1841	85.881	Circular	4.9087	0.013	2.5	2.5
ID*1842	230.858	Circular	3.1416	0.013	2	2
ID*1843	116.153	Circular	3.1416	0.013	2	2
ID*1844	365.977	Rectangle	117	0.012	19.5	6
ID*1845	45.188	Rectangle	117	0.012	19.5	6
ID*1846	105.226	Circular	3.1416	0.013	2	2
ID*1847	204.608	Circular	3.1416	0.013	2	2
ID*1848	83.949	Circular	3.1416	0.013	2	2
ID*1849	161.25	Circular	3.1416	0.013	2	2
ID*1850	309.236	Circular	3.1416	0.013	2	2
ID*1851	104.465	Rectangle	117	0.012	19.5	6
ID*1852	139.517	Circular	1.7671	0.013	1.5	1.5
ID*1853	15	Circular	1.2272	0.013	1.25	1.25
ID*1854	111.513	Circular	1.2272	0.013	1.25	1.25
ID*1855	72.726	Circular	4.9087	0.013	2.5	2.5
ID*1856	48.149	Circular	12.5664	0.013	4	4
ID*1857	160.018	Circular	3.1416	0.013	2	2
ID*1858	83	Rectangle	117	0.012	19.5	6
ID*1859	193.228	Circular	1.7671	0.013	1.5	1.5
ID*1860	148.006	Circular	1.7671	0.013	1.5	1.5
ID*1861	72.702	Circular	1.7671	0.013	1.5	1.5
ID*1862	161.5	Circular	1.7671	0.013	1.5	1.5
ID*1863	127.015	Circular	0.7854	0.013	1	1
ID*1864	193.471	Circular	1.7671	0.013	1.5	1.5
ID*1865	92.577	Circular	1.7671	0.013	1.5	1.5
ID*1866	29.31	Circular	1.7671	0.013	1.5	1.5
ID*1867	80.899	Circular	3.1416	0.013	2	2
ID*1868	342.032	Circular	12.5664	0.013	4	4
ID*1869	79.64	Circular	2.4053	0.013	1.75	1.75
ID*1870	275.011	Circular	2.4053	0.013	1.75	1.75
ID*1871	224.123	H Ellipse	5.1	0.012	3.1667	2
ID*1872	167.917	Circular	0.7854	0.013	1	1
ID*1873	67.469	Circular	4.9087	0.013	2.5	2.5
ID*1874	36.122	Circular	1.7671	0.013	1.5	1.5
ID*1875	57.72	Circular	1.7671	0.013	1.5	1.5
ID*1876	161.746	Circular	4.9087	0.013	2.5	2.5
ID*1877	150.637	Circular	1.7671	0.013	1.5	1.5
ID*1878	35.838	Circular	1.7671	0.013	1.5	1.5
ID*1879	144.961	Rectangle	102	0.012	17	6
ID*1880	228	Circular	0.7854	0.013	1	1
ID*1881	133.005	Circular	9.6211	0.013	3.5	3.5
ID*1882	143.005	Circular	9.6211	0.013	3.5	3.5
ID*1883	97.004	H Ellipse	10.2	0.012	4.4167	2.8333
ID*1884	157.006	H Ellipse	10.2	0.012	4.4167	2.8333
ID*1885	64	Circular	1.2272	0.013	1.25	1.25
ID*1886	44.788	Circular	1.2272	0.013	1.25	1.25
ID*1887	30.471	Circular	1.2272	0.013	1.25	1.25
ID*1888	34.348	Circular	1.7671	0.013	1.5	1.5
ID*1889	406.157	Circular	3.1416	0.013	2	2
ID*1890	144.016	Circular	1.7671	0.013	1.5	1.5
ID*1891	225.027	Circular	1.7671	0.013	1.5	1.5
ID*1892	137.015	Circular	1.7671	0.013	1.5	1.5
ID*1893	50.006	Circular	1.2272	0.013	1.25	1.25
ID*1894	157.872	Circular	1.2272	0.013	1.25	1.25
ID*1895	30	Circular	1.2272	0.014	1.25	1.25
ID*1896	51.885	Circular	1.7671	0.013	1.5	1.5
ID*1897	41.072	Circular	1.7671	0.013	1.5	1.5
ID*1898	25.933	H Ellipse	1.8	0.012	1.9167	1.1667
ID*1899	372.044	Circular	1.7671	0.013	1.5	1.5
ID*1900	435.324	Circular	1.7671	0.013	1.5	1.5
ID*1901	60.229	Circular	1.7671	0.014	1.5	1.5
ID*1902	74.527	Circular	2.4053	0.014	1.75	1.75
ID*1903	47.668	Circular	1.2272	0.013	1.25	1.25
ID*1904	32.263	Circular	1.2272	0.013	1.25	1.25
ID*1905	68.969	Circular	1.7671	0.014	1.5	1.5
ID*1906	274.486	Circular	0.7854	0.013	1	1
ID*1907	67.307	Arch	11.6	0.024	4.75	3.1667
ID*1908	23.963	Circular	1.7671	0.014	1.5	1.5
ID*1909	335.353	Circular	2.4053	0.013	1.75	1.75
ID*1910	175	Circular	12.5664	0.013	4	4
ID*1911	97.516	Circular	12.5664	0.013	4	4
ID*1912	332.973	Circular	12.5664	0.013	4	4
ID*1913	93.547	Circular	2.4053	0.013	1.75	1.75
ID*1914	114.416	Circular	3.9761	0.013	2.25	2.25
ID*1915	135.015	Circular	9.6211	0.013	3.5	3.5
ID*1916	257.704	Circular	12.5664	0.013	4	4
ID*1917	273.071	Circular	9.6211	0.013	3.5	3.5
ID*1918	186.295	Circular	2.4053	0.013	1.75	1.75
ID*1919	277.634	Circular	9.6211	0.013	3.5	3.5
ID*1920	211.036	Circular	2.4053	0.013	1.75	1.75
ID*1921	171.147	Circular	1.2272	0.014	1.25	1.25
ID*1922	45	Circular	1.2272	0.014	1.25	1.25
AS3447-008_LKMED-004	120.004	Circular	3.1416	0.014	2	2
ID*1924	316.231	Circular	2.4053	0.014	1.75	1.75
ID*1925	524.042	Circular	3.1416	0.014	2	2
ID*1926	114.907	Circular	4.9087	0.013	2.5	2.5
ID*1927	207.966	Circular	4.9087	0.013	2.5	2.5
ID*1928	110.013	Circular	3.1416	0.013	2	2
ID*1929	375.043	Circular	3.1416	0.013	2	2
ID*1930	87.626	Circular	9.6211	0.013	3.5	3.5
ID*1931	47.689	Circular	7.0686	0.013	3	3
ID*1932	58.08	Circular	7.0686	0.013	3	3
ID*1933	118.184	Circular	3.1416	0.013	2	2
ID*1934	23.692	Circular	5.9396	0.013	2.75	2.75
ID*1935	44.463	Circular	4.9087	0.013	2.5	2.5
ID*1936	102.086	Circular	4.9087	0.013	2.5	2.5

Conduit ID	Length (ft)	Conduit Shape	Flow Area (sf)	Manning's n Value	Span (ft)	Depth (ft)
ID*1937	96.617	Circular	3.9761	0.013	2.25	2.25
ID*1938	288.905	Circular	4.9087	0.013	2.5	2.5
ID*1939	72.193	Circular	9.6211	0.013	3.5	3.5
ID*1940	312.797	Circular	3.9761	0.013	2.25	2.25
ID*1941	75.776	Circular	0.7854	0.013	1	1
ID*1942	102.969	Circular	0.7854	0.013	1	1
ID*1943	222.913	Circular	0.7854	0.013	1	1
ID*1944	81.917	Circular	7.0686	0.013	3	3
ID*1945	196.813	Circular	4.9087	0.013	2.5	2.5
ID*1946	81.328	Circular	7.0686	0.013	3	3
ID*1947	14	Circular	4.9087	0.013	2.5	2.5
ID*1948	16	Circular	4.9087	0.013	2.5	2.5
ID*1949	24	Circular	3.1416	0.013	2	2
ID*1950	198.076	Circular	4.9087	0.013	2.5	2.5
ID*1951	174.459	Circular	2.4053	0.013	1.75	1.75
ID*1952	198.092	Circular	1.7671	0.013	1.5	1.5
BELTLINE_UNDERPASS	259.509	Rectangle	100	0.014	10	10
BIOFILTRATION_OUTLET	15.7	Rectangle	20	0.012	5	4
ID*1964	25.385	Circular	1.7671	0.013	1.5	1.5
ID*1965	216.09	Circular	7.0686	0.013	3	3
ID*1966	347.346	Circular	7.0686	0.013	3	3
ID*1967	127.015	Circular	1.7671	0.013	1.5	1.5
ID*1968	132.016	Circular	1.7671	0.013	1.5	1.5
ID*1969	106	Circular	3.1416	0.013	2	2
ID*1970	212.024	Circular	3.1416	0.013	2	2
ID*1971	20.003	Circular	3.1416	0.013	2	2
ID*1972	133.015	Circular	3.1416	0.013	2	2
ID*1973	148.017	Circular	3.1416	0.013	2	2
ID*1974	100.012	Circular	3.1416	0.013	2	2
ID*1975	20.424	Circular	12.5664	0.013	4	4
ID*1976	82.01	Circular	12.5664	0.013	4	4
ID*1977	147.017	Circular	12.5664	0.013	4	4
ID*1978	205.024	Circular	9.6211	0.013	3.5	3.5
ID*1979	349.779	Circular	7.0686	0.013	3	3
ID*1980	265.343	Circular	7.0686	0.013	3	3
CDT-101	74.345	Circular	12.5664	0.013	4	4
CDT-143	57	Circular	1.7671	0.013	1.5	1.5
CDT-169	27.268	Circular	3.1416	0.013	2	2
CDT-183	93	Circular	7.0686	0.013	3	3
CDT-185	163	Circular	7.0686	0.013	3	3
CDT-187	139	Circular	7.0686	0.013	3	3
CDT-189	236	Circular	9.6211	0.013	3.5	3.5
CDT-191	79	Circular	9.6211	0.013	3.5	3.5
CDT-193	87	Circular	9.6211	0.013	3.5	3.5
CDT-195	116	Circular	9.6211	0.013	3.5	3.5
CDT-197	83	Circular	12.5664	0.013	4	4
CDT-199	95	Circular	12.5664	0.013	4	4
CDT-201	168	Circular	12.5664	0.013	4	4
CDT-203	180.608	Circular	12.5664	0.013	4	4
CDT-209	76	Circular	3.1416	0.013	2	2
CDT-211	215	Circular	1.7671	0.013	1.5	1.5
CDT-213	145	Circular	3.1416	0.013	2	2
CDT-215	65	Circular	7.0686	0.013	3	3
CDT-217	42	Circular	7.0686	0.013	3	3
CDT-219	65	Circular	7.0686	0.013	3	3
CDT-221	94	Circular	7.0686	0.013	3	3
CDT-223	94	Circular	7.0686	0.013	3	3
CDT-225	68	Circular	9.6211	0.013	3.5	3.5
CDT-227	165.763	Circular	3.9761	0.013	2.25	2.25
CDT-229	110	Circular	1.7671	0.013	1.5	1.5
CDT-231	165	Circular	1.7671	0.013	1.5	1.5
CDT-233	35	Circular	1.7671	0.013	1.5	1.5
CDT-235	191	Circular	4.9087	0.013	2.5	2.5
CDT-237	175	Circular	7.0686	0.013	3	3
CDT-239	184	Circular	7.0686	0.013	3	3
CDT-241	36	Circular	1.7671	0.013	1.5	1.5
CDT-243	89.83	Circular	1.7671	0.013	1.5	1.5
CDT-245	97.82	Circular	3.9761	0.013	2.25	2.25
CDT-247	131.748	Circular	7.0686	0.013	3	3
CDT-249	161	Circular	7.0686	0.013	3	3
CDT-251	127	Circular	7.0686	0.013	3	3
CDT-253	69	Circular	7.0686	0.013	3	3
CDT-255	108.591	Circular	2.4053	0.013	1.75	1.75
CDT-257	103.061	Circular	3.9761	0.013	2.25	2.25
CDT-259	227	Circular	7.0686	0.013	3	3
CDT-261	203	Circular	7.0686	0.013	3	3
CDT-263	183	Circular	7.0686	0.013	3	3
CDT-265	159	Circular	7.0686	0.013	3	3
CDT-267	263.049	Circular	7.0686	0.013	3	3
CDT-269	207.418	Circular	7.0686	0.013	3	3
CDT-271	186.732	Circular	7.0686	0.013	3	3
CDT-273	230	Circular	9.6211	0.013	3.5	3.5
CDT-275	153.362	Circular	1.7671	0.013	1.5	1.5
CDT-277	166.734	Circular	2.4053	0.013	1.75	1.75
CDT-279	66	Circular	2.4053	0.013	1.75	1.75
CDT-281	36	Circular	2.4053	0.013	1.75	1.75
CDT-283	277.403	Circular	3.1416	0.013	2	2
CDT-289	190.574	Circular	7.0686	0.013	3	3
CDT-291	24.874	Circular	12.5664	0.013	4	4
CDT-293	522.243	Circular	33.1831	0.013	6.5	6.5
CDT-299	107	H Ellipse	12.9	0.012	5	3.1667
CDT-301	387.988	Circular	12.5664	0.013	4	4
CDT-311	43	Circular	4.9087	0.013	2.5	2.5
CDT-335	25.925	Circular	4.9087	0.013	2.5	2.5
CDT-363	114	Circular	12.5664	0.013	4	4
CDT-365	25.747	Circular	12.5664	0.013	4	4
CDT-369	186	Circular	1.7671	0.013	1.5	1.5
CDT-371	131	Circular	12.5664	0.013	4	4
CDT-373	100.23	Circular	0.7854	0.013	1	1
CDT-375	48.897	Circular	7.0686	0.013	3	3
CDT-377	152.406	Arch	1.1	0.024	1.5	0.9167
CDT-379	83.5	Rectangle	87.38	0.012	17	5.14
CDT-385	51.9	Rectangle	113.3125	0.012	25.9	4.375
CDT-387	81	Rectangle	104.025	0.012	21.9	4.75
CDT-391	121	Rectangle	165	0.012	30	5.5
CDT-393	144	Rectangle	99	0.012	16.5	6
ID*2053	130	Rectangle	99	0.012	16.5	6
ID*2054	25.515	Rectangle	12	0.013	4	3
ID*2055	36.388	Circular	1.7671	0.013	1.5	1.5
EXACT_LN1_AS2960-017	44.923	Circular	7.0686	0.013	3	3
EXACT_LN2_EXACT_LN1	349.463	Circular	7.0686	0.013	3	3
EXACT_LN3_EXACT_LN2	253.169	Circular	7.0686	0.013	3	3
EXACT_LN4_EXACT_LN3	198.749	Circular	7.0686	0.013	3	3
FSFDS	55	Circular	1.7671	0.012	1.5	1.5
GAMMON_CB111_IN112	45	Circular	3.1416	0.013	2	2
GAMMON_CB143_CB_144	22	Circular	4.9087	0.013	2.5	2.5
GAMMON_CB144_MH90	25	Circular	4.9087	0.013	2.5	2.5
GAMMON_IN154_IN85	28	Circular	1.7671	0.013	1.5	1.5
GAMMON_IN84_IN85	59	Circular	3.1416	0.013	2	2
GAMMON_IN85_MH90	318	Circular	4.9087	0.013	2.5	2.5
GAMMON_MH104_MH111	50	Circular	3.1416	0.013	2	2
GAMMON_MH105_MH110	62	Circular	1.2272	0.013	1.25	1.25
GAMMON_MH110_MH104	270	Circular	1.7671	0.013	1.5	1.5
GAMMON_MH120_MH101	363	Circular	12.5664	0.013	4	4

Conduit ID	Length (ft)	Conduit Shape	Flow Area (sf)	Manning's n Value	Span (ft)	Depth (ft)
GAMMON_MH149_MH150	213	Circular	3.1416	0.013	2	2
GAMMON_MH150_MH151	135	Circular	12.5664	0.013	4	4
GAMMON_MH151_MH93	315	Circular	12.5664	0.013	4	4
GAMMON_MH90_MH91	380	Circular	12.5664	0.013	4	4
GAMMON_MH91_MH150	84	Circular	12.5664	0.013	4	4
GAMMON_MH93_MH120	79	Circular	12.5664	0.013	4	4
ID*2085	105.124	Circular	9.6211	0.013	3.5	3.5
ID*2086	102	H Ellipse	24.8	0.012	6.9167	4.4167
ID*2087	161.074	Circular	12.5664	0.013	4	4
ID*2088	6	H Ellipse	46.1	0.012	9.4167	6
HAWSER_HP3	120	Circular	0.7854	0.013	1	1
HAWSER_HP3A	145	Circular	0.7854	0.013	1	1
HAWSER_HP4	133	Circular	0.7854	0.013	1	1
HAWSER_HP5	173	Circular	0.7854	0.013	1	1
ID*2093	21	Circular	0.7854	0.013	1	1
ID*2094	29	Arch	11.6	0.024	4.75	3.1667
ID*2097	76.077	Rectangle	116	0.012	20	5.8
ID*2098	16	Circular	12.5664	0.013	4	4
ID*2099	51.733	Circular	3.1416	0.013	2	2
ID*2100	30	Circular	2.4053	0.013	1.75	1.75
ID*2101	90.018	Circular	3.9761	0.013	2.25	2.25
ID*2102	30.003	Circular	3.9761	0.013	2.25	2.25
ID*2103	160.809	Circular	3.9761	0.013	2.25	2.25
ID*2104	290.547	Circular	2.4053	0.013	1.75	1.75
ID*2105	161.812	Circular	1.7671	0.013	1.5	1.5
ID*2106	32.156	Circular	4.9087	0.013	2.5	2.5
ID*2107	113.001	Circular	1.7671	0.013	1.5	1.5
ID*2108	32.798	Circular	3.1416	0.013	2	2
ID*2109	355.602	Circular	12.5664	0.013	4	4
ID*2110	20.901	Circular	3.1416	0.013	2	2
ID*2111	200.135	Circular	1.7671	0.013	1.5	1.5
ID*2112	56	Circular	9.6211	0.013	3.5	3.5
ID*2113	369.076	Circular	7.0686	0.013	3	3
ID*2114	90.714	Circular	1.7671	0.013	1.5	1.5
ID*2115	190.254	Circular	1.7671	0.013	1.5	1.5
ID*2116	48.874	Circular	2.4053	0.013	1.75	1.75
ID*2117	51.803	Circular	1.7671	0.013	1.5	1.5
ID*2118	302.788	Circular	28.2743	0.013	6	6
ID*2119	142.583	Circular	1.2272	0.013	1.25	1.25
ID*2120	165.577	Circular	1.2272	0.013	1.25	1.25
ID*2121	76.507	Circular	0.7854	0.013	1	1
ID*2122	39.211	H Ellipse	7.4	0.012	3.75	2.4167
ID*2123	65.763	Circular	4.9087	0.013	2.5	2.5
ID*2124	224	Circular	9.6211	0.013	3.5	3.5
ID*2125	56.165	Circular	1.7671	0.013	1.5	1.5
ID*2126	60.224	Circular	3.1416	0.013	2	2
ID*2127	323.515	Circular	1.2272	0.013	1.25	1.25
ID*2128	193.893	Circular	1.2272	0.013	1.25	1.25
ID*2129	112.331	Circular	1.7671	0.013	1.5	1.5
ID*2130	54	Circular	3.1416	0.013	2	2
ID*2131	47.476	Circular	3.1416	0.013	2	2
ID*2132	184.543	Circular	9.6211	0.013	3.5	3.5
ID*2133	35.951	Circular	1.7671	0.013	1.5	1.5
ID*2134	59.979	Circular	1.7671	0.013	1.5	1.5
ID*2135	37.197	Circular	3.1416	0.013	2	2
ID*2136	291.047	Circular	4.9087	0.013	2.5	2.5
ID*2137	320.719	Circular	1.7671	0.013	1.5	1.5
ID*2138	108.25	Circular	1.7671	0.013	1.5	1.5
ID*2139	32.722	Circular	4.9087	0.013	2.5	2.5
ID*2140	242.926	Circular	1.2272	0.013	1.25	1.25
ID*2141	29.628	Circular	4.9087	0.013	2.5	2.5
ID*2142	29.242	H Ellipse	1.8	0.012	1.9167	1.1667
ID*2143	156	Circular	5.9396	0.013	2.75	2.75
ID*2144	187	Circular	5.9396	0.013	2.75	2.75
ID*2145	48	Circular	0.7854	0.013	1	1
ID*2146	132.176	Circular	0.7854	0.013	1	1
ID*2149	57.628	Circular	3.1416	0.024	2	2
ID*2152	305	Circular	1.7671	0.013	1.5	1.5
ID*2153	48.936	Circular	1.7671	0.013	1.5	1.5
ID*2154	44.33	Circular	1.7671	0.013	1.5	1.5
ID*2155	80.702	Circular	1.7671	0.013	1.5	1.5
ID*2156	66.594	Circular	1.7671	0.013	1.5	1.5
ID*2157	239.018	Circular	1.7671	0.013	1.5	1.5
ID*2158	169.923	Circular	1.7671	0.013	1.5	1.5
ID*2159	30	Circular	7.0686	0.013	3	3
ID*2160	37	Circular	7.0686	0.013	3	3
ID*2161	30.066	Circular	1.7671	0.013	1.5	1.5
ID*2162	70.26	Circular	1.2272	0.013	1.25	1.25
ID*2163	80.85	Circular	0.7854	0.013	1	1
ID*2164	43.926	Circular	12.5664	0.013	4	4
ID*2165	26.438	Circular	1.7671	0.013	1.5	1.5
ID*2166	30.873	Circular	2.4053	0.013	1.75	1.75
ID*2167	56.194	Circular	1.7671	0.013	1.5	1.5
ID*2168	45	Circular	1.7671	0.013	1.5	1.5
ID*2169	35.065	Circular	3.1416	0.013	2	2
ID*2170	478	Circular	4.9087	0.013	2.5	2.5
ID*2171	353.94	Circular	19.635	0.013	5	5
ID*2172	127.03	Circular	23.7583	0.013	5.5	5.5
ID*2173	147.838	Circular	1.7671	0.013	1.5	1.5
ID*2174	96.901	Circular	1.7671	0.013	1.5	1.5
ID*2175	72.501	Circular	28.2743	0.013	6	6
ID*2176	40.899	Circular	1.7671	0.013	1.5	1.5
IN2860-21_AS2860-001	330.953	Circular	23.7583	0.013	5.5	5.5
ID*2178	53.721	Circular	1.7671	0.013	1.5	1.5
ID*2179	26.196	Arch	11.6	0.024	4.75	3.1667
ID*2180	19	Circular	1.7671	0.013	1.5	1.5
ID*2181	78.009	Circular	4.9087	0.013	2.5	2.5
ID*2182	48.005	Circular	4.9087	0.013	2.5	2.5
ID*2183	110.883	Circular	3.1416	0.013	2	2
ID*2184	35.087	Circular	1.7671	0.013	1.5	1.5
ID*2185	50	Circular	1.7671	0.013	1.5	1.5
ID*2186	47	Circular	3.1416	0.013	2	2
ID*2187	33.693	H Ellipse	1.8	0.012	1.9167	1.1667
ID*2189	160.301	Circular	3.1416	0.013	2	2
ID*2190	36.059	Circular	1.7671	0.013	1.5	1.5
ID*2191	44.577	Circular	3.1416	0.013	2	2
ID*2192	231.061	Circular	3.1416	0.013	2	2
ID*2193	195.691	Circular	3.1416	0.013	2	2
ID*2194	45.596	Circular	4.9087	0.013	2.5	2.5
ID*2195	136.573	Circular	1.2272	0.013	1.25	1.25
ID*2196	47.418	Circular	3.1416	0.024	2	2
ID*2197	119.777	Circular	3.1416	0.024	2	2
ID*2198	146.235	Circular	3.1416	0.024	2	2
ID*2199	38.976	Circular	1.2272	0.013	1.25	1.25
ID*2200	144.771	Circular	1.2272	0.013	1.25	1.25
ID*2201	157.578	Circular	1.2272	0.013	1.25	1.25
ID*2202	55.502	Circular	1.2272	0.013	1.25	1.25
ID*2203	23	Circular	1.2272	0.013	1.25	1.25
ID*2204	74	Circular	3.1416	0.013	2	2
ID*2205	73	Circular	1.7671	0.013	1.5	1.5
ID*2206	63.185	Circular	1.2272	0.013	1.25	1.25
ID*2207	145.906	Circular	1.7671	0.024	1.5	1.5
ID*2208	131	Circular	3.1416	0.013	2	2
ID*2209	7	Circular	3.1416	0.013	2	2

Conduit ID	Length (ft)	Conduit Shape	Flow Area (sf)	Manning's n Value	Span (ft)	Depth (ft)
ID*2210	27.025	Circular	1.7671	0.013	1.5	1.5
ID*2211	117.069	Circular	2.4053	0.013	1.75	1.75
ID*2212	43.975	Circular	1.7671	0.013	1.5	1.5
ID*2213	20.112	Circular	1.7671	0.013	1.5	1.5
ID*2214	71	Circular	1.7671	0.013	1.5	1.5
ID*2215	46.379	H Ellipse	3.3	0.024	2.5	1.5833
ID*2216	285.35	Circular	2.4053	0.013	1.75	1.75
ID*2217	38.864	Circular	1.7671	0.013	1.5	1.5
ID*2218	20	Circular	2.4053	0.013	1.75	1.75
ID*2219	249.305	Circular	3.1416	0.013	2	2
ID*2220	25.904	Circular	3.1416	0.013	2	2
ID*2221	50.115	Circular	1.7671	0.013	1.5	1.5
ID*2222	208.029	Circular	3.1416	0.013	2	2
ID*2223	38	Circular	3.1416	0.013	2	2
ID*2224	57.631	Circular	3.1416	0.013	2	2
ID*2225	37.763	Circular	3.1416	0.013	2	2
ID*2226	97.765	Circular	3.1416	0.013	2	2
ID*2227	30.627	Circular	3.1416	0.013	2	2
ID*2228	93.652	Circular	3.1416	0.013	2	2
ID*2229	22	Circular	3.1416	0.013	2	2
ID*2230	89.926	Circular	1.7671	0.013	1.5	1.5
ID*2231	93.305	Circular	7.0686	0.013	3	3
ID*2232	101	Circular	3.1416	0.024	2	2
ID*2233	47.609	Circular	1.7671	0.013	1.5	1.5
ID*2234	297.172	Circular	1.7671	0.013	1.5	1.5
ID*2235	116.589	Circular	2.4053	0.013	1.75	1.75
ID*2236	45.175	Circular	1.7671	0.013	1.5	1.5
ID*2237	50.899	Circular	2.4053	0.013	1.75	1.75
ID*2238	39.446	Circular	7.0686	0.013	3	3
ID*2239	71.261	Circular	2.4053	0.014	1.75	1.75
ID*2240	96.277	Circular	1.7671	0.013	1.5	1.5
ID*2241	87.485	Circular	1.7671	0.013	1.5	1.5
ID*2242	203.266	Circular	1.7671	0.013	1.5	1.5
ID*2243	112.415	Circular	1.7671	0.012	1.5	1.5
ID*2244	142.123	Circular	1.7671	0.012	1.5	1.5
ID*2245	111	Circular	1.7671	0.013	1.5	1.5
ID*2246	290.071	Circular	3.1416	0.013	2	2
ID*2247	712.103	Circular	3.1416	0.013	2	2
ID*2248	202.351	Circular	4.9087	0.013	2.5	2.5
ID*2249	21	Circular	1.7671	0.013	1.5	1.5
ID*2250	160.658	Rectangle	4	0.013	2	2
ID*2251	63.206	Circular	3.1416	0.013	2	2
ID*2252	200.641	Circular	1.7671	0.013	1.5	1.5
ID*2253	17	Circular	1.2272	0.013	1.25	1.25
ID*2254	24	Circular	7.0686	0.013	3	3
ID*2255	20	Circular	7.0686	0.013	3	3
ID*2256	58.331	Circular	2.4053	0.013	1.75	1.75
ID*2257	318.864	Circular	3.1416	0.013	2	2
ID*2258	38.382	H Ellipse	5.1	0.012	3.1667	2
ID*2259	144.264	Circular	2.4053	0.013	1.75	1.75
ID*2260	18	Circular	2.4053	0.013	1.75	1.75
ID*2261	63.9	Circular	2.4053	0.013	1.75	1.75
ID*2262	132.949	Circular	2.4053	0.013	1.75	1.75
ID*2263	20.369	Circular	1.7671	0.013	1.5	1.5
ID*2264	126.21	Circular	1.7671	0.013	1.5	1.5
ID*2265	196.616	Circular	1.7671	0.013	1.5	1.5
ID*2266	20	Circular	1.2272	0.013	1.25	1.25
ID*2267	30.219	Circular	0.7854	0.013	1	1
ID*2268	45.16	Circular	2.4053	0.013	1.75	1.75
ID*2269	59.073	Circular	1.7671	0.013	1.5	1.5
ID*2270	73.694	Circular	1.2272	0.013	1.25	1.25
ID*2271	237.13	Circular	1.2272	0.013	1.25	1.25
ID*2272	11	Circular	1.7671	0.013	1.5	1.5
ID*2273	334.035	Circular	1.2272	0.013	1.25	1.25
ID*2274	62.717	Circular	1.7671	0.013	1.5	1.5
ID*2275	17	Circular	1.7671	0.013	1.5	1.5
ID*2276	26.86	Circular	1.7671	0.013	1.5	1.5
ID*2277	26.611	Circular	3.1416	0.013	2	2
ID*2278	26.138	Circular	2.4053	0.024	1.75	1.75
ID*2279	24.547	Circular	1.7671	0.013	1.5	1.5
ID*2280	36.523	Circular	1.7671	0.013	1.5	1.5
ID*2281	85.582	Circular	1.7671	0.013	1.5	1.5
ID*2282	172	Circular	1.7671	0.013	1.5	1.5
ID*2283	30	Circular	0.7854	0.024	1	1
ID*2284	20.804	Circular	1.7671	0.024	1.5	1.5
ID*2285	210	Circular	1.7671	0.012	1.5	1.5
ID*2286	97.495	Circular	0.3494	0.012	0.667	0.667
ID*2287	208.901	Circular	7.0686	0.012	3	3
ID*2288	64.053	Circular	1.7671	0.013	1.5	1.5
ID*2289	239.894	Circular	5.9396	0.013	2.75	2.75
ID*2290	65.643	Circular	1.7671	0.013	1.5	1.5
ID*2291	75.25	Circular	0.7854	0.013	1	1
ID*2292	22	Circular	0.7854	0.013	1	1
ID*2293	45.089	Circular	0.7854	0.013	1	1
ID*2294	84.52	Circular	3.1416	0.013	2	2
ID*2295	24	Circular	3.1416	0.013	2	2
ID*2296	35.951	Circular	3.1416	0.013	2	2
ID*2297	56	Circular	3.1416	0.013	2	2
ID*2298	82.009	Circular	1.7671	0.013	1.5	1.5
ID*2299	164.019	Circular	1.7671	0.013	1.5	1.5
JCT2_1750_WATTS_ROAD	349.485	Circular	7.0686	0.013	3	3
KETTLE_POND_P-5	70	Circular	1.7671	0.013	1.5	1.5
KETTLE_POND_P-6_	12	Circular	1.7671	0.013	1.5	1.5
KETTLE_POND_P1	39.005	Circular	1.7671	0.013	1.5	1.5
KETTLE_POND_S-1_S7	59	Trapezoid	175	0.03	20	5
ID*2305	656	Rectangle	102	0.012	17	6
MASTHEAD_PM0	104.798	Circular	3.9761	0.013	2.25	2.25
MASTHEAD_PM1	166	Circular	3.9761	0.013	2.25	2.25
MASTHEAD_PM2	87.482	Circular	3.9761	0.013	2.25	2.25
MASTHEAD_PM3	30	Circular	3.9761	0.013	2.25	2.25
MASTHEAD_PM5	66.624	Circular	3.9761	0.013	2.25	2.25
ID*2318	224.805	Circular	1.7671	0.024	1.5	1.5
MEM_HS_SOUTH_CDT	30.946	Circular	4.9087	0.024	2.5	2.5
MHS_AS2755-007	29.846	Circular	7.0686	0.012	3	3
MHS_CB1_MHS_CB2	137.355	Circular	3.1416	0.012	2	2
MHS_CB2_MHS_CB3	149.583	Circular	3.1416	0.012	2	2
MHS_CB3_MHS_CB4	154.945	Circular	7.0686	0.012	3	3
MHS_CB4_MHS_CB6	423.727	Circular	7.0686	0.012	3	3
MHS_CB6_AS2755-007	35.789	Circular	7.0686	0.012	3	3
ID*2328	19.105	Circular	3.1416	0.013	2	2
ID*2329	18	Circular	1.7671	0.013	1.5	1.5
ID*2330	27.304	Circular	1.7671	0.013	1.5	1.5
ID*2331	64	Circular	3.1416	0.013	2	2
ID*2332	32.004	Circular	3.1416	0.024	2	2
ID*2333	183.337	Rectangle	117	0.012	19.5	6
ID*2334	170	Rectangle	102	0.012	17	6
ID*2335	52.007	Circular	0.7854	0.013	1	1
ID*2336	196.807	H Ellipse	5.1	0.012	3.1667	2
ID*2337	77.166	H Ellipse	12.9	0.012	5	3.1667
ID*2338	16	Circular	3.1416	0.013	2	2
NAUTILUS_P2	39.5	Circular	12.5664	0.01	4	4
NAUTILUS_P3	26	Circular	12.5664	0.01	4	4
NAUTILUS_P5	84.3	Circular	9.6211	0.013	3.5	3.5
ID*2345	58	Rectangle	60	0.012	15	4

Conduit ID	Length (ft)	Conduit Shape	Flow Area (sf)	Manning's n Value	Span (ft)	Depth (ft)
ID*2347	31	Rectangle	60	0.012	15	4
N_BROOOKLY_DR	121	Circular	3.1416	0.013	2	2
ID*2349	30	Arch	11.6	0.024	4.75	3.1667
OWEN_RT_PD_CDT_734	57	Circular	0.7854	0.013	1	1
OWEN_RT_POND_CDT_710	47.305	Circular	15.9043	0.013	4.5	4.5
OWEN_RT_POND_CDT_712	72.79	Circular	12.5664	0.013	4	4
OWEN_RT_POND_CDT_713	84.011	Circular	15.9043	0.013	4.5	4.5
OWEN_RT_POND_CDT_718	150	Circular	0.545	0.013	0.833	0.833
OWEN_RT_POND_CDT_720	301	Circular	0.545	0.013	0.833	0.833
OWEN_RT_POND_CDT_722	140	Circular	15.9043	0.013	4.5	4.5
OWEN_RT_POND_CDT_727	128	Circular	0.7854	0.013	1	1
OWEN_RT_POND_CDT_728	55.007	Circular	0.545	0.013	0.833	0.833
OWEN_RT_POND_CDT_729	76.158	Circular	0.7854	0.011	1	1
OWEN_RT_POND_CDT_730	138.017	Circular	15.9043	0.013	4.5	4.5
OWEN_RT_POND_CDT_731	29	Circular	0.7854	0.012	1	1
OWEN_RT_POND_CDT_734	36	Circular	0.7854	0.013	1	1
OWEN_RT_POND_CDT_735	57.006	Circular	12.5664	0.013	4	4
ID*2370	142.246	Circular	12.5664	0.013	4	4
ID*2371	81.922	Circular	7.0686	0.013	3	3
ID*2372	197.212	Circular	4.9087	0.013	2.5	2.5
ID*2373	72.305	Circular	1.7671	0.012	1.5	1.5
ID*2374	55.007	Circular	3.1416	0.013	2	2
ID*2375	150	Circular	4.9087	0.013	2.5	2.5
ID*2376	338.09	Circular	7.0686	0.01	3	3
RR_CULVERT-02	96.45	Circular	1.7671	0.013	1.5	1.5
RR_UNDERPASS_CDT	91.697	Circular	38.4845	0.02	7	7
ID*2384	138.923	Circular	3.1416	0.013	2	2
ID*2385	57.695	Circular	7.0686	0.013	3	3
ID*2386	73.008	Circular	3.1416	0.013	2	2
ID*2387	36	H Ellipse	7.4	0.012	3.75	2.4167
ID*2388	31.342	Circular	0.7854	0.013	1	1
ID*2389	245.623	Circular	1.7671	0.013	1.5	1.5
ID*2390	21.016	Circular	1.2272	0.013	1.25	1.25
ID*2391	1066.058	Circular	33.1831	0.013	6.5	6.5
ID*2392	347	Rectangle	84	0.012	14	6
ID*2393	39.5	Rectangle	100.02	0.012	16.67	6
ID*2394	39.5	Rectangle	60	0.012	10	6
ID*2395	18.666	Rectangle	84	0.012	14	6
ID*2396	28.128	Rectangle	60	0.012	15	4
ID*2397	35	Rectangle	60	0.012	15	4
ID*2398	264.057	Rectangle	102	0.012	17	6
ID*2399	119.056	Rectangle	102	0.012	17	6
ID*2400	76.342	Rectangle	12	0.013	4	3
ID*2401	36	Rectangle	117	0.012	19.5	6
TP3347-016_LKMED-003	100	Rectangle	117	0.012	19.5	6
ID*2403	244.023	Rectangle	117	0.012	19.5	6
ID*2404	89.152	Rectangle	117	0.012	19.5	6
ID*2405	391.689	Rectangle	117	0.012	19.5	6
ID*2406	173.729	Rectangle	117	0.012	19.5	6
ID*2407	305.315	Rectangle	117	0.012	19.5	6
ID*2408	345.882	Rectangle	117	0.012	19.5	6
ID*2409	400.398	Circular	1.7671	0.013	1.5	1.5
ID*2495	160	Circular	2.4053	0.013	1.75	1.75
ID*2496	113	H Ellipse	12.9	0.012	5	3.1667
YELLOWSTONE_PY10	37	Circular	0.7854	0.013	1	1
YELLOWSTONE_PY11	229	Circular	0.7854	0.013	1	1
YELLOWSTONE_PY12	243	Circular	0.7854	0.013	1	1
YELLOWSTONE_PY2	20	Circular	4.9087	0.013	2.5	2.5
YELLOWSTONE_PY3	271	Circular	3.9761	0.013	2.25	2.25
YELLOWSTONE_PY4	314	Circular	1.7671	0.013	1.5	1.5
YELLOWSTONE_PY5	318	Circular	1.2272	0.013	1.25	1.25
YELLOWSTONE_PY6	224	Circular	0.7854	0.013	1	1
YELLOWSTONE_PY7	55	Circular	0.7854	0.013	1	1
_AE2458-003	43	Circular	1.7671	0.012	1.5	1.5
ID*C{1572.1}	36.264	Circular	12.5664	0.013	4	4
CDT-27	36.264	Circular	12.5664	0.013	4	4
ID*C{1573.1}	30	Circular	3.1416	0.012	2	2
ID*C{1577.1}	35.992	Circular	1.7671	0.013	1.5	1.5
ID*C{2052.1}	93.085	Circular	1.2272	0.013	1.25	1.25
ID*C{2095.1}	110.464	Circular	4.9087	0.012	2.5	2.5
ID*C{2095.2}	110.464	Circular	4.9087	0.012	2.5	2.5
ID*C{2096.1}	95.379	H Ellipse	24.8	0.012	6.9167	4.4167
ID*C{2096.2}	90.5	H Ellipse	24.8	0.012	6.9167	4.4167
ID*C{2147.1}	22.519	Circular	3.1416	0.024	2	2
ID*C{2147.2}	22.53	Circular	1.7671	0.012	1.5	1.5
ID*C{2148.1}	33.827	Circular	3.1416	0.024	2	2
ID*C{2148.2}	33.833	Circular	1.7671	0.012	1.5	1.5
ID*C{2150.1}	33.992	Circular	3.1416	0.024	2	2
ID*C{2150.2}	33.996	Circular	1.7671	0.012	1.5	1.5
ID*C{2188.1}	21.116	Arch	1.1	0.024	1.4167	1.0833
ID*C{2188.2}	20.831	Arch	1.1	0.024	1.4167	1.0833
ID*C{2339.1}	127.623	Circular	9.6211	0.024	3.5	3.5
ID*C{2339.2}	125.11	Circular	9.6211	0.024	3.5	3.5
NAUTILUS_P4	99.8	Circular	0.7854	0.01	1	1
NAUTILUS_PIPE1	44.5	Circular	0.7854	0.01	1	1
ID*C{2346.1}	66	Rectangle	60	0.012	15	4
ID*C{2346.2}	66	Rectangle	60	0.012	15	4
OWEN_RT_POND_CDT_714	55.435	Rectangle	12	0.013	4	3
garn-vnotch	1000	Closd Cnd	0	0.014	0	0
uw-res-vnotch	1000	Closd Cnd	0	0.014	0	0
vnotch_Naut	1000	Closd Cnd	0	0.014	0	0

Conduit ID	Number of Barrels	Entrance Loss Coefficient	Exit Loss Coefficient
302_S_GAMMON_CB1_EX	1	0.25	0.25
302_S_GAMMON_CB2_CB1	1	0.25	0.25
302_S_GAMMON_CB3_CB2	1	0.25	0.25
302_S_GAMMON_CB4_CB3	1	0.5	0.25
ID*1566	1	0.5	0.05
ID*1567	1	0.5	0.05
ID*1568	1	0.5	0.5
ID*1569	1	0.5	0.5
ID*1570	1	0.5	0.5
ID*1571	1	0.5	0.25
ID*1574	1	0.5	0.05
ID*1575	1	0.5	0.25
ID*1576	1	0.5	0.5
ID*1578	1	0.5	0.25
ID*1579	1	0.5	0.05
ID*1580	1	0.5	0.05
ID*1581	1	0.05	1
ID*1582	1	0.5	1
ID*1583	1	0.5	0.25
ID*1584	1	0.5	0.5
ID*1585	1	0.5	0.5
ID*1586	1	0.05	0.5
ID*1587	1	0.5	0.05
ID*1588	1	0.05	0.05
ID*1589	1	0.05	0.05
ID*1590	1	0.05	0.05
ID*1591	1	0.5	0.05
ID*1592	1	0.25	0.5
ID*1593	1	0.5	0.25
ID*1594	1	0.5	0.05
ID*1595	1	0.05	1
ID*1596	1	0.5	0.5
ID*1597	1	0.5	0.05
ID*1598	1	0.05	0.5
ID*1599	1	0.05	0.5
ID*1600	1	0.05	0.05
ID*1601	1	0.25	0.05
ID*1602	1	0.05	0.05
ID*1603	1	0.5	0.05
ID*1604	1	0.05	0.05
ID*1605	1	0.05	0.05
ID*1606	1	0.05	0.05
ID*1607	1	0.05	0.05
ID*1608	1	0.5	0.05
ID*1609	1	0.05	0.05
ID*1610	1	0.05	0.05
ID*1611	1	0.05	0.05
ID*1612	1	0.5	0.05
ID*1613	1	0.05	0.05
ID*1614	1	0.05	0.05
ID*1615	1	0.05	0.25
ID*1616	1	0.25	0.5
ID*1617	1	0.25	0.05
ID*1618	1	0.5	0.05
ID*1619	1	0.05	0.5
ID*1620	1	0.25	0.05
ID*1621	1	0.05	0.25
ID*1622	1	0.05	0.05
ID*1623	1	0.05	0.05
ID*1624	1	0.5	0.05
ID*1625	1	0.5	0.25
ID*1626	1	0.05	0.5
ID*1627	1	0.5	0.25
ID*1628	1	0.25	0.05
ID*1629	1	0.25	0.5
ID*1630	1	0.5	0.05
ID*1631	1	0.05	0.25
ID*1632	1	0.25	0.25
ID*1633	1	0.05	0.5
ID*1634	1	0.5	0.05
ID*1635	1	0.5	0.05
ID*1636	1	0.05	0.05
ID*1637	1	0.5	0.05
ID*1638	1	0.5	0.25
ID*1639	1	0.05	0.05
ID*1640	1	0.5	0.5
ID*1641	1	0.05	0.05
ID*1642	1	0.05	0.05
ID*1643	1	0.05	0.25
ID*1644	1	0.25	0.5
ID*1645	1	0.05	0.5
ID*1646	1	0.5	0.05
ID*1647	1	0.05	0.05
ID*1648	1	0.25	0.05
ID*1649	1	0.5	0.5
ID*1650	1	0.05	0.05
ID*1651	1	0.5	1
ID*1652	1	0.05	0.25
ID*1653	1	0.5	1
ID*1654	1	0.05	0.05
ID*1655	1	0.5	0.25
ID*1656	1	0.5	1
ID*1657	1	0.5	0.5
ID*1658	1	0.05	0.05
ID*1659	1	0.5	0.05
ID*1660	1	0.25	0.05
ID*1661	1	0.5	0.5
ID*1662	1	0.25	0.5
ID*1663	1	0.25	0.25
ID*1664	1	0.25	0.25
ID*1665	1	0.05	0.25
ID*1666	1	0.05	0.05
ID*1667	1	0.05	0.5
ID*1668	1	0.05	0.05
ID*1669	1	0.05	0.05
ID*1670	1	0.05	0.5
ID*1671	1	0.05	0.05
ID*1672	1	0.25	0.5
ID*1673	1	0.05	0.5
ID*1674	1	0.5	0.25
ID*1675	1	0.25	0.05
ID*1676	1	0.05	0.5
ID*1677	1	0.5	0.25
ID*1678	1	0.05	0.5
ID*1679	1	0.05	0.05
ID*1680	1	0.5	0.05
ID*1681	1	0.25	0.25
ID*1682	1	0.5	0.25
ID*1683	1	0.25	0.5
ID*1684	1	0.05	0.05
ID*1685	1	0.05	0.05
ID*1686	1	0.5	0.05
ID*1687	1	0.05	0.05
ID*1688	1	0.05	0.25

Conduit ID	Number of Barrels	Entrance Loss Coefficient	Exit Loss Coefficient
ID*1689	1	0.05	0.05
ID*1690	1	0.05	0.05
ID*1691	1	0.25	0.05
ID*1692	1	0.5	0.05
ID*1693	1	0.05	0.5
ID*1694	1	0.05	0.5
ID*1695	1	0.5	0.05
ID*1696	1	0.05	0.05
ID*1697	1	0.5	1
ID*1698	1	0.5	0.5
ID*1699	1	0.5	0.05
ID*1700	1	0.5	1
ID*1701	1	0.25	0.05
ID*1702	1	0.05	0.25
ID*1703	1	0.25	0.05
ID*1704	1	0.25	0.25
ID*1705	1	0.05	0.05
ID*1706	1	0.25	0.25
ID*1707	1	0.25	0.05
ID*1708	1	0.5	0.05
ID*1709	1	0.05	0.05
ID*1710	1	0.5	0.05
ID*1711	1	0.5	0.5
ID*1712	1	0.05	0.25
ID*1713	1	0.05	0.05
ID*1714	1	0.05	0.5
ID*1715	1	0.5	0.05
ID*1716	1	0.05	0.5
ID*1717	1	0.5	0.05
ID*1718	1	0.05	0.5
ID*1719	1	0.5	0.05
ID*1720	1	0.05	0.5
ID*1721	1	0.25	0.25
ID*1722	1	0.05	0.25
ID*1723	1	0.25	0.05
ID*1724	1	0.5	0.25
ID*1725	1	0.05	0.5
ID*1726	1	0.5	0.05
ID*1727	1	0.05	0.5
ID*1728	1	0.5	0.05
ID*1729	1	0.05	0.5
ID*1730	1	0.5	0.25
ID*1731	1	0.25	0.5
ID*1732	1	0.25	0.5
ID*1733	1	0.5	0.05
ID*1734	1	0.05	0.25
ID*1735	1	0.5	0.25
ID*1736	1	0.5	0.05
ID*1737	1	0.05	0.5
ID*1738	1	0.05	0.05
ID*1739	1	0.25	0.05
ID*1740	1	0.05	0.25
ID*1741	1	0.5	0.05
ID*1742	1	0.5	0.5
ID*1743	1	0.05	0.5
ID*1744	1	0.5	0.5
ID*1745	1	0.05	0.05
ID*1746	1	0.05	0.05
ID*1747	1	0.5	0.05
ID*1748	1	0.05	0.05
ID*1749	1	0.25	0.05
ID*1750	1	0.05	0.25
ID*1751	1	0.25	0.05
ID*1752	1	0.05	0.05
ID*1753	1	0.05	0.05
ID*1754	1	0.05	0.5
ID*1755	1	0.5	0.5
ID*1756	1	0.25	0.5
ID*1757	1	0.25	0.25
ID*1758	1	0.05	0.05
ID*1759	1	0.25	0.05
ID*1760	1	0.5	0.25
ID*1761	1	0.05	0.5
ID*1762	1	0.05	0.05
ID*1763	1	0.25	0.05
ID*1764	1	0.05	0.25
ID*1765	1	0.25	0.25
ID*1766	1	0.25	0.05
ID*1767	1	0.05	0.25
ID*1768	1	0.25	0.25
ID*1769	1	0.5	0.05
ID*1770	1	0.5	0.25
ID*1771	1	0.5	0.05
ID*1772	1	0.5	0.05
ID*1773	1	0.05	0.05
ID*1774	1	0.05	0.05
ID*1775	1	0.05	0.05
ID*1776	1	0.5	0.05
ID*1777	1	0.5	0.5
ID*1778	1	0.05	0.5
ID*1779	1	0.5	0.05
ID*1780	1	0.5	0.5
ID*1781	1	0.05	0.05
ID*1782	1	0.25	0.05
ID*1783	1	0.25	0.25
ID*1784	1	0.25	0.25
ID*1785	1	0.25	0.25
ID*1786	1	0.05	0.05
ID*1787	1	0.05	0.5
ID*1788	1	0.5	0.05
ID*1789	1	0.05	0.25
ID*1790	1	0.25	0.05
ID*1791	1	0.05	0.25
ID*1792	1	0.5	0.05
ID*1793	1	-1	0
ID*1794	1	0.05	0.05
ID*1795	1	0.05	0.05
ID*1796	1	0.5	0.25
ID*1797	1	0.5	0.5
ID*1798	1	0.05	0.05
ID*1799	1	0.05	0.5
ID*1800	1	0.5	0.05
ID*1801	1	0.05	0.05
ID*1802	1	0.05	0.05
ID*1803	1	0.05	0.5
ID*1804	1	0.05	0.05
ID*1805	1	0.5	0.05
ID*1806	1	0.05	0.25
ID*1807	1	0.05	0.05
ID*1808	1	0.05	0.05
ID*1809	1	0.05	0.05
ID*1810	1	0.05	0.05
ID*1811	1	0.05	0.5
ID*1812	1	0.5	0.25

Conduit ID	Number of Barrels	Entrance Loss Coefficient	Exit Loss Coefficient
ID*1813	1	0.05	0.05
ID*1814	1	0.25	0.05
ID*1815	1	0.5	0.5
ID*1816	1	0.5	0.05
ID*1817	1	0.05	0.05
ID*1818	1	0.05	0.25
ID*1819	1	0.5	0.05
ID*1820	1	0.5	0.25
ID*1821	1	0.25	0.05
ID*1822	1	0.05	0.05
ID*1823	1	0.5	0.05
ID*1824	1	0.05	0.05
AS3346-005_LKMED-001	1	0.25	1
ID*1826	1	0.5	0.05
AS3346-012_LKMED-002	1	0.05	1
ID*1828	1	0.05	0.05
ID*1829	1	0.05	0.05
ID*1830	1	0.25	0.25
ID*1831	1	0.05	0.5
ID*1832	1	0.5	0.05
ID*1833	1	0.25	0.25
ID*1834	1	0.5	0.25
ID*1835	1	0.05	0.5
ID*1836	1	0.5	0.5
ID*1837	1	0.05	0.5
ID*1838	1	0.05	0.05
ID*1839	1	0.05	0.05
ID*1840	1	0.25	0.25
ID*1841	1	0.25	0.25
ID*1842	1	0.25	0.05
ID*1843	1	0.05	0.25
ID*1844	1	0.05	0.25
ID*1845	1	0.05	0.05
ID*1846	1	0.05	0.5
ID*1847	1	0.5	0.25
ID*1848	1	0.5	0.5
ID*1849	1	0.5	0.25
ID*1850	1	0.25	0.25
ID*1851	1	0.25	0.5
ID*1852	1	0.25	0.05
ID*1853	1	0.5	0.5
ID*1854	1	0.5	0.5
ID*1855	1	0.05	0.5
ID*1856	1	0.25	0.25
ID*1857	1	0.5	0.05
ID*1858	1	0.05	0.05
ID*1859	1	0.05	0.25
ID*1860	1	0.25	0.25
ID*1861	1	0.25	0.5
ID*1862	1	0.5	0.05
ID*1863	1	0.5	0.5
ID*1864	1	0.5	0.05
ID*1865	1	0.05	0.25
ID*1866	1	0.25	0.5
ID*1867	1	0.5	0.5
ID*1868	1	0.5	0.5
ID*1869	1	0.05	0.25
ID*1870	1	0.05	0.05
ID*1871	1	0.5	0.05
ID*1872	1	0.05	0.05
ID*1873	1	0.25	0.5
ID*1874	1	0.5	0.5
ID*1875	1	0.05	0.5
ID*1876	1	0.5	0.05
ID*1877	1	0.05	0.25
ID*1878	1	0.25	0.05
ID*1879	1	0.5	0.05
ID*1880	1	0.5	0.25
ID*1881	1	0.05	0.05
ID*1882	1	0.05	0.25
ID*1883	1	0.25	0.25
ID*1884	1	0.25	0.5
ID*1885	1	0.25	0.5
ID*1886	1	0.25	0.5
ID*1887	1	0.25	0.5
ID*1888	1	0.25	0.5
ID*1889	1	0.25	0.25
ID*1890	1	0.05	0.25
ID*1891	1	0.05	0.05
ID*1892	1	0.05	0.05
ID*1893	1	0.05	0.05
ID*1894	1	0.5	0.05
ID*1895	1	0.25	0.5
ID*1896	1	0.05	0.5
ID*1897	1	0.25	0.05
ID*1898	1	0.25	0.25
ID*1899	1	0.05	0.25
ID*1900	1	0.5	0.05
ID*1901	1	0.5	0.5
ID*1902	1	0.05	0.5
ID*1903	1	0.5	0.05
ID*1904	1	0.05	0.5
ID*1905	1	0.5	0.5
ID*1906	1	0.5	0.05
ID*1907	1	0.5	0.5
ID*1908	1	0.25	0.5
ID*1909	1	0.5	0.5
ID*1910	1	0.05	0.05
ID*1911	1	0.05	0.25
ID*1912	1	0.5	0.05
ID*1913	1	0.5	0.5
ID*1914	1	0.5	0.5
ID*1915	1	0.25	0.05
ID*1916	1	0.05	0.05
ID*1917	1	0.05	0.05
ID*1918	1	0.5	0.05
ID*1919	1	0.05	0.05
ID*1920	1	0.5	0.05
ID*1921	1	0.05	0.05
ID*1922	1	0.05	0.05
AS3447-008_LKMED-004	1	0.05	1
ID*1924	1	0.5	0.5
ID*1925	1	0.5	0.05
ID*1926	1	0.05	0.05
ID*1927	1	0.25	0.05
ID*1928	1	0.25	0.25
ID*1929	1	0.5	0.05
ID*1930	1	0.5	0.05
ID*1931	1	0.05	0.05
ID*1932	1	0.5	0.05
ID*1933	1	0.25	0.25
ID*1934	1	0.05	0.05
ID*1935	1	0.25	0.05
ID*1936	1	0.5	0.05

Conduit ID	Number of Barrels	Entrance Loss Coefficient	Exit Loss Coefficient
ID*1937	1	0.5	0.25
ID*1938	1	0.05	0.5
ID*1939	1	0.05	0.05
ID*1940	1	0.25	0.05
ID*1941	1	0.25	0.05
ID*1942	1	0.05	0.25
ID*1943	1	0.5	0.05
ID*1944	1	0.5	1
ID*1945	1	0.5	0.5
ID*1946	1	0.5	1
ID*1947	1	0.5	0.5
ID*1948	1	0.5	0.05
ID*1949	1	0.5	0.5
ID*1950	1	0.5	0.5
ID*1951	1	0.25	0.05
ID*1952	1	0.25	0.25
BELTLINE_UNDERPASS	1	0.5	0.5
BIOFILTRATION_OUTLET	1	0.5	0.05
ID*1964	1	0.5	0.05
ID*1965	1	0.05	0.5
ID*1966	1	0.5	0.05
ID*1967	1	0.05	0.25
ID*1968	1	0.05	0.05
ID*1969	1	0.25	0.5
ID*1970	1	0.5	0.05
ID*1971	1	0.05	0.05
ID*1972	1	0.05	0.05
ID*1973	1	0.05	0.05
ID*1974	1	0.5	0.05
ID*1975	1	0.05	0.25
ID*1976	1	0.25	0.05
ID*1977	1	0.05	0.25
ID*1978	1	0.05	0.05
ID*1979	1	0.05	0.05
ID*1980	1	0.05	0.05
CDT-101	1	0.5	0.5
CDT-143	1	0.05	0.5
CDT-169	1	0.05	1
CDT-183	1	0.05	0.05
CDT-185	1	0.05	0.05
CDT-187	1	0.05	0.05
CDT-189	1	0.25	0.05
CDT-191	1	0.05	0.05
CDT-193	1	0.05	0.05
CDT-195	1	0.05	0.25
CDT-197	1	0.25	0.05
CDT-199	1	0.05	0.05
CDT-201	1	0.05	0.05
CDT-203	1	0.05	0.05
CDT-209	1	0.05	0.25
CDT-211	1	0.05	0.05
CDT-213	1	0.05	0.25
CDT-215	1	0.25	0.05
CDT-217	1	0.05	0.05
CDT-219	1	0.05	0.25
CDT-221	1	0.25	0.05
CDT-223	1	0.05	0.25
CDT-225	1	0.25	0.05
CDT-227	1	0.05	0.05
CDT-229	1	0.05	0.5
CDT-231	1	0.5	0.05
CDT-233	1	0.05	0.05
CDT-235	1	0.25	0.05
CDT-237	1	0.05	0.5
CDT-239	1	0.5	0.25
CDT-241	1	0.05	0.25
CDT-243	1	0.05	0.05
CDT-245	1	0.05	0.05
CDT-247	1	0.05	0.05
CDT-249	1	0.05	0.05
CDT-251	1	0.05	0.05
CDT-253	1	0.05	0.5
CDT-255	1	0.05	0.25
CDT-257	1	0.25	0.25
CDT-259	1	0.25	0.05
CDT-261	1	0.05	0.05
CDT-263	1	0.05	0.05
CDT-265	1	0.05	0.5
CDT-267	1	0.5	0.05
CDT-269	1	0.05	0.05
CDT-271	1	0.05	0.5
CDT-273	1	0.5	0.05
CDT-275	1	0.05	0.05
CDT-277	1	0.05	0.05
CDT-279	1	0.05	0.05
CDT-281	1	0.05	0.05
CDT-283	1	0.05	0.5
CDT-289	1	0.05	0.25
CDT-291	1	0.25	0.5
CDT-293	1	0.25	1
CDT-299	1	0.05	1
CDT-301	1	0.25	1
CDT-311	1	0.05	0.25
CDT-335	1	0.25	0.05
CDT-363	1	0.05	0.05
CDT-365	1	0.05	0.05
CDT-369	1	0.5	0.25
CDT-371	1	0.05	0.05
CDT-373	1	0.05	0.5
CDT-375	1	0.5	0.5
CDT-377	1	0.5	0.05
CDT-379	1	0.05	0.25
CDT-385	1	0.05	0.25
CDT-387	1	0.25	0.05
CDT-391	1	0.25	0.05
CDT-393	1	0.25	0.05
ID*2053	1	0.5	0.25
ID*2054	1	0.05	0.05
ID*2055	1	0.05	0.05
EXACT_LN1_AS2960-017	1	0.05	0.05
EXACT_LN2_EXACT_LN1	1	0.05	0.05
EXACT_LN3_EXACT_LN2	1	0.25	0.05
EXACT_LN4_EXACT_LN3	1	0.5	0.25
FSFDS	1	0.5	1
GAMMON_CB111_IN112	1	0.5	0.05
GAMMON_CB143_CB_144	1	0.25	0.25
GAMMON_CB144_MH90	1	0.25	0.25
GAMMON_IN154_IN85	1	0.05	0.5
GAMMON_IN84_IN85	1	0.5	0.25
GAMMON_IN85_MH90	1	0.5	0.5
GAMMON_MH104_MH111	1	0.05	0.5
GAMMON_MH105_MH110	1	0.5	0.05
GAMMON_MH110_MH104	1	0.05	0.05
GAMMON_MH120_MH101	1	0.5	0.5

Conduit ID	Number of Barrels	Entrance Loss Coefficient	Exit Loss Coefficient
GAMMON_MH149_MH150	1	0.5	0.05
GAMMON_MH150_MH151	1	0.25	0.05
GAMMON_MH151_MH93	1	0.05	0.05
GAMMON_MH90_MH91	1	0.5	0.25
GAMMON_MH91_MH150	1	0.25	0.25
GAMMON_MH93_MH120	1	0.05	0.05
ID*2085	1	0.5	0.25
ID*2086	1	0.5	0.5
ID*2087	1	0.5	0.5
ID*2088	1	0.5	0.05
HAWSER_HP3	1	0.05	0.25
HAWSER_HP3A	1	0.05	0.05
HAWSER_HP4	1	0.05	0.05
HAWSER_HP5	1	0.5	0.05
ID*2093	1	0.25	0.5
ID*2094	1	0.5	0.05
ID*2097	3	0.7	0.5
ID*2098	1	0.05	0.05
ID*2099	1	0.05	0.05
ID*2100	1	0.05	0.05
ID*2101	1	0.05	0.05
ID*2102	1	0.05	0.05
ID*2103	1	0.05	0.05
ID*2104	1	0.25	0.05
ID*2105	1	0.5	0.25
ID*2106	1	0.05	0.5
ID*2107	1	0.5	0.5
ID*2108	1	0.5	0.5
ID*2109	1	0.05	0.05
ID*2110	1	0.05	0.5
ID*2111	1	0.5	0.5
ID*2112	1	0.5	0.5
ID*2113	1	0.5	0.5
ID*2114	1	0.5	0.05
ID*2115	1	0.5	0.05
ID*2116	1	0.5	0.5
ID*2117	1	0.25	0.05
ID*2118	1	0.05	0.05
ID*2119	1	0.05	0.05
ID*2120	1	0.5	0.05
ID*2121	1	0.05	0.05
ID*2122	1	0.05	0.05
ID*2123	1	0.05	0.05
ID*2124	1	0.05	0.05
ID*2125	1	0.25	0.25
ID*2126	1	0.25	0.25
ID*2127	1	0.5	0.25
ID*2128	1	0.5	0.25
ID*2129	1	0.5	0.5
ID*2130	1	0.05	0.25
ID*2131	1	0.25	0.5
ID*2132	1	0.5	1
ID*2133	1	0.25	0.05
ID*2134	1	0.05	0.25
ID*2135	1	0.5	0.5
ID*2136	1	0.05	0.25
ID*2137	1	0.05	0.5
ID*2138	1	0.25	0.05
ID*2139	1	0.05	0.05
ID*2140	1	0.05	0.5
ID*2141	1	0.05	0.05
ID*2142	1	0.5	0.25
ID*2143	1	0.05	0.05
ID*2144	1	0.05	0.5
ID*2145	1	0.25	0.25
ID*2146	1	0.05	0.5
ID*2149	1	0.05	1
ID*2152	1	0.5	0.05
ID*2153	1	0.25	0.05
ID*2154	1	0.05	0.25
ID*2155	1	0.05	0.25
ID*2156	1	0.05	0.5
ID*2157	1	0.05	0.05
ID*2158	1	0.5	0.05
ID*2159	1	0.25	0.25
ID*2160	1	0.25	0.5
ID*2161	1	0.05	0.05
ID*2162	1	0.05	0.05
ID*2163	1	0.25	0.05
ID*2164	1	0.5	0.5
ID*2165	1	0.05	0.25
ID*2166	1	0.05	0.5
ID*2167	1	0.5	0.05
ID*2168	1	0.05	0.5
ID*2169	1	0.5	0.05
ID*2170	1	0.05	1
ID*2171	1	0.05	0.25
ID*2172	1	0.25	0.25
ID*2173	1	0.05	0.25
ID*2174	1	0.05	0.05
ID*2175	1	0.05	0.5
ID*2176	1	0.25	0.05
IN2860-21_AS2860-001	1	0.05	0.05
ID*2178	1	0.05	0.5
ID*2179	1	0.05	0.25
ID*2180	1	0.05	0.05
ID*2181	1	0.25	0.5
ID*2182	1	0.05	0.5
ID*2183	1	0.05	1
ID*2184	1	0.05	0.25
ID*2185	1	0.05	0.5
ID*2186	1	0.25	0.05
ID*2187	1	0.05	0.25
ID*2189	1	0.25	0.5
ID*2190	1	0.5	0.05
ID*2191	1	0.5	0.5
ID*2192	1	0.5	0.5
ID*2193	1	0.5	0.05
ID*2194	1	0.25	0.25
ID*2195	1	0.5	0.5
ID*2196	1	0.25	0.05
ID*2197	1	0.05	0.05
ID*2198	1	0.05	0.05
ID*2199	1	0.05	0.05
ID*2200	1	0.05	0.5
ID*2201	1	0.25	0.5
ID*2202	1	0.25	0.25
ID*2203	1	0.25	0.5
ID*2204	1	0.5	0.5
ID*2205	1	0.5	0.05
ID*2206	1	0.05	0.25
ID*2207	1	0.05	0.25
ID*2208	1	0.05	0.5
ID*2209	1	0.05	0.05

Conduit ID	Number of Barrels	Entrance Loss Coefficient	Exit Loss Coefficient
ID*2210	1	0.5	0.5
ID*2211	1	0.5	0.05
ID*2212	1	0.25	0.5
ID*2213	1	0.05	0.5
ID*2214	1	0.05	0.5
ID*2215	1	0.25	0.5
ID*2216	1	0.05	0.25
ID*2217	1	0.5	0.05
ID*2218	1	0.05	0.5
ID*2219	1	0.5	0.05
ID*2220	1	0.05	0.5
ID*2221	1	0.5	0.05
ID*2222	1	0.5	0.05
ID*2223	1	0.25	0.25
ID*2224	1	0.25	0.25
ID*2225	1	0.25	0.25
ID*2226	1	0.5	0.05
ID*2227	1	0.05	0.25
ID*2228	1	0.05	0.05
ID*2229	1	0.25	0.5
ID*2230	1	0.25	0.25
ID*2231	1	0.05	0.05
ID*2232	1	0.05	0.5
ID*2233	1	0.5	0.5
ID*2234	1	0.5	0.05
ID*2235	1	0.5	0.25
ID*2236	1	0.5	0.5
ID*2237	1	0.25	0.25
ID*2238	1	0.25	0.05
ID*2239	1	0.5	0.5
ID*2240	1	0.25	0.05
ID*2241	1	0.05	0.05
ID*2242	1	0.05	0.5
ID*2243	1	0.05	0.5
ID*2244	1	0.5	0.05
ID*2245	1	0.05	0.25
ID*2246	1	0.05	0.05
ID*2247	1	0.05	0.05
ID*2248	1	0.05	0.5
ID*2249	1	0.25	0.05
ID*2250	1	0.25	0.05
ID*2251	1	0.5	0.05
ID*2252	1	0.25	0.25
ID*2253	1	0.5	0.25
ID*2254	1	0.5	0.05
ID*2255	1	0.05	0.25
ID*2256	1	0.5	0.05
ID*2257	1	0.05	0.5
ID*2258	1	0.5	0.05
ID*2259	1	0.25	0.5
ID*2260	1	0.05	0.5
ID*2261	1	0.05	0.05
ID*2262	1	0.5	0.05
ID*2263	1	0.5	0.5
ID*2264	1	0.05	0.5
ID*2265	1	0.25	0.05
ID*2266	1	0.25	0.5
ID*2267	1	0.05	0.25
ID*2268	1	0.25	0.25
ID*2269	1	0.5	0.25
ID*2270	1	0.5	0.5
ID*2271	1	0.5	0.05
ID*2272	1	0.25	0.25
ID*2273	1	0.25	0.05
ID*2274	1	0.05	0.25
ID*2275	1	0.25	0.05
ID*2276	1	0.05	0.5
ID*2277	1	0.05	0.5
ID*2278	1	0.05	0.5
ID*2279	1	0.05	0.5
ID*2280	1	0.5	0.05
ID*2281	1	0.05	0.5
ID*2282	1	0.5	0.25
ID*2283	1	0.5	0.05
ID*2284	1	0.5	0.05
ID*2285	1	0.05	1
ID*2286	1	0.05	0.5
ID*2287	1	0.05	1
ID*2288	1	0.05	0.25
ID*2289	1	0.05	0.5
ID*2290	1	0.5	0.5
ID*2291	1	0.5	0.05
ID*2292	1	0.05	0.5
ID*2293	1	0.05	0.05
ID*2294	1	0.05	0.25
ID*2295	1	0.05	0.05
ID*2296	1	0.05	0.05
ID*2297	1	0.25	0.5
ID*2298	1	0.05	0.5
ID*2299	1	0.5	0.05
JCT2_1750_WA	1	0.5	0.25
KETTLE_POND_	1	0.25	1
KETTLE_POND_	1	0.5	0.25
KETTLE_POND_	1	0.5	0.05
KETTLE_POND_	1	0.1	0.3
ID*2305	1	0.05	0.5
MASTHEAD_PN	1	0.5	0.5
MASTHEAD_PN	1	0.05	0.5
MASTHEAD_PN	1	0.5	0.05
MASTHEAD_PN	1	0.5	0.05
MASTHEAD_PN	1	0.5	0.5
ID*2318	1	0.5	0.5
MEM_HS_SOUT	1	0.5	0.05
MHS_AS2755-0	1	0.5	0.25
MHS_CB1_MHS	1	0.05	0.5
MHS_CB2_MHS	1	0.5	0.25
MHS_CB3_MHS	1	0.25	0.25
MHS_CB4_MHS	1	0.25	0.5
MHS_CB6_AS2	1	0.5	0.5
ID*2328	1	0.05	0.5
ID*2329	1	0.05	0.5
ID*2330	1	0.05	0.5
ID*2331	1	0.05	0.05
ID*2332	1	0.05	0.25
ID*2333	1	0.05	0.05
ID*2334	1	0.05	0.25
ID*2335	1	0.05	0.25
ID*2336	1	0.25	0.25
ID*2337	1	0.05	1
ID*2338	1	0.05	0.25
NAUTILUS_P2	1	0.25	1
NAUTILUS_P3	1	0.5	1
NAUTILUS_P5	1	0.25	1
ID*2345	1	0.05	0.05

Conduit ID	Number of Barrels	Entrance Loss Coefficient	Exit Loss Coefficient
ID*2347	1	0.5	0.05
N_BROOOKLY_DR	1	0.5	0.25
ID*2349	1	0.05	0.05
OWEN_RT_PD_CDT_734	1	0.5	0.5
OWEN_RT_POND_CDT_710	1	0.05	0.5
OWEN_RT_POND_CDT_712	1	0.05	1
OWEN_RT_POND_CDT_713	1	0.5	0.05
OWEN_RT_POND_CDT_718	1	0.5	0.05
OWEN_RT_POND_CDT_720	1	0.05	0.25
OWEN_RT_POND_CDT_722	1	0.25	0.25
OWEN_RT_POND_CDT_727	1	0.05	0.5
OWEN_RT_POND_CDT_728	1	0.25	0.25
OWEN_RT_POND_CDT_729	1	0.5	0.05
OWEN_RT_POND_CDT_730	1	0.25	0.25
OWEN_RT_POND_CDT_731	1	0.5	0.05
OWEN_RT_POND_CDT_734	1	0.05	0.25
OWEN_RT_POND_CDT_735	1	0.5	0.05
ID*2370	1	0.5	0.25
ID*2371	1	0.05	0.25
ID*2372	1	0.05	0.05
ID*2373	1	0.5	0.5
ID*2374	1	0.05	0.25
ID*2375	1	0.5	0.25
ID*2376	1	0.5	0.05
RR_CULVERT-02	1	0.5	1
RR_UNDERPASS_CDT	1	0.5	0.5
ID*2384	1	0.05	0.05
ID*2385	1	0.5	0.05
ID*2386	1	0.05	0.5
ID*2387	1	0.25	0.5
ID*2388	1	0.05	0.25
ID*2389	1	0.05	0.05
ID*2390	1	0.05	0.5
ID*2391	1	0.5	0.25
ID*2392	1	0.5	0.05
ID*2393	3	0.5	0.05
ID*2394	3	0.05	0.05
ID*2395	1	0.05	0.05
ID*2396	1	0.05	0.5
ID*2397	1	0.05	0.5
ID*2398	1	0.5	0.05
ID*2399	1	0.5	0.05
ID*2400	1	0.25	0.05
ID*2401	1	0.25	0.25
TP3347-016_LKMED-003	1	0.25	1
ID*2403	1	0.25	0.05
ID*2404	1	0.05	0.05
ID*2405	1	0.25	0.25
ID*2406	1	0.05	0.05
ID*2407	1	0.25	0.25
ID*2408	1	0.5	0.05
ID*2409	1	0.5	0.05
ID*2495	1	0.05	0.05
ID*2496	1	0.5	0.05
YELLOWSTONE_PY10	1	0.25	0.5
YELLOWSTONE_PY11	1	0.05	0.25
YELLOWSTONE_PY12	1	0.5	0.05
YELLOWSTONE_PY2	1	0.25	0.25
YELLOWSTONE_PY3	1	0.05	0.25
YELLOWSTONE_PY4	1	0.05	0.05
YELLOWSTONE_PY5	1	0.05	0.05
YELLOWSTONE_PY6	1	0.05	0.05
YELLOWSTONE_PY7	1	0.5	0.05
_AE2458-003	1	0.5	0.05
ID*C{1572.1}	1	0.5	0.05
CDT-27	1	0.5	0.05
ID*C{1573.1}	1	0.5	0.25
ID*C{1577.1}	1	0.5	1
ID*C{2052.1}	1	0.5	1
ID*C{2095.1}	1	0.5	1
ID*C{2095.2}	1	0.5	1
ID*C{2096.1}	1	0.5	1
ID*C{2096.2}	1	0.5	1
ID*C{2147.1}	1	0.05	0.05
ID*C{2147.2}	1	0.05	0.05
ID*C{2148.1}	1	0.05	0.05
ID*C{2148.2}	1	0.05	0.05
ID*C{2150.1}	1	0.05	0.05
ID*C{2150.2}	1	0.05	0.05
ID*C{2188.1}	1	0.05	0.25
ID*C{2188.2}	1	0.05	0.25
ID*C{2339.1}	1	0.5	1
ID*C{2339.2}	1	0.5	1
NAUTILUS_PIPE1	1	0.5	1
ID*C{2346.1}	1	0.05	1
ID*C{2346.2}	1	0.05	1

Conduit ID	Upstream Node	Downstream Node	Upstream Elev.	Downstream Elev.
302_S_GAMMON_CB1_EX	302_S_GAMMON_CB1	AS2655-002	1034.32	1034.25
302_S_GAMMON_CB2_CB1	302_S_GAMMON_RD_CB2	302_S_GAMMON_CB1	1034.52	1034.32
302_S_GAMMON_CB3_CB2	302_S_GAMMON_CB3	302_S_GAMMON_RD_CB2	1035.02	1034.52
302_S_GAMMON_CB4_CB3	ME02-A-0054-H-011	302_S_GAMMON_CB3	1035.5	1035.02
ID*1566	ME02-A-0272-H-000	IN2458-002-001	1075.05	1072
ID*1567	ME02-A-0272-H-007	AS2459-003	1094.256	1091.46
ID*1568	ME02-A-0057-H-004	AS2658-009	1077	1070.7
ID*1569	ME02-A-0057-H-023	AS2659-017	1077.15	1072.1
ID*1570	AE2753-014	AE2753-015	1038.5	1038.2
ID*1571	WTP_N_Outlet	AS2755-013	1025.49	1024.48
ID*1574	ME02-A-0067-H-000	AS2956-015	1005.6	1003.3
ID*1575	ME02-A-0068-H-003	AS2956-019	1006.1	1005.68
ID*1576	AE3052-006	AE3052-007	921.6	919.3
ID*1578	ME02-A-0043-A-076	IN3152-019	901.56	898.452
ID*1579	ME03-C-0041-A-005	IN3247-023	902.16	897.84
ID*1580	ME02-A-0047-H-006	IN3356-025	986.553	986.39
ID*1581	ID*1510	UW_RSCH_PARK_E_POND3	983.77	983.55
ID*1582	ID*1509	ME02-A-0275-H-001	985.96	985.82
ID*1583	ME02-A-0275-H-005	IN3457-020	989.7	989.56
ID*1584	AS2359-025	AS2459-019	1102.56	1101.45
ID*1585	AS2360-006	AS2359-025	1102.79	1102.56
ID*1586	AS2456-017	AS2457-015	1075.9	1072.21
ID*1587	AS2456-018	AS2456-017	1077.36	1075.9
ID*1588	AS2457-001	AS2557-008	1066.86	1063.05
ID*1589	AS2457-004	AS2457-001	1068.983	1066.86
ID*1590	AS2457-005	AS2457-004	1070.57	1068.983
ID*1591	AS2457-015	AS2457-005	1072.21	1070.57
ID*1592	AS2458-005	ME02-A-0272-H-001	1099	1095.41
ID*1593	AS2458-008	AS2458-005	1102.37	1099
ID*1594	AS2459-003	AS2459-006	1091.46	1081.6
ID*1595	AS2459-006	ME02-A-0272-H-004	1081.6	1081.26
ID*1596	AS2459-003	AS2459-007	1091.46	1088.98
ID*1597	AS2459-019	AS2459-020	1101.45	1100.61
ID*1598	AS2459-020	IN2459-014	1100.61	1098.82
ID*1599	AS2459-022	IN2459-014	1101.23	1098.82
ID*1600	AS2460-001	AS2460-003	1149.51	1114.64
ID*1601	AS2460-003	AS2460-005	1114.64	1102.95
ID*1602	AS2460-005	AS2459-019	1102.95	1101.45
ID*1603	AS2461-020	AS2461-021	1162.75	1161.13
ID*1604	AS2461-021	AS2460-001	1161.13	1149.51
ID*1605	AS2555-003	AS2555-021	1058.2	1057
ID*1606	AS2555-007	AS2555-003	1061.75	1058.2
ID*1607	AS2555-008	AS2555-007	1063.51	1061.75
ID*1608	AS2555-009	AS2555-008	1074.75	1063.51
ID*1609	AS2555-021	AS2655-016	1057	1055.27
ID*1610	AS2557-001	TP2557-006	1042.46	1042.46
ID*1611	AS2557-003	IN2557-002	1054.6	1049
ID*1612	AS2557-004	AS2557-003	1056.14	1054.6
ID*1613	AS2557-008	AS2557-004	1063.05	1056.14
ID*1614	AS2558-002	AS2558-003	1061.87	1059.149
ID*1615	AS2558-003	AS2558-004	1059.149	1058.28
ID*1616	AS2558-004	AS2557-004	1058.28	1056.14
ID*1617	AS2653-001	AS2654-008	1041.54	1041.3
ID*1618	IN2654-009	AS2654-004	1040.92	1040.84
ID*1619	AS2654-008	AS2654-004	1041.3	1040.84
ID*1620	AS2655-002	AS2756-056	1033.94	1032.63
ID*1621	AS2655-003	AS2655-002	1037.21	1033.94
ID*1622	AS2655-012	IN2655-018	1050.41	1043.584
ID*1623	AS2655-016	AS2655-012	1055.27	1050.41
ID*1624	AS2655-019	IN2655-020	1042.01	1040.279
ID*1625	AS2658-009	GAMMON_CB143	1070.7	1069.78
ID*1626	ME02-A-0273-H-004	ME02-A-0273-H-000	1084.6	1084.56
ID*1627	ME02-A-0057-H-007	AS2659-008	1073.88	1072.988
ID*1628	AS2659-008	AS2659-017	1072.988	1072.1
ID*1629	AS2659-010	AE2659-011	1075.2	1075
ID*1630	AS2659-017	AS2659-019	1072.1	1071.337
ID*1631	AS2659-019	AS2658-009	1071.337	1070.7
ID*1632	AS2659-020	AS2659-017	1072.946	1072.1
ID*1633	AS2660-003	AS2660-006	1078.17	1078
ID*1634	AS2660-006	AS2660-029	1078	1077.52
ID*1635	AS2660-007	AS2660-006	1078.35	1078
ID*1636	AS2660-011	IN2660-018	1077.24	1077
ID*1637	AS2660-013	AS2660-003	1079.2	1078.17
ID*1638	AS2660-027	ME02-A-0273-H-004	1086.4	1084.6
ID*1639	AS2660-029	AS2660-011	1077.52	1077.24
ID*1640	AS2752-010	AS2752-009	1044.77	1040.52
ID*1641	AS2752-011	AS2753-002	1038.4	1036
ID*1642	AS2753-002	IN2753-001	1036	1034.6
ID*1643	AS2753-004	AS2754-006	1036.9	1035.32
ID*1644	AS2753-007	AS2754-003	1042.13	1040.08
ID*1645	AS2754-001	AS2854-014	1022.27	1021.17
ID*1646	AS2754-003	AS2754-005	1040.08	1037.23
ID*1647	AS2754-005	AS2754-006	1037.23	1035.32
ID*1648	AS2754-006	AS2754-007	1035.32	1033.78
ID*1649	AS2754-007	ME02-A-0053-A-008	1033.78	1032.99
ID*1650	AS2754-012	AS2754-001	1023.37	1022.27
ID*1651	AS2755-007	ME02-A-0050-H-001	1032.25	1028.53
ID*1652	AS2755-013	AS2754-012	1024.48	1023.37
ID*1653	AS2756-008	ME02-A-0050-H-001	1031.25	1030.6
ID*1654	AS2756-041	AS2756-063	1031.95	1030.39
ID*1655	AS2756-056	AS2756-041	1032.63	1031.95
ID*1656	AS2756-063	ME02-A-0050-H-001	1030.39	1030.03
ID*1657	AS2757-056	IN2757-055	1044.75	1043.5
ID*1658	AS2851-002	AS2852-024	1038.09	1023.15
ID*1659	AS2851-003	AS2851-002	1049.41	1038.09
ID*1660	YELLOWSTONE_YS2	YELLOWSTONE_1	1012.91	1012
ID*1661	YELLOWSTONE_1	IN2852-016	1012	1010.4
ID*1662	AS2852-020	YELLOWSTONE_1	1012.76	1012
ID*1663	AS2852-021	AS2852-020	1012.85	1012.76
ID*1664	AS2852-022	AS2852-021	1015.67	1012.85
ID*1665	AS2852-024	AS2852-022	1023.15	1015.67
ID*1666	AS2853-004	AS2854-001	1022.3	1018.64
ID*1667	AS2853-009	CB2853-007	1030.86	1022.86
ID*1668	AS2853-010	AS2853-009	1033.52	1030.86
ID*1669	AS2853-015	IN2853-011	1037.56	1034.66
ID*1670	AS2854-001	IN2854-033	1018.64	1017.53
ID*1671	AS2854-008	CB2854-036	1023.25	1022.03
ID*1672	AS2854-010	TP2854-027	1020.2	1017.6
ID*1673	AS2854-014	GR2854-015	1021.17	1020.04
ID*1674	AS2854-016	AS2854-018	1030.72	1028.38
ID*1675	AS2854-018	AS2854-019	1028.38	1026.6
ID*1676	AS2854-019	CB2854-037	1026.6	1025.03
ID*1677	AS2856-009	AS2756-008	1033.83	1031.25
ID*1678	AS2856-012	AS2856-009	1035.77	1033.83
ID*1679	AS2856-017	AS2856-012	1037.39	1035.77
ID*1680	AS2856-019	AS2856-017	1037.82	1037.39
ID*1681	AS2857-015	AS2857-015_001	1031.15	1029.46
ID*1682	AS2857-020	ME02-A-0050-H-000	1028.57	1027.31
ID*1683	AS2857-021	AS2857-020	1028.74	1028.57
ID*1684	AS2858-005	IN2859-001	1027.8	1025.369
ID*1685	AS2858-018	AS2858-027	1035.23	1033.45
ID*1686	AS2858-020	AS2857-021	1029.17	1028.74
ID*1687	AS2858-021	AS2858-005	1028.96	1027.8
ID*1688	AS2858-027	AS2857-015	1033.45	1031.15

Conduit ID	Upstream Node	Downstream Node	Upstream Elev.	Downstream Elev.
ID*1689	AS2858-029	AS2858-020	1029.93	1029.17
ID*1690	AS2858-029	AS2858-029-001	1029.93	1029.634
ID*1691	AS2859-005	IN2860-021	1021.81	1018.875
ID*1692	AS2860-001	IN2860-013	1015.95	1015.946
ID*1693	AS2860-003	AS2860-001	1018.95	1015.95
ID*1694	AS2860-011	AS2860-001	1017.77	1015.95
ID*1695	AS2860-020	AS2860-029	1020.06	1017.96
ID*1696	AS2860-029	AS2860-011	1017.96	1017.77
ID*1697	AS2952-023	ME02-A-0049-H-005	959.88	959.33
ID*1698	AS2952-025	AS2952-023	964.65	959.88
ID*1699	AS2952-026	AS2952-025	965.97	964.65
ID*1700	AS2952-027	ME02-A-0049-H-005	959.72	958.92
ID*1701	AS2953-001	AS3053-014	955.98	951.96
ID*1702	AS2953-002	AS2953-001	977.68	955.98
ID*1703	AS2953-003	AS2953-002	999.17	977.68
ID*1704	AS2955-001	S-9_PN11399	1001.2	1000.211
ID*1705	AS2956-006	AS2956-036	1027.4	1019.9
ID*1706	AS2956-009	AS2956-010	1016.58	1007.78
ID*1707	AS2956-010	AS2956-019	1007.78	1005.68
ID*1708	AS2956-011	AS2956-030	1029.69	1028.62
ID*1709	AS2956-014	ID*771	1002.07	1001
ID*1710	AS2956-015	AS2956-014	1003.3	1002.07
ID*1711	AS2956-019	AS2956-015	1005.68	1003.3
ID*1712	AS2956-025	AS2956-009	1017.86	1016.58
ID*1713	AS2956-030	AS2956-031	1028.62	1028.22
ID*1714	AS2956-031	AS2956-032	1028.22	1028.12
ID*1715	AS2956-032	AS2956-033	1028.12	1025.38
ID*1716	AS2956-033	AS2956-034	1025.38	1024.66
ID*1717	AS2956-034	AS2956-035	1024.66	1024.12
ID*1718	AS2956-035	AS2956-036	1024.12	1019.9
ID*1719	AS2956-036	AS2956-025	1019.9	1017.86
ID*1720	AS2957-005	AS2956-011	1031.86	1029.69
ID*1721	AS2958-007	TE2958-023	1055	1048
ID*1722	AS2958-008	IN2958-030	1040.6	1040.267
ID*1723	AS2958-010	AS2958-013	1039.85	1037.29
ID*1724	AS2958-013	AS2858-018	1037.29	1035.23
ID*1725	AS2958-014	AS2958-013	1037.43	1037.29
ID*1726	AS2960-003	AS2860-020	1027.39	1020.06
ID*1727	AS2960-017	AS2960-003	1029.19	1027.39
ID*1728	AS3050-002	AS3050-010	979.1	972
ID*1729	AS3050-010	IN3050-009	972	928.85
ID*1730	AS3053-001	AS3053-003	941.373	934.1
ID*1731	AS3053-002	AS3053-001	943.055	941.373
ID*1732	AS3053-002	DT3053-016	943.055	938.557
ID*1733	AS3053-003	IN3052-002	934.1	923.38
ID*1734	AS3053-014	AE_3053-019	951.96	947.46
ID*1735	AS3054-003	IN3054-020	968.6	966.6
ID*1736	AS3054-010	AS3054-012	987.6	980.6
ID*1737	AS3054-012	AE3054-023	980.6	969.921
ID*1738	AS3055-002	AS3055-009	1006.17	1004.13
ID*1739	AS3055-003	AS3055-013	1012.12	1008.985
ID*1740	AS3055-004	AS3055-003	1013.82	1012.12
ID*1741	AS3055-005	AS3055-004	1016.92	1013.82
ID*1742	AS3055-006	AS3055-005	1017.08	1016.92
ID*1743	AS3055-009	AS2955-001	1004.13	1001.2
ID*1744	AS3055-010	AS3055-006	1020.96	1017.08
ID*1745	AS3055-012	AS3055-002	1007.429	1006.17
ID*1746	AS3055-013	AS3055-012	1008.985	1007.429
ID*1747	AS3149-004	AS3149-009	911.99	908.83
ID*1748	AS3149-009	AS3150-022-000	908.83	906.73
ID*1749	AS3150-001	AS3150-008	905.76	904.3
ID*1750	AS3150-004	AS3150-019	901.2	895.25
ID*1751	AS3150-008	AS3150-009	904.3	901.9
ID*1752	AS3150-009	AS3150-012	901.9	898.6
ID*1753	AS3150-012	AS3150-013	898.6	896.1
ID*1754	AS3150-013	TP3150-014-000	896.1	893.6
ID*1755	AS3150-016	TP3150-014-001	895.6	892.6
ID*1756	AS3150-019	TRANS_JCT-163	895.25	892.094
ID*1757	AS3150-022-000	AS3150-001	906.73	905.76
ID*1758	AS3150-026	CB3150-024	942.81	922.11
ID*1759	AS3150-027	AS3150-026	964.8	942.81
ID*1760	AS3150-039	CB3150-037	903.31	902.83
ID*1761	AS3150-041	AS3150-039	905.15	903.31
ID*1762	AS3150-044	AS3150-041	912.57	905.15
ID*1763	AS3150-047	AS3150-044	919.67	912.57
ID*1764	AS3150-048	AS3150-047	921.28	919.67
ID*1765	AS3151-001	MI3151-032	896.6	894.76
ID*1766	AS3151-005	MI3151-030	894.85	894.3
ID*1767	AS3151-008	AS3151-009	903.1	899.6
ID*1768	AS3151-009	TP3151-011	899.6	894.32
ID*1769	AS3151-042	IN3151-040	898.32	898.22
ID*1770	AS3151-050	AS3151-001	896.85	896.6
ID*1771	AS3151-054	AS3151-005	895	894.85
ID*1772	AS3152-001	AS3152-008	948.6	917.6
ID*1773	AS3152-003	AS3152-001	971.6	948.6
ID*1774	AS3152-008	AS3151-008	917.6	903.1
ID*1775	AS3153-009	AS3152-003	978.6	971.6
ID*1776	AS3153-021	AS3153-009	980.67	978.6
ID*1777	AS3153-023	AS3153-021	982.7	980.67
ID*1778	AS3153-025	AS3153-023	992.42	982.7
ID*1779	AS3153-028	AS3153-025	997.62	992.42
ID*1780	AS3154-007	IN3154-003	1001.79	997.96
ID*1781	AS3155-001	AS3055-005	1025.72	1016.92
ID*1782	AS3155-003	AS3155-001	1034.1	1025.72
ID*1783	AS3246-032	IN3246-031	897.68	897.68
ID*1784	AS3246-035	IN3246-034	898.54	897.44
ID*1785	AS3246-036	AS3246-035	903.73	898.54
ID*1786	AS3247-003	AS3347-001	875.66	866.06
ID*1787	AS3247-004	IN3246-028	890.67	886.01
ID*1788	AS3247-007	AS3247-009	907.8	906.6
ID*1789	AS3247-009	AS3247-013	906.6	899.1
ID*1790	AS3247-013	AS3247-026	899.1	889.85
ID*1791	AS3247-026	IN3247-025	889.85	888.98
ID*1792	AS3247-028	CB3247-024	897.47	886.33
ID*1793	AS3248-001	AS3248-010	890.1	877.6
ID*1794	AS3248-010	AS3248-011	877.6	870.7
ID*1795	AS3248-011	MI3248-016	870.7	868.394
ID*1796	AS3250-002	IN3250-001	906.73	906.2
ID*1797	AS3250-003	AS3250-002	907.71	906.73
ID*1798	AS3250-013-001	AS3250-013	888.6	886.6
ID*1799	AS3250-017	AS3250-013	889.6	889.6
ID*1800	AS3250-013	AS3250-018	886.6	886.35
ID*1801	AS3250-018	TP3250-030	886.35	885.6
ID*1802	AS3250-021	AS3250-017	894.27	889.6
ID*1803	AS3250-026	AS3250-013	894.2	886.6
ID*1804	AS3250-028	AS3250-026	898.53	894.2
ID*1805	ME02-A-0043-A-054	AS3250-028	909.6	898.53
ID*1806	AS3250-034	AS3350-031	884	883.6
ID*1807	AS3251-024	AS3251-028	900.73	898.81
ID*1808	AS3251-028	IN3250-027	898.81	897.04
ID*1809	AS3251-032	AS3251-033	904.1	900.95
ID*1810	AS3251-033	AS3251-044	900.95	898.61
ID*1811	AS3251-044	TP3250-030	898.61	890.2
ID*1812	AS3252-005	IN3252-006	943.71	942.8

Conduit ID	Upstream Node	Downstream Node	Upstream Elev.	Downstream Elev.
ID*1813	AS3252-008	IN3252-006	943.4	942.8
ID*1814	AS3252-009	AS3252-008	945.8	943.4
ID*1815	AS3252-019	AS3252-020	969.9	969.4
ID*1816	AS3252-020	AS3252-021	969.4	968.9
ID*1817	AS3252-021	AS3252-027	968.9	967.3
ID*1818	AS3252-027	AS3252-009	967.3	945.8
ID*1819	AS3253-006	AS3252-020	970.1	969.4
ID*1820	AS3253-011	AS3253-012	969.2	967.6
ID*1821	AS3253-012	AS3253-013	967.6	965.63
ID*1822	AS3253-013	AS3353-029	965.63	964.7
ID*1823	AS3256-010	AS3256-013	1035.45	1017.46
ID*1824	AS3256-013	AS3356-043	1017.46	986.89
AS3346-005_LKMED-001	AS3346-005	LKMED-001_	854.022	850.37
ID*1826	AS3346-011	AS3346-012	853.14	851.95
AS3346-012_LKMED-002	AS3346-012	LKMED-002	851.95	851.07
ID*1828	AS3347-001	AS3347-002	866.06	856.96
ID*1829	AS3347-002	AS3347-003	856.96	855.05
ID*1830	AS3347-003	AS3347-025	855.05	853.83
ID*1831	AS3347-004	AS3346-011	853.3	853.14
ID*1832	AS3347-021	AS3347-027	860	859.48
ID*1833	AS3347-025	TP3346-009	853.83	853.485
ID*1834	AS3347-027	IN3347-022	859.48	852.298
ID*1835	AS3347-028	AS3347-027	861.65	859.48
ID*1836	AS3347-036	IN3347-035	865.4	865.29
ID*1837	AS3347-042	AS3347-036	868.75	865.4
ID*1838	AS3348-002	AS3348-004	864.94	863.4
ID*1839	AS3348-004	AS3348-063	863.4	861.68
ID*1840	AS3348-006	TP3348-017	855.2	855.1
ID*1841	AS3348-007	IN3348-064	858.6	856.382
ID*1842	AS3348-008	AS3348-009	864.4	861.6
ID*1843	AS3348-009	AS3348-007	861.6	858.6
ID*1844	AS3348-018	TP3347-015	852.1	844.6
ID*1845	AS3348-028	TP3348-026	857.35	857.3
ID*1846	AS3348-035	AS3348-041	867.31	866.4
ID*1847	AS3348-041	AS3348-008	866.4	864.4
ID*1848	AS3348-041	AS3348-042	866.4	866.23
ID*1849	AS3348-042	AS3348-043	866.23	865.83
ID*1850	AS3348-043	AS3349-027	865.83	864.6
ID*1851	AS3348-045	TP3348-017	855.6	855.1
ID*1852	AS3348-050	AS3347-028	874.12	861.65
ID*1853	AS3348-056	IN3348-055	885.11	885.04
ID*1854	AS3348-059	AS3348-056	889	885.11
ID*1855	AS3348-063	IN3348-064	861.68	856.382
ID*1856	AS3348-095	TP3348-027	859.94	858.6
ID*1857	AS3348-100	AS3348-095	864.39	861.94
ID*1858	AS3349-005	TP3349-003	865.9	864.771
ID*1859	AS3349-008	AS3349-011	869.8	868
ID*1860	AS3349-011	AS3349-014	868	866.6
ID*1861	AS3349-014	AS3349-015	866.6	866
ID*1862	AS3349-015	TP3349-003	866	864.771
ID*1863	AS3349-018	AS3349-019	866.6	865.1
ID*1864	AS3349-019	AS3349-025	865.1	864.6
ID*1865	AS3349-026	AS3349-025	864.76	864.6
ID*1866	AS3349-026	AS3349-027	864.76	864.6
ID*1867	AS3349-027	TP3349-004	864.6	861.061
ID*1868	AS3349-048	TP3349-055	875.259	870.518
ID*1869	AS3349-049	AS3349-048	883.62	875.259
ID*1870	AS3349-050	AS3349-049	885	883.62
ID*1871	AS3349-057	AS3349-056	872.85	872.06
ID*1872	AS3350-003	AS3349-008	874.1	869.8
ID*1873	AS3350-006	AS3350-031	893.15	883.6
ID*1874	AS3350-014	IN3350-016	896.353	895.242
ID*1875	AS3350-015-001	AS3350-015	895.35	895.35
ID*1876	AS3350-015	AS3350-006	895.35	893.15
ID*1877	AS3350-022	AS3350-015-001	897.6	895.35
ID*1878	AS3350-025	TP3350-033	915.2	913.754
ID*1879	AS3350-031	MI3350-007	883.6	881.6
ID*1880	AS3350-035	IN3350-030	931.29	916.52
ID*1881	AS3350-040	AS3350-041	887.98	887.33
ID*1882	AS3350-041	AS3350-042	887.33	886.59
ID*1883	AS3350-042	AS3350-043	886.59	886.11
ID*1884	AS3350-043	AS3349-048	886.11	875.259
ID*1885	IN3352-005	TRANS_JCT-175	964.755	950.89
ID*1886	AS3352-013	TRANS_JCT-175	957.6	956.03
ID*1887	AS3352-018	TRANS_JCT-173	963.3	959.11
ID*1888	AS3352-020	MSH_GRNW_S_HILL_763	965.6	961.02
ID*1889	AS3352-028	AS3352-020	968.19	965.6
ID*1890	AS3352-036	IN3352-034	968.92	968.19
ID*1891	AS3352-039	AS3352-036	970.05	968.92
ID*1892	AS3352-042	AS3352-039	970.57	970.05
ID*1893	AS3352-044	AS3352-042	970.75	970.57
ID*1894	AS3352-048	AS3352-044	972.03	970.75
ID*1895	AS3353-003	TRANS_JCT-171	965	964.72
ID*1896	AS3353-006	TRANS_JCT-170	963.35	962.12
ID*1897	AS3353-006	AS3353-007	963.35	963.2
ID*1898	AS3353-008	AS3353-007	963.56	963.2
ID*1899	AS3353-015	AS3353-008	964.52	963.56
ID*1900	AS3353-018	AS3353-015	965.6	964.52
ID*1901	AS3353-028	TRANS_JCT-168	966.3	965.78
ID*1902	AS3353-029	TRANS_JCT-168	964.7	963.6
ID*1903	AS3353-033	AS3353-034	966.5	965.91
ID*1904	AS3353-034	TRANS_JCT-168	965.91	965.73
ID*1905	AS3353-040	MSH_GRNW_S_HILL_763	965.6	960.77
ID*1906	AS3353-058	IN3453-003	968.83	967.45
ID*1907	AS3354-003	AE3354-004	968.82	968.64
ID*1908	AS3354-010	AE3354-004	970.84	970.74
ID*1909	AS3354-023	AS3354-003	973.09	968.82
ID*1910	AS3355-002-000	AS3355-002	977.11	976.27
ID*1911	AS3355-002	MI3355-003	976.27	973.732
ID*1912	AS3356-023	AS3355-002-000	984.501	977.11
ID*1913	AS3356-028	AS3356-023	985.3	984.501
ID*1914	AS3356-023	AS3356-031	984.501	982.39
ID*1915	AS3356-032	AS3356-033	981.26	980.26
ID*1916	AS3356-023	AS3356-033	984.501	980.26
ID*1917	AS3356-038	AS3356-032	984.05	981.26
ID*1918	AS3356-043	AS3356-028	986.89	985.3
ID*1919	AS3357-007	AS3356-038	987.98	984.05
ID*1920	AS3357-008	AS3357-007	998.9	987.98
ID*1921	AS3447-004	AS3447-005	890.945	855.459
ID*1922	AS3447-005	AS3447-008	855.459	850.137
AS3447-008_LKMED-004	OFALL_SPRING_CT-STM	AS3447-008	850.23	850.137
ID*1924	AS3449-006	AS3449-008	904.1	899.6
ID*1925	AS3449-008	MI3449-033	899.6	897.679
ID*1926	AS3449-023	CB3449-017	895.77	894.66
ID*1927	AS3449-027	AS3449-023	896.81	895.77
ID*1928	AS3449-032	AS3449-027	897.62	896.81
ID*1929	AS3449-035	AS3449-027	920.21	896.81
ID*1930	AS3450-002	AS3450-055	890.08	889.11
ID*1931	AS3450-003	AS3450-002	892.1	890.08
ID*1932	AS3450-004	AS3450-003	894.12	892.1
ID*1933	AS3450-016	AS3450-022	910.87	908.48
ID*1934	AS3450-021	IN3450-038	902.84	900
ID*1935	AS3450-022	AS3450-021	908.48	902.84
ID*1936	AS3450-025	AS3450-022	913.65	908.48

Conduit ID	Upstream Node	Downstream Node	Upstream Elev.	Downstream Elev.
ID*1937	ME02-A-0044-A-004	AS3450-057	922	921
ID*1938	AS3450-036	AS3450-025	916.7	913.65
ID*1939	AS3450-055	AS3350-040	889.11	887.98
ID*1940	AS3450-057	AS3450-036	921	916.7
ID*1941	AS3452-002	MI3353-062	970.07	970
ID*1942	AS3452-005	AS3452-002	970.33	970.07
ID*1943	AS3452-006	AS3452-005	975.6	970.33
ID*1944	AS3457-008	ME02-A-0275-H-000	988.1	987.7
ID*1945	AS3457-012	AS3457-016	989.05	988.09
ID*1946	AS3457-016	ME02-A-0275-H-000	988.09	988
ID*1947	AS3457-008	AS3457-016	988.1	988.09
ID*1948	AS3457-017	AS3457-016	988.16	988.09
ID*1949	AS3457-018	AS3457-012	989.18	989.05
ID*1950	AS3457-018	AS3457-017	989.18	988.16
ID*1951	AS3458-022	AS3457-012	991.45	989.05
ID*1952	AS3458-023	AS3458-022	999.4	991.45
BELTLINE_UNDERPASS	BELTLINE_UNDERPASS_N	BELTLINE_UNDERPASS_S	1035.5	1032
BIOFILTRATION_OUTLET	BIOFILTER_US_JCT	AS3349-005	866.05	865.9
ID*1964	CB2853-007	IN2853-008	1022.86	1022.46
ID*1965	CB2854-036	HD2854-032-001	1022.03	1017.69
ID*1966	CB2854-037	AS2854-008	1025.03	1023.25
ID*1967	CB3150-023	AS3150-022-000	912.38	906.73
ID*1968	CB3150-024	CB3150-023	922.11	912.38
ID*1969	CB3150-037	AS3150-004	902.83	901.2
ID*1970	CB3247-024	AS3347-042	886.33	868.75
ID*1971	CB3348-074	SS3348-073	857.07	857.06
ID*1972	CB3348-081	CB3348-074	857.53	857.07
ID*1973	CB3348-088	CB3348-081	858.89	857.53
ID*1974	CB3348-091	CB3348-088	859.71	858.89
ID*1975	AS3348-095	CB3348-096	859.94	857.2
ID*1976	CB3348-097	CB3348-096	857.58	857.2
ID*1977	CB3349-028	CB3348-097	858.37	857.58
ID*1978	CB3349-030	CB3349-028	869.11	858.37
ID*1979	CB3349-041	CB3349-030	882.51	869.11
ID*1980	CB3449-017	CB3349-041	894.66	882.51
CDT-101	ME02-A-0050-H-006	GAMMON_MH101	1032.44	1031.95
CDT-143	GAMMON_MH125	GAMMON_MH120	1039.44	1038.35
CDT-169	GAMMON_IN112	ME02-A-0050-H-006	1032.78	1031.02
CDT-183	JCT-142	JCT-144	1054	1052.09
CDT-185	JCT-144	JCT-146	1052.09	1048.945
CDT-187	JCT-146	ID*1514	1048.945	1046.27
CDT-189	ID*1514	ID*1513	1045.8	1043.67
CDT-191	ID*1513	ID*1512	1043.62	1042.79
CDT-193	ID*1512	JCT-154	1042.79	1041.97
CDT-195	JCT-154	WEST_TOWN_MALL_EX100	1041.96	1040.42
CDT-197	WEST_TOWN_MALL_EX100	JCT-158	1040.12	1039.492
CDT-199	JCT-158	JCT-160	1039.492	1038.772
CDT-201	JCT-160	JCT-162	1038.772	1037.5
CDT-203	JCT-162	JCT-258	1037.5	1036.019
CDT-209	ID*1515	ID*1514	1047.68	1047.3
CDT-211	JCT-172	JCT-174	1055.83	1044.881
CDT-213	JCT-174	JCT-176	1044.881	1043.209
CDT-215	JCT-178	JCT-176	1043.876	1043.209
CDT-217	JCT-180	JCT-178	1044.307	1043.876
CDT-219	JCT-182	JCT-180	1044.974	1044.307
CDT-221	JCT-184	JCT-182	1045.938	1044.974
CDT-223	JCT-184	JCT-186	1045.938	1045.07
CDT-225	JCT-186	JCT-188	1045.07	1044.441
CDT-227	JCT-188	IN2557-005	1044.441	1042.91
CDT-229	WEST_TOWNE_MALL_ST9	WEST_TOWNE_MALL_ST10	1055.05	1054.3
CDT-231	WEST_TOWNE_MALL_ST10	WEST_TOWNE_MALL_ST11	1052.36	1050.053
CDT-233	WEST_TOWNE_MALL_ST11	WEST_TOWNE_MALL_ST12	1049.953	1049.55
CDT-235	WEST_TOWNE_MALL_ST12	JCT-200	1049.55	1048.628
CDT-237	JCT-200	JCT-202	1048.628	1045.987
CDT-239	JCT-202	JCT-176	1045.987	1043.248
CDT-241	JCT-204	WEST_TOWNE_MALL_ST12	1051.011	1050.43
CDT-243	JCT-206	JCT-208	1047.55	1046.588
CDT-245	JCT-208	JCT-210	1046.588	1046.16
CDT-247	JCT-210	JCT-212	1045.54	1045.013
CDT-249	JCT-212	JCT-214	1045.013	1044.368
CDT-251	JCT-214	JCT-216	1044.368	1043.88
CDT-253	JCT-216	TP2557-006	1043.86	1042.201
CDT-255	JCT-220	JCT-222	1048.3	1047.124
CDT-257	JCT-222	JCT-224	1047.124	1046.008
CDT-259	JCT-224	JCT-226	1046.008	1043.55
CDT-261	JCT-226	JCT-228	1043.55	1042.229
CDT-263	JCT-228	JCT-230	1042.229	1041.038
CDT-265	JCT-230	JCT-232	1041.038	1040.003
CDT-267	JCT-232	JCT-234	1040.003	1038.291
CDT-269	JCT-234	JCT-236	1038.291	1036.466
CDT-271	JCT-236	JCT-238	1036.466	1035.364
CDT-273	JCT-238	IN2657-008	1035.364	1033.75
CDT-275	JCT-240	JCT-242	1042.081	1040.249
CDT-277	JCT-242	JCT-246	1040.249	1038.428
CDT-279	JCT-246	JCT-248	1038.428	1037.653
CDT-281	JCT-248	JCT-250	1037.653	1037.23
CDT-283	JCT-250	IN2657-008	1037.23	1033.75
CDT-289	JCT-256	IN2557-005	1046.939	1043.209
CDT-291	IN2557-005	TP2557-006	1042.81	1042.201
CDT-293	JCT-258	ME02-A-0050-H-006	1035.943	1031.13
CDT-299	WT_FORBAY_COLLAR	ME02-A-0050-H-000	1029.04	1026.6
CDT-301	AS2857-015_001	ME02-A-0050-H-000	1029.46	1027.33
CDT-311	ID*771	S-9_PN11399	1001	1000
CDT-335	AE2459-004_000	IN2660-026	1087.1	1087.1
CDT-363	AS2858-029-001	AS2858-029-002	1029.634	1029.081
CDT-365	AS2858-029-002	AS2858-021	1029.081	1028.96
CDT-369	ME03-C-0041-A-003	AS3347-003	856.91	855.05
CDT-371	IN2458-002-001	IN2458-002	1072	1066.73
CDT-373	Box_Inlet	IN2459-027	1104.935	1101.69
CDT-375	ME02-A-0272-H-005	ME02-A-0272-H-003	1088.921	1086.456
CDT-377	ME02-A-0043-A-031	TP3347-016	851.5	844.6
CDT-379	ND3151-023-003	ND3151-023-002	894.871	894.679
CDT-385	ND3151-023-001	ND3151-023	894.492	894.372
CDT-387	ND3151-023-002	ND3151-023-001	894.679	894.492
CDT-391	TP3152-020	ND3151-023-003	895.155	894.871
CDT-393	TP3152-020-001	TP3152-020	895.486	895.155
ID*2053	DT3152-009	TP3152-020-001	895.73	895.486
ID*2054	DT3346-010	TP3346-009	854.309	853.485
ID*2055	DT3447-003	AS3447-004	894.892	890.945
EXACT_LN1_AS2960-017	PVT_EXACT_LN1	AS2960-017	1031.6	1029.19
EXACT_LN2_EXACT_LN1	PVT_EXACT_LN2	PVT_EXACT_LN1	1036.6	1031.6
EXACT_LN3_EXACT_LN2	PVT_EXACT_LN3	PVT_EXACT_LN2	1038.6	1036.6
EXACT_LN4_EXACT_LN3	BM03-A-0340-H-005	PVT_EXACT_LN3	1041.6	1038.6
FSFDS	WTP_Structure	ME02-A-0050-H-001	1025.6	1024.1
GAMMON_CB111_IN112	GAMMON_CB111	GAMMON_IN112	1033.09	1032.78
GAMMON_CB143_CB_144	GAMMON_CB143	GAMMON_CB144	1059.15	1058.18
GAMMON_CB144_MH90	GAMMON_CB144	GAMMON_MH90	1058.18	1057.07
GAMMON_IN154_IN85	GAMMON_IN88	GAMMON_IN85	1059.2	1059.06
GAMMON_IN84_IN85	GAMMON_IN84	GAMMON_IN85	1069.91	1067
GAMMON_IN85_MH90	GAMMON_IN85	GAMMON_MH90	1058.66	1057.07
GAMMON_MH104_MH111	GAMMON_MH104	GAMMON_CB111	1033.22	1032.88
GAMMON_MH105_MH110	GAMMON_MH105	GAMMON_MH110	1038.09	1036.09
GAMMON_MH110_MH104	GAMMON_MH110	GAMMON_MH104	1036.09	1033.72
GAMMON_MH120_MH101	GAMMON_MH120	GAMMON_MH101	1038.35	1031.95

Conduit ID	Upstream Node	Downstream Node	Upstream Elev.	Downstream Elev.
GAMMON_MH149_MH150	GAMMON_MH149	GAMMON_MH150	1065.38	1062.2
GAMMON_MH150_MH151	GAMMON_MH150	GAMMON_MH151	1053.17	1048.94
GAMMON_MH151_MH93	GAMMON_MH151	GAMMON_MH93	1048.94	1040.3
GAMMON_MH90_MH91	GAMMON_MH90	GAMMON_MH91	1055.57	1053.68
GAMMON_MH91_MH150	GAMMON_MH91	GAMMON_MH150	1053.68	1053.27
GAMMON_MH93_MH120	GAMMON_MH93	GAMMON_MH120	1040.3	1038.35
ID*2085	GR2953-004	AS2953-003	1000.81	999.17
ID*2086	ME02-A-0048-A-000	GR3053-010	947.98	947.37
ID*2087	ME02-A-0048-A-031	TRANS_JCT-143	986.89	979.36
ID*2088	HD3261-040	GR-3251-039	904.6	904.39
HAWSER_HP3	HAWSER_HS3	HAWSER_HS-2	974	967.93
HAWSER_HP3A	HAWSER_HS4	HAWSER_HS3	983.11	974
HAWSER_HP4	HAWSER_HS5	HAWSER_HS4	991.74	984.11
HAWSER_HP5	HAWSER_HS6	HAWSER_HS5	993.97	991.74
ID*2093	AS3054-003	HAWSER_HS-2	968.6	967.51
ID*2094	ME02-A-0049-H-010	IN2952-004	970.6	966.5
ID*2097	Bord_P_Outflow	TP3150-014-001	891.348	891.17
ID*2098	HD3261-040	AS3251-032	904.6	904.1
ID*2099	IN2358-001	IN2458-009	1104	1103.36
ID*2100	IN2358-025	IN2358-001	1104.8	1104
ID*2101	IN2359-010	IN2359-011	1099.77	1099.39
ID*2102	IN2359-011	IN2459-014	1099.39	1098.82
ID*2103	IN2359-017	IN2359-010	1102.09	1099.77
ID*2104	IN2359-019	IN2359-017	1116.74	1102.09
ID*2105	IN2359-023	IN2359-019	1123.45	1116.74
ID*2106	IN2360-009	AS2360-006	1103.97	1102.79
ID*2107	IN2455-011	IN2555-013	1078.6	1074.9
ID*2108	IN2456-019	AS2456-018	1077.56	1077.36
ID*2109	IN2458-002	AS2558-002	1066.73	1061.87
ID*2110	IN2458-009	AS2458-008	1103.36	1102.37
ID*2111	IN2459-002	AS2459-003	1104.46	1091.46
ID*2112	AS2459-013	AS2459-007	1089.2	1088.98
ID*2113	IN2459-014	AS2459-013	1098.82	1089.2
ID*2114	IN2459-027	AS2459-022	1101.69	1101.23
ID*2115	IN2459-029	IN2459-027	1102.74	1101.69
ID*2116	IN2555-013	AS2555-009	1074.9	1074.75
ID*2117	IN2556-008	IN2555-013	1075.38	1074.9
ID*2118	IN2557-002	AS2557-001	1049	1042.46
ID*2119	IN2560-001	IN2660-028	1106.6	1099.5
ID*2120	IN2560-003	IN2560-001	1113.04	1106.6
ID*2121	IN2653-009	IN2753-013	1044.58	1043.856
ID*2122	IN2654-009	AS2754-003	1040.92	1040.08
ID*2123	IN2655-018	AS2655-019	1043.584	1042.01
ID*2124	IN2655-020	AS2655-003	1040.279	1037.21
ID*2125	IN2655-023	IN2655-024	1033.232	1032.942
ID*2126	IN2655-024	AS2756-056	1032.942	1032.63
ID*2127	IN2655-025	IN2655-023	1034.906	1033.232
ID*2128	IN2656-004	AS2656-007	1036.987	1035.6
ID*2129	IN2656-022	AS2655-019	1043.567	1042.01
ID*2130	AS2656-007	IN2656-027	1035.6	1034.013
ID*2131	IN2656-027	AS2756-056	1034.013	1032.63
ID*2132	IN2657-008	ME02-A-0050-H-006	1033.75	1031.13
ID*2133	IN2659-001	IN2659-002	1075.399	1075.354
ID*2134	IN2659-002	AS2659-010	1075.354	1075.2
ID*2135	IN2660-015	AS2660-013	1080.55	1079.2
ID*2136	IN2660-018	AS2659-010	1077	1075.2
ID*2137	IN2660-021	IN2660-015	1082.3	1080.55
ID*2138	IN2660-022	IN2660-021	1083.3	1082.3
ID*2139	IN2660-026	IN2660-031	1087.1	1087
ID*2140	IN2660-028	AS2660-027	1099.5	1086.4
ID*2141	IN2660-031	AS2660-027	1087	1086.4
ID*2142	ME02-A-0057-H-016	IN2660-015	1080.71	1080.55
ID*2143	AS2752-009	AS2752-011	1040.52	1038.4
ID*2144	IN2753-001	AS2754-007	1034.6	1033.78
ID*2145	IN2753-011	AS2753-007	1042.605	1042.13
ID*2146	IN2753-013	IN2753-011	1043.856	1042.605
ID*2149	IN2756-060	ME02-A-0050-H-001	1029.25	1025.615
ID*2152	IN2757-055	GAMMON_MH125	1043.5	1039.44
ID*2153	IN2759-002	IN2759-003	1076.225	1075.865
ID*2154	IN2759-003	IN2659-001	1075.865	1075.399
ID*2155	IN2759-004	AS2659-020	1073.9	1072.946
ID*2156	IN2759-012	IN2759-004	1074.49	1073.9
ID*2157	IN2760-001	IN2860-007	1045.18	1034.38
ID*2158	IN2760-002	IN2760-001	1056.06	1045.18
ID*2159	IN2852-016	IN2852-028	1010.4	1009.97
ID*2160	IN2852-028	TRANS_JCT-181	1009.97	1006.057
ID*2161	IN2853-008	AS2853-004	1022.46	1022.3
ID*2162	IN2853-011	AS2853-010	1034.66	1033.52
ID*2163	IN2853-018	AS2853-015	1038.83	1037.56
ID*2164	TP2854-027	HD2854-032-001	1017.6	1016.62
ID*2165	IN2854-023	CB2854-037	1027.28	1025.03
ID*2166	IN2854-033	HD2854-032-001	1017.53	1017.04
ID*2167	IN2856-010	AS2856-009	1039.34	1033.83
ID*2168	IN2856-008	IN2856-010	1039.81	1039.34
ID*2169	IN2857-014	IN2857-012	1030.396	1030.381
ID*2170	ME02-A-0050-H-000	IN2857-014	1030.6	1030.396
ID*2171	IN2859-001	IN2859-003	1025.369	1022.75
ID*2172	IN2859-003	AS2859-005	1022.75	1021.81
ID*2173	IN2860-006	IN2860-034	1030.68	1021.492
ID*2174	IN2860-007	IN2860-006	1034.38	1030.68
ID*2175	IN2860-013	BM03-A-0315-H-000	1015.946	1015.93
ID*2176	IN2860-034	AS2860-003	1021.492	1018.95
IN2860-21_AS2860-001	IN2860-021	AS2860-001	1018.875	1015.95
ID*2178	IN2952-003	ME02-A-0049-H-010	972.3	970.6
ID*2179	IN2952-005	AS2952-027	963	959.72
ID*2180	IN2952-011	AS2952-023	972.85	959.88
ID*2181	IN2952-015	AS2952-026	975.2	965.97
ID*2182	IN2952-020	AS2952-025	975	964.65
ID*2183	IN2955-010	ME02-A-0048-A-033	1004.02	1003.5
ID*2184	IN2956-002	IN2956-023	1030.58	1029.9
ID*2185	IN2955-006	AS2956-019	1010.85	1005.68
ID*2186	IN2956-023	AS2956-011	1029.9	1029.69
ID*2187	IN2957-008	IN2957-009	1040.56	1040.2
ID*2189	IN2957-010	IN2958-024	1040.15	1038.73
ID*2190	IN2957-012	AS2957-005	1033.4	1031.86
ID*2191	IN2958-024	IN2958-025	1038.73	1038.62
ID*2192	IN2958-025	IN2958-026	1038.62	1038.01
ID*2193	IN2958-026	AS2958-014	1038.01	1037.43
ID*2194	IN2958-030	AS2958-010	1040.267	1039.85
ID*2195	IN3050-001	AS3050-002	980.81	979.1
ID*2196	IN3050-009	IN3150-003	928.85	928
ID*2197	IN3052-001	MI3052-008	917.34	917.34
ID*2198	IN3052-002	IN3052-001	923.38	917.34
ID*2199	IN3053-028	AS3053-001	944.1	941.373
ID*2200	IN3053-029	AS3053-003	942.102	934.1
ID*2201	IN3054-004	TRANS_JCT-146	972.85	969.98
ID*2202	IN3054-004	IN3054-005	972.85	972.53
ID*2203	IN3054-020	TRANS_JCT-148	966.6	957.94
ID*2204	ME02-A-0067-H-004	AS3055-010	1022.6	1020.96
ID*2205	IN3149-003	AS3149-004	913	911.99
ID*2206	IN3149-011	AS3150-027	970.58	964.8
ID*2207	IN3150-003	AS3150-048	928	921.28
ID*2208	IN3151-034	TP3151-036	897.53	895.68
ID*2209	IN3151-035	IN3151-034	897.61	897.53

Conduit ID	Upstream Node	Downstream Node	Upstream Elev.	Downstream Elev.
ID*2210	IN3151-038	IN3151-034	897.83	897.53
ID*2211	IN3151-040	IN3151-035	898.22	897.61
ID*2212	IN3151-041	IN3151-040	898.57	898.22
ID*2213	IN3151-043	AS3151-042	899.2	898.32
ID*2214	MI3252-039	AS3152-001	952.032	948.6
ID*2215	IN3152-019	TP3152-020	898.452	897.155
ID*2216	IN3153-015	IN3153-020	982.54	981.04
ID*2217	IN3153-017	IN3153-015	983.04	982.54
ID*2218	IN3153-020	AS3153-021	981.04	980.67
ID*2219	IN3154-003	IN3254-001	997.96	992.86
ID*2220	IN3154-005	AS3154-007	1002.231	1001.79
ID*2221	IN3154-008	IN3154-005	1002.397	1002.231
ID*2222	IN3246-028	AS3247-003	886.01	875.66
ID*2223	IN3246-031	SS3247-020	897.68	892.13
ID*2224	IN3246-033	AS3246-032	898.26	897.68
ID*2225	IN3246-033	IN3246-034	898.26	897.44
ID*2226	IN3246-041	IN3246-048	899.2	898.68
ID*2227	IN3246-048	AS3246-035	898.68	898.54
ID*2228	IN3247-023	AS3247-004	897.84	890.67
ID*2229	IN3247-025	CB3247-024	888.98	886.33
ID*2230	IN3250-001	AS3150-008	906.2	904.3
ID*2231	IN3250-027	AS3250-021	897.04	894.27
ID*2232	IN3250-032	TP3250-033	889.6	885.5
ID*2233	IN3251-011	IN3251-013	930.87	929.39
ID*2234	IN3251-013	IN3251-014	929.39	907.1
ID*2235	IN3251-014	IN3251-018	907.1	905.1
ID*2236	IN3251-015	IN3251-014	908.78	907.1
ID*2237	IN3251-018	IN3251-020	905.1	902.32
ID*2238	IN3251-020	AS3251-024	902.32	900.73
ID*2239	IN3252-006	TRANS_JCT-179	942.8	937.89
ID*2240	IN3252-011	IN3252-014	956.58	954.39
ID*2241	IN3252-014	IN3252-015	954.39	950.37
ID*2242	IN3252-015	IN3252-006	950.37	942.8
ID*2243	IN3252-028	IN3252-029	963.4	960.5
ID*2244	IN3252-029	IN3252-030	960.5	955.56
ID*2245	IN3252-030	MI3252-039	955.56	952.032
ID*2246	IN3254-001	IN3254-002	992.86	989.04
ID*2247	IN3254-002	IN3254-003	989.04	971.68
ID*2248	IN3254-003	AS3354-003	971.68	968.82
ID*2249	IN3255-003	AS3256-010	1035.57	1035.45
ID*2250	IN3347-022	MI3347-026	852.298	850.666
ID*2251	IN3347-035	AS3348-002	865.29	864.94
ID*2252	IN3348-052	AS3348-050	884.146	874.12
ID*2253	IN3348-055	IN3348-052	885.04	884.146
ID*2254	IN3348-064	SS3348-070	856.382	856.26
ID*2255	AS3348-006	IN3348-109	855.2	854.55
ID*2256	IN3349-051	AS3349-050	885.32	885
ID*2257	IN3349-062	AS3349-057	879.44	872.85
ID*2258	IN3349-064	IN3349-062	886	879.44
ID*2259	IN3349-065	IN3349-064	891.61	886
ID*2260	IN3349-066	IN3349-064	886.15	886
ID*2261	IN3349-067	IN3349-066	886.37	886.15
ID*2262	IN3349-068	IN3349-067	887.5	886.37
ID*2263	AS3350-015	IN3350-016	895.35	895.242
ID*2264	IN3350-018	AS3350-014	914.35	896.353
ID*2265	IN3350-021	IN3350-018	930.582	914.35
ID*2266	IN3350-029	TP3350-033	914.92	913.754
ID*2267	IN3350-030	IN3350-029	916.52	914.92
ID*2268	IN3350-046	IN3349-065	892.58	891.61
ID*2269	IN3350-047	IN3350-046	892.88	892.58
ID*2270	IN3352-002	IN3352-003	971.92	969.8
ID*2271	IN3352-003	IN3352-005	969.8	964.755
ID*2272	IN3352-034	AS3352-028	968.19	968.19
ID*2273	IN3353-054	TE3353-056	970.17	967.608
ID*2274	IN3356-025	IN3356-026	985.97	985.7
ID*2275	IN3356-026	IN3356-027	985.7	985.529
ID*2276	IN3356-027	AS3356-028	985.529	985.3
ID*2277	IN3356-030	AS3356-031	982.76	982.39
ID*2278	IN3356-044	AS3356-043	992.6	986.89
ID*2279	IN3357-012	AS3357-008	999.35	998.9
ID*2280	IN3358-003	IN3358-002	1010.06	1008.58
ID*2281	IN3358-004	IN3358-003	1013.38	1010.06
ID*2282	IN3358-002	AS3458-023	1008.58	999.4
ID*2283	IN3447-019	AS3447-008	850.49	850.137
ID*2284	IN3447-016	IN3447-017	881.15	879.8
ID*2285	IN3447-017	LKMED-006	879.8	845
ID*2286	IN3447-018	IN3447-019	850.926	850.49
ID*2287	IN3447-021	LKMED-005	879.136	850.95
ID*2288	IN3450-011	AS3450-016	915.06	910.87
ID*2289	IN3450-038	AS3450-004	900	894.12
ID*2290	IN3450-054	AS3450-002	896.9	890.08
ID*2291	IN3453-001	AS3353-018	965.81	965.6
ID*2292	IN3453-002	IN3453-001	966.5	965.81
ID*2293	IN3453-003	IN3453-002	967.45	966.5
ID*2294	IN3457-010	AS3457-008	992.85	988.1
ID*2295	AS3457-018	IN3457-013	989.18	989.1
ID*2296	IN3457-014	IN3457-013	989.56	989.1
ID*2297	IN3457-020	AS3457-018	989.56	989.18
ID*2298	IN3547-001	IN3447-016	881.41	881.15
ID*2299	IN3547-002	IN3547-001	881.93	881.41
JCT2_1750_WATTS_ROAD	JCT_1_7050_WATTS_RD	ME02-A-0273-H-004	1085.36	1084.6
KETTLE_POND_P-5	KETTLE_POND_S6_	ME03-U-0037-Q-001	906	904.5
KETTLE_POND_P-6_	KETTLE_POND_S7	KETTLE_POND_S6_	910.3	909.7
KETTLE_POND_P1	KETTLE_POND_S-2_	KETTLE_POND_S-1_	918.47	918
KETTLE_POND_S-1_S7	KETTLE_POND_S-1_	KETTLE_POND_S7	918	910.3
ID*2305	MI3350-001-002	MI3350-001-000	882.025	873.1
MASTHEAD_PM0	MASTHEAD_MH1	TRANS_JCT-143	987.21	982.74
MASTHEAD_PM1	MASTHEAD_MH2	MASTHEAD_MH1	988.04	987.21
MASTHEAD_PM2	MASTHEAD_MH3	MASTHEAD_MH2	988.35	988.04
MASTHEAD_PM3	MASTHEAD_MH4	MASTHEAD_MH3	990.28	990.1
MASTHEAD_PM5	MASTHEAD_MH5	MASTHEAD_MH3	989.53	988.35
ID*2318	ME02-A-0053-A-007	TRANS_JCT-126	1036.9	1031.393
MEM_HS_SOUTH_CDT	ME02-A-0050-H-005	IN2755-019	1032	1030
MHS_AS2755-007	MHS_ENDWALL	AS2755-007	1032.483	1032.25
MHS_CB1_MHS_CB2	MHS_CB1	MHS_CB2	1042.64	1041.05
MHS_CB2_MHS_CB3	MHS_CB2	MHS-CB3	1041.05	1037.051
MHS_CB3_MHS_CB4	MHS-CB3	MHS_CB4	1037.051	1035.84
MHS_CB4_MHS_CB6	MHS_CB4	MHS-CB6	1035.84	1032.53
MHS_CB6_AS2755-007	MHS-CB6	AS2755-007	1032.53	1032.25
ID*2328	MI3052-008	TRANS_JCT-156	917.34	914
ID*2329	MI3151-030	TRANS_JCT-164	894.3	893.606
ID*2330	MI3151-032	TRANS_JCT-160	894.76	892.66
ID*2331	MI3248-016	AS3348-035	868.394	867.31
ID*2332	MI3347-026	TP3347-015	850.666	844.6
ID*2333	MI3350-001-000	TP3349-055	873.1	870.518
ID*2334	MI3350-001-002	MI3350-007	882.025	881.6
ID*2335	IN3353-054	MI3353-062	970.17	970
ID*2336	MI3355-003	MI3355-022	973.732	969.6
ID*2337	GARNER_RET_POND	MI3355-022	970.77	969.6
ID*2338	MI3449-033	AS3449-032	897.679	897.62
NAUTILUS_P2	S-4-PB11399B	TRANS_JCT-141	997.1	996.8
NAUTILUS_P3	ME02-A-0048-A-033	S-4-PB11399	998.5	998.5
NAUTILUS_P5	S-9_PN11399	ME02-A-0048-A-033	1000	996.75
ID*2345	ND3151-023	TP3151-011	894.372	894.32

Conduit ID	Upstream Node	Downstream Node	Upstream Elev.	Downstream Elev.
ID*2347	TP3151-036	ND3151-023	895.68	894.372
N_BROOOKLY_DR	PVT_N_BROOKLYN_DR	AS2460-003	1126.91	1114.64
ID*2349	IN2952-004	IN2952-005	966.5	963
OWEN_RT_PD_CDT_734	OWEN_RT_POND_JCT_746	ME02-A-0049-H-000	958	957.5
OWEN_RT_POND_CDT_710	53W1183-001	ME02-A-0043-A-078	938	937.78
OWEN_RT_POND_CDT_712	OWEN_RT_POND_JCT_737	ME02-A-0049-H-004	953	953
OWEN_RT_POND_CDT_713	ME02-A-0049-H-004	OWEN_RT_POND_JCT_744	953	950
OWEN_RT_POND_CDT_718	ME02-A-0049-H-008	OWEN_RT_POND_JCT_740	956.4	956.4
OWEN_RT_POND_CDT_720	OWEN_RT_POND_JCT_740	OWEN_RT_POND_JCT_741	956.4	955.5
OWEN_RT_POND_CDT_722	OWEN_RT_POND_JCT_748	53W1183-001	940.52	938
OWEN_RT_POND_CDT_727	OWEN_RT_POND_JCT_749	OWEN_RT_POND_JCT_748	955	940.52
OWEN_RT_POND_CDT_728	OWEN_RT_POND_JCT_741	OWEN_RT_POND_JCT_744	955.5	953.67
OWEN_RT_POND_CDT_729	ME02-A-0049-H-004	OWEN_RT_POND_JCT_742	959	958.3
OWEN_RT_POND_CDT_730	OWEN_RT_POND_JCT_744	OWEN_RT_POND_JCT_748	950	940.52
OWEN_RT_POND_CDT_731	ME02-A-0049-H-000	OWEN_RT_POND_JCT_749	958	955
OWEN_RT_POND_CDT_734	OWEN_RT_POND_JCT_742	OWEN_RT_POND_JCT_746	958.3	958
OWEN_RT_POND_CDT_735	ME02-A-0049-H-005	OWEN_RT_POND_JCT_737	956	953
ID*2370	ME02-A-0046-H-000	AS3354-003	969.3	968.82
ID*2371	ME02-A-0047-H-011	AS3356-032	981.93	981.26
ID*2372	PL2753-005	AS2753-004	1038.3	1036.9
ID*2373	ME02-A-0048-A-032	AS2854-010	1024	1020.2
ID*2374	PL3246-039	AS3246-036	904.005	903.73
ID*2375	ME02-A-0057-H-026	AE2459-004_000	1087.7	1087.1
ID*2376	ME02-A-0273-H-000	JCT-142	1082.15	1054
RR_CULVERT-02	ME02-A-0042-A-016	RR_STORAGE-02	916	912
RR_UNDERPASS_CDT	RR_UNDERPASS_JCT-US	RR_UNDERPASS_JCT-DS	888	887.5
ID*2384	SS3247-020	IN3246-028	892.13	886.01
ID*2385	SS3348-070	IN3348-109	856.26	854.55
ID*2386	SS3348-073	SS3348-070	857.06	856.26
ID*2387	AS3349-056	ME02-A-0044-A-009	872.06	869
ID*2388	ST3053-018	AS3053-002	945.298	943.055
ID*2389	TE2958-023	AS2958-008	1048	1040.6
ID*2390	TE3353-056	AS3353-018	967.608	965.6
ID*2391	TP2557-006	JCT-258	1042.46	1035.943
ID*2392	TP3150-014-000	AS3250-013-001	889.2	888.6
ID*2393	TP3150-014-001	TP3150-014-002	891.17	889.8
ID*2394	TP3150-014-002	TP3150-014-003	889.8	889.5
ID*2395	TP3150-014-003	TP3150-014-000	889.5	889.2
ID*2396	TP3151-011	GR3151-018	894.32	894.27
ID*2397	TP3151-036	GR3151-018	895.68	894.17
ID*2398	TP3250-030	TP3250-033	885.6	885.5
ID*2399	TP3250-033	AS3250-034	885.5	884
ID*2400	TP3346-009	AS3346-011	853.485	853.14
ID*2401	TP3347-015	TP3347-016	844.6	844.6
TP3347-016_LKMED-003	TP3347-016	LKMED-003	844.6	844.6
ID*2403	TP3348-017	AS3348-018	855.1	852.1
ID*2404	TP3348-026	TP3348-027	857.3	856.6
ID*2405	TP3348-027	AS3348-045	856.6	855.6
ID*2406	TP3349-003	TP3349-004	864.771	861.061
ID*2407	TP3349-004	AS3348-028	861.061	857.35
ID*2408	TP3349-055	AS3349-005	870.518	865.9
ID*2409	TP3350-033	AS3350-022	913.754	897.6
ID*2495	WEST_TOWN_MALL_EX106	ID*1515	1049.3	1048.14
ID*2496	ME02-A-0050-H-006	WT_FORBAY_COLLAR	1029.6	1029.04
YELLOWSTONE_PY10	YELLOWSTONE_11	TRANS_JCT-181	1012.26	1006.057
YELLOWSTONE_PY11	YELLOWSTONE_12	YELLOWSTONE_11	1015.82	1012.26
YELLOWSTONE_PY12	YELLOWSTONE_13	YELLOWSTONE_12	1024.81	1015.82
YELLOWSTONE_PY2	YELLOWSTONE_YS3	YELLOWSTONE_YS2	1013.24	1012.91
YELLOWSTONE_PY3	YELLOWSTONE_YS4	YELLOWSTONE_YS3	1016.36	1013.24
YELLOWSTONE_PY4	YELLOWSTONE_YS5	YELLOWSTONE_YS4	1031.18	1017.11
YELLOWSTONE_PY5	YELLOWSTONE_YS6	YELLOWSTONE_YS5	1046.76	1031.18
YELLOWSTONE_PY6	YELLOWSTONE_YS7	YELLOWSTONE_YS6	1058.95	1047.01
YELLOWSTONE_PY7	YELLOWSTONE_YS8	YELLOWSTONE_YS7	1061.31	1058.95
_AE2458-003	ME02-A-0272-H-004	AE2458-003_001	1076.579	1076
ID*C{1572.1}	TP2854-027	ME02-A-0048-A-026	1017.6	1017.3
CDT-27	TP2854-027	ME02-A-0048-A-026	1017.6	1017.3
ID*C{1573.1}	BM03-A-0339-H-006	IN2859-001	1028.1	1025.369
ID*C{1577.1}	AE3052-010	TRANS_JCT-156	914.59	914.19
ID*C{2052.1}	BM03-A-0315-H-001	BM03-A-0315-H-000	1026.77	1019.744
ID*C{2095.1}	ME02-A-0048-A-009	HD2953-008	1013.19	1012.36
ID*C{2095.2}	ME02-A-0048-A-009	HD2953-008	1013.16	1012.4
ID*C{2096.1}	ME02-A-0048-A-013	HD3053-021_2	945.49	943.97
ID*C{2096.2}	ME02-A-0048-A-013	HD3053-021_2	945.28	943.97
ID*C{2147.1}	IN2755-018	IN2756-061	1029.75	1029.5
ID*C{2147.2}	IN2755-018	IN2756-061	1029.75	1029.5
ID*C{2148.1}	IN2755-019	IN2755-018	1030	1029.75
ID*C{2148.2}	IN2755-019	IN2755-018	1030	1029.75
ID*C{2150.1}	IN2756-061	IN2756-060	1029.5	1029.25
ID*C{2150.2}	IN2756-061	IN2756-060	1029.5	1029.25
ID*C{2188.1}	IN2957-009	IN2957-010	1040.2	1040.15
ID*C{2188.2}	IN2957-009	IN2957-010	1040.2	1040.15
ID*C{2339.1}	ME02-A-0045-A-019	MSH_GRNW_S_HILL_763	960.06	957.84
ID*C{2339.2}	ME02-A-0045-A-019	MSH_GRNW_S_HILL_763	960.06	959.09
NAUTILUS_P4	ME02-A-0048-A-033	ME02-A-0048-A-034	998.5	997.5
NAUTILUS_PIPE1	ME02-A-0048-A-034	NAUTILUS_S1	996	995.7
ID*C{2346.1}	ND3151-023	GR3151-018	894.372	894.22
ID*C{2346.2}	ND3151-023	GR3151-018	894.372	894.25
OWEN_RT_POND_CDT_714	ME02-A-0049-H-005	ME02-A-0049-H-004	963	962.6
garn-vnotch	GARNER_RET_POND	ME02-A-0046-H-000	970.77	969.3
uw-res-vnotch	UW_RSCH_PARK_E_POND3	ME02-A-0047-H-011	981.93	981.93
vnotch_Naut	S-4-PB11399	S-4-PB11399B	998.5	997.1

Appendix D – Existing Flooding Depth and Duration at 25 Locations

University Avenue Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	0.12	26.8
10% ACE	0.54	29.2
4% ACE	0.88	29.3
2% ACE	0.94	29.4
1% ACE	1.10	29.7
0.2% ACE	1.66	30.0
Back_to_Back_100	1.66	53.7

Gettle Avenue Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	0.44	28.3
10% ACE	0.96	29.6
4% ACE	1.58	30.1
2% ACE	3.18	44.8
1% ACE	4.31	45.1
0.2% ACE	6.33	45.8
Back_to_Back_100	4.73	69.7

Greenway Upstream Park Way		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	3.78	44.8
10% ACE	5.83	45.3
4% ACE	6.08	45.6
2% ACE	6.38	45.7
1% ACE	6.77	45.8
0.2% ACE	7.40	46.2
Back_to_Back_100	6.88	70.0

Bordner Park Downstream		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	3.27	46.3
10% ACE	6.40	47.0
4% ACE	7.52	47.3
2% ACE	9.54	47.6
1% ACE	10.15	47.7
0.2% ACE	12.40	47.7
Back_to_Back_100	10.60	71.8

Bordner Park Upstream		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	2.20	46.5
10% ACE	3.15	46.7
4% ACE	5.03	46.8
2% ACE	7.31	46.9
1% ACE	8.04	47.0
0.2% ACE	9.70	47.2
Back_to_Back_100	8.17	71.2

DS Concrete Channel		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	4.27	39.1
10% ACE	5.31	40.8
4% ACE	6.06	41.4
2% ACE	7.97	41.9
1% ACE	9.34	42.3
0.2% ACE	11.08	43.2
Back_to_Back_100	9.66	43.2

Upstream Regent Street		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	5.74	45.1
10% ACE	8.39	45.8
4% ACE	9.40	46.0
2% ACE	9.79	46.1
1% ACE	10.18	46.4
0.2% ACE	10.76	46.7
Back_to_Back_100	10.22	70.7

Burnett Drive		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	1.60	30.1
10% ACE	3.12	30.2
4% ACE	4.08	31.4
2% ACE	4.48	30.4
1% ACE	4.89	31.6
0.2% ACE	5.52	31.8
Back_to_Back_100	4.93	54.7

Garner Pond		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	4.29	44.3
10% ACE	4.64	44.9
4% ACE	4.75	45.3
2% ACE	4.75	45.4
1% ACE	4.98	45.7
0.2% ACE	5.27	46.0
Back_to_Back_100	5.01	69.8

Mineral Point Road East Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	0.25	26.3
10% ACE	0.56	25.9
4% ACE	1.02	26.2
2% ACE	1.30	26.6
1% ACE	1.52	26.6
0.2% ACE	1.85	26.6
Back_to_Back_100	1.52	50.8

Greenway Upstream of Inner Dr.		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	4.44	47.5
10% ACE	6.55	47.6
4% ACE	7.21	47.6
2% ACE	7.46	47.7
1% ACE	7.71	47.7
0.2% ACE	8.12	47.7
Back_to_Back_100	7.78	71.8

Greenway Upstream of Nautilus Dr.		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	4.20	47.5
10% ACE	6.99	47.6
4% ACE	7.78	47.6
2% ACE	8.15	47.7
1% ACE	8.52	47.7
0.2% ACE	9.10	47.7
Back_to_Back_100	8.63	71.8

Greenway Upstream of Masthead Dr		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	5.58	47.4
10% ACE	8.01	47.5
4% ACE	8.31	47.6
2% ACE	8.51	47.6
1% ACE	8.72	47.6
0.2% ACE	9.19	47.7

Nautilus Pond		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	4.35	47.8
10% ACE	4.86	47.8
4% ACE	4.96	47.8
2% ACE	5.02	47.8
1% ACE	5.09	47.8
0.2% ACE	5.30	47.8
Back_to_Back_100	5.11	72.0

Mineral Point Road West Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	0.49	35.0
10% ACE	1.05	35.5
4% ACE	1.19	36.2
2% ACE	1.26	34.7
1% ACE	1.33	34.9
0.2% ACE	1.51	36.2
Back_to_Back_100	1.38	59.8

Greenway Upstream of Jetty Drive		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	3.43	23.3
10% ACE	4.75	25.1
4% ACE	4.98	25.5
2% ACE	5.15	25.6
1% ACE	5.36	26.4
0.2% ACE	5.77	27.3
Back_to_Back_100	5.36	50.6

Greenway Upstream of Quarterdeck		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	7.76	47.5
10% ACE	7.98	47.6
4% ACE	8.08	47.6
2% ACE	8.15	47.6
1% ACE	8.23	47.7
0.2% ACE	8.76	47.7
Back_to_Back_100	8.31	47.7

Greenway Upstream of Yellowstone		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	6.07	47.6
10% ACE	7.16	47.6
4% ACE	7.74	47.7
2% ACE	8.58	47.7
1% ACE	9.31	47.7
0.2% ACE	10.00	47.7
Back_to_Back_100	9.42	71.8

Intersection of Tree and Gammon		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	0.73	31.3
10% ACE	1.43	32.4
4% ACE	1.68	32.6
2% ACE	2.07	33.4
1% ACE	1.98	33.5
0.2% ACE	2.33	33.8
Back_to_Back_100	2.14	33.8

Mineral Pt Rd North of West Towne Ponds		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	0.31	27.8
10% ACE	0.91	27.8
4% ACE	1.30	28.1
2% ACE	2.15	28.3
1% ACE	3.02	28.3
0.2% ACE	4.55	31.6
Back_to_Back_100	4.40	54.6

West Towne Pond - South		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	3.96	47.8
10% ACE	5.94	47.8
4% ACE	7.30	47.8
2% ACE	8.15	47.8
1% ACE	9.02	47.8
0.2% ACE	10.55	47.8
Back_to_Back_100	10.41	72.0

Odana Drive Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	1.96	47.6
10% ACE	3.36	47.7
4% ACE	4.91	47.7
2% ACE	5.89	47.7
1% ACE	7.07	47.7
0.2% ACE	8.54	47.7
Back_to_Back_100	8.40	71.8

Gammon Road Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	1.08	29.3
10% ACE	1.37	29.7
4% ACE	1.56	30.4
2% ACE	1.59	31.2
1% ACE	1.63	31.5
0.2% ACE	1.81	31.4
Back_to_Back_100	1.60	54.8

West Towne Pond - Upper (South of Beltline)		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	8.41	47.6
10% ACE	8.95	47.7
4% ACE	9.84	47.7
2% ACE	10.07	47.7
1% ACE	10.26	47.7
0.2% ACE	10.63	47.7
Back_to_Back_100	10.29	71.8

Watts Road Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	0.91	27.8
10% ACE	1.09	28.4
4% ACE	1.31	28.2
2% ACE	1.42	28.8
1% ACE	1.61	28.9
0.2% ACE	1.99	28.7
Back-to-Back	1.65	52.7

*ACE design storms with durations greater than 45 hours have not drained down at the end of the simulation (48-hour simulation). Back to back storms with durations greater than 65 hours have not drained down at the end of simulation (72 hours).

Appendix E – Inlet Capacity Analysis Documentation

Storm Structure ID	structure size (ftxft)	Equivalent Weir Length prior to adding Clogging	Slope (%)	Clog Factor	Notes	Adjusted weir length after Clogging (ft)	Assigned Weir
IN 3353-002	2x3	7	1.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-012
IN 2577-028-041	2x3	7	1.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-005
IN 2359-011	4x4	12	1.0	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0271-H-001
IN 2760-017	2x3	7	1.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-014
IN 2759-013	2x3	7	1.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-006
IN 2656-001	2x3	7	1.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0050-H-010
IN 2655-024	2x3	7	1.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-009
IN 2958-024	3x3	9	1.1	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0066-H-002
IN 2577-029-001	3x3	9	1.1	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0057-H-008
IN 2659-009	5x7 *updated from ortho	7	1.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-008
IN 2555-023	2x3	7	1.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-004
IN 3247-032	2x3	7	1.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-003
IN 2758-015	2x3	7	1.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-022
IN 3450-051	2x3	7	1.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-002
IN 3153-022	2x3	7	1.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-051
IN 3450-043	2x3	7	1.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-002
IN 2577-029-003	3x3	9	1.3	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-073
IN 3151-013	5x7 *updated from ortho	7	1.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-073
IN 3050-001	2x3	7	1.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-064
IN 2577-028-029	2x3	7	1.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-052
IN 3348-072	2x3	7	1.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 2760-016	2x3	7	1.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-014
IN 2759-003	2x3	7	1.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-010
IN 2760-021	2x3	7	1.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-015
IN 2756-064	2x6	10	1.5	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0054-H-014
IN 3353-017	2x3	7	1.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-022
IN 3353-060	2x3	7	1.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-023
IN 2655-007	2x3	7	1.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-011
IN 3251-047	2x3	7	1.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-043
IN 2359-033	2x3	7	1.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-002
IN 2752-012	2x6	10	1.5	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0053-A-005
IN 3352-040	2x3	7	1.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-029
IN 2757-055	3x3	9	1.6	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0057-H-001
IN 3054-001	2x3	7	1.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-018
IN 2760-006	2x3	7	1.6	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-003
IN 3250-031	3x3	9	1.6	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-052
IN 3151-058	2x3	7	1.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-041
IN 2852-002	2x3	7	1.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-000
IN 2756-055	2x3	7	1.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-010
IN 3352-016	2x3	7	1.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-031
IN 2852-023	2x3	7	1.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-008
IN 3353-038	2x3	7	1.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-008
IN 2756-047	2x3	7	1.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0050-H-010
IN 2754-015	2x3	7	1.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-004
IN 3348-087	2x3	7	1.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 2459-014	3x3	9	1.7	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0271-H-001
IN 2361-018	2x3	7	1.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-012
IN 2854-040	2x3	7	1.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-030
IN 2760-019	2x3	7	1.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-015
IN 3348-077	2x3	7	1.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 3250-015	2x3	7	1.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-036
IN 3246-046	2x3	7	1.8	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-008
IN 2654-003	2x3	7	1.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-009
IN 2577-028-010	2x3	7	1.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-001
IN 3355-008	2x3	7	1.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-001
IN 3346-004	2x3	7	1.9	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-010
IN 3251-026	2x3	7	1.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-034
IN 3149-008	2x3	7	1.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-056
IN 2756-035	2x3	7	1.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0050-H-010
IN 3246-047	2x3	7	1.9	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-008
IN 3353-010	2x3	7	1.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-021
IN 3151-057	2x3	7	1.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-041
IN 3251-048	2x3	7	1.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-042
IN 3450-037	3x3	9	2.0	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0044-A-005
IN 2577-028-024	2x3	7	2.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-005
IN 2577-029-002	3x3	9	2.0	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-073
IN 3151-012	5x7 *updated from ortho	7	2.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-073
IN 2656-028	2x3	7	2.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-013
IN 2655-017	2x3	7	2.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-005
IN 3355-006	2x3	7	2.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-000
IN 3352-012	2x3	7	2.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-005
IN 2753-001	3x3	9	2.0	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0053-A-009
IN 3350-046	3x3	9	2.0	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0044-A-012
IN 2758-010	2x3	7	2.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-005
IN 3250-039	2x3	7	2.0	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0043-A-006
IN 3348-075	2x3	7	2.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 2952-001	2x3	7	2.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0049-H-011
IN 2958-025	3x3	9	2.0	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0066-H-002
IN 2756-058	2x3	7	2.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-014
IN 3348-109	2x3	7	2.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 3453-002	2x3	7	2.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-024
IN 3350-010	2x3	7	2.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-094
IN 3056-001	2x3	7	2.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-001
IN 3150-030	2x3	7	2.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-088
IN 3054-006	2x3	7	2.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-015
IN 2854-021	2x3	7	2.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-038
IN 3150-006	2x3	7	2.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-056
IN 2577-028-022	2x3	7	2.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-002
IN 2957-010	3x3	9	2.1	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0066-H-005
IN 3354-020	2x3	7	2.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-006
IN 2856-018	2x3	7	2.1	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0052-H-000
IN 2760-012	2x3	7	2.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-014
IN 2577-028-044	2x3	7	2.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-004
IN 3449-021	2x3	7	2.2	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0044-A-018
IN 3250-024	2x3	7	2.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-039
IN 3346-016	2x3	7	2.2	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-010
IN 2660-021	2x3	7	2.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-021
IN 2851-004	2x3	7	2.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-005
IN 3347-033	2x3	7	2.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-030
IN 3250-008	2x3	7	2.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-055
IN 3151-038	2x3	7	2.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-073
IN 3447-014	2x3	7	2.2	1.0	Greater than 1%	7.0	1-CTY-ME03-U-0295-A-000
IN 3154-003	3X3	9	2.2	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0046-H-004
IN 3346-014	2x3	7	2.2	1.0	Greater than 1%	7.0	Not modeled
IN 3352-029	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-025
IN 2954-003	2x3	7	2.3	1.0	Greater than 1%	7.0	not modeled
IN 2556-010	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-003
IN 2855-003	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0052-H-001
IN 2359-031	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-002
IN 2577-028-023	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-002
IN 3248-002	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-012
IN 3353-024	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-013
IN 3049-001	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-064
IN 3348-067	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-000
IN 3252-016	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-007
IN 3348-092	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-007
IN 3251-018	4x4	12	2.3	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0043-A-034
IN 2753-013	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-002
IN 2654-014	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-004
IN 3251-015	2x3	7	2.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-035
IN 3349-066	4x4	12	2.4	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0044-A-017
IN 2858-013	2x3	7	2.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-002
IN 3253-004	2x3	7	2.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-010
IN 3252-011	4x4	12	2.4	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0045-A-003

*City inlets from GIS database (source "stm_structures_updated_DANE.shp)
*Stucture size from CITY GIS data
*Equivalent wier leng prior to clogging assuming three sides of the inlet
*Slope calculated from DEM

Storm Structure ID	structure size (ftxft)	Equivalent Weir Length prior to adding Clogging	Slope (%)	Clog Factor	Notes	Adjusted weir length after Clogging (ft)	Assigned Weir
IN 2858-042	2x6	10	2.4	1.0	Greater than 1%	10.0	1-CTY-BM03-A-0339-H-009
IN 3250-038	2x3	7	2.4	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0043-A-006
IN 2858-033	4x4	12	2.4	1.0	Greater than 1%	12.0	1-CTY-BM03-A-0339-H-009
IN 3250-044	2x3	7	2.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-010
IN 3246-034	4x4	12	2.4	1.0	Greater than 1%	12.0	1-CTY-ME03-C-0041-A-007
IN 3450-012	2x3	7	2.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-006
IN 3450-024	2x3	7	2.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-013
IN 3352-052	2x3	7	2.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-032
IN 2754-013	2x3	7	2.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-004
IN 3353-025	2x3	7	2.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-013
IN 3450-013	2x3	7	2.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-006
IN 3352-045	2x3	7	2.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-030
IN 3250-041	2x3	7	2.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-092
IN 2857-016	2x3	7	2.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-000
IN 3247-023	4x4	12	2.5	1.0	Greater than 1%	12.0	1-CTY-ME03-C-0041-A-004
IN 3151-045	2x3	7	2.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-073
Yellowstone6 2x3	2x3	7	2.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-019
IN 2857-011	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0050-H-002
IN 2659-002	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-010
IN 3348-086	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 3348-031	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-047
IN 3152-017	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-044
IN 3450-054	4x4	12	2.6	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0044-A-016
IN 3349-067	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-017
IN 3349-068	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-007
IN 3153-029	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-100
IN 2752-003	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0053-A-000
IN 2760-020	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-015
IN 3250-004	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-053
IN 3150-040	2x3	7	2.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-068
IN 2853-013	2x3	7	2.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-007
IN 3353-061	2x3	7	2.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-023
IN 2557-002	3x3	9	2.7	1.0	Greater than 1%	9.0	2-CTY-ME02-A-0057-H-000
IN 2660-023	2x3	7	2.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-021
IN 3354-021	2x3	7	2.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-006
IN 3153-006	2x6	10	2.7	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0043-A-051
IN 3156-004	2x3	7	2.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-007
IN 3349-065	4x4	12	2.7	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0044-A-012
IN 2756-062	2x3	7	2.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0052-H-001
IN 3348-039	2x3	7	2.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-009
IN 3348-082	2x3	7	2.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 3251-010	2x3	7	2.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-040
IN 3348-099	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-047
IN 3150-007	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-087
IN 3355-011	2x6	10	2.8	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0047-H-010
IN 2756-042	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-013
IN 2359-012	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-001
IN 2759-012	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-006
IN 3450-056	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-008
IN 3246-033	4x4	12	2.8	1.0	Greater than 1%	12.0	1-CTY-ME03-C-0041-A-005
IN 2754-009	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-004
IN 3248-006	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-012
IN 3348-090	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-007
IN 3348-093	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-007
IN 3350-017	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-096
IN 2656-022	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-007
IN 3450-026	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-019
IN 2856-020	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0052-H-000
IN 3355-004	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-000
IN 3350-013	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-094
IN 3150-031	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-084
IN 2577-028-039	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-025
IN 3251-045	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-033
IN 2760-013	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-015
IN 2577-028-015	2x3	7	2.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-021
IN 3250-042	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-092
IN 3447-021	3x3	9	2.9	1.0	Greater than 1%	9.0	1-CTY-ME03-U-0295-A-002
IN 3056-004	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-002
IN 2557-009	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-000
IN 3054-009	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-029
IN 3247-011	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-005
IN 2959-006	2x3	7	2.9	1.0	Greater than 1%	7.0	not modeled
IN 2857-012	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0050-H-002
IN 3350-047	3x3	9	2.9	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0044-A-020
IN 2577-028-020	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-008
IN 2577-028-019	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-003
IN 3156-001	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-007
IN 3353-053	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-025
IN 2856-023	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0052-H-000
IN 3447-018	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-ME03-U-0295-A-003
IN 2858-037	2x3	7	2.9	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-010
IN 3250-035	2x6	10	2.9	1.0	Greater than 1%	10.0	2-CTY-ME02-A-0043-A-006
IN 3149-003	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-060
IN 3348-106	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-019
IN 2654-001	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-009
IN 2957-012	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0068-H-004
IN 3152-012	5x5 *updated from ortho	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-048
IN 2657-002	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-024
IN 2756-037	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0050-H-010
IN 3056-010	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-005
IN 2758-016	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-022
IN 3250-047	5.58x4.56	14.7	3.0	1.0	Greater than 1%	14.7	1-CTY-ME02-A-0043-A-052
IN 3055-008	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-003
IN 2760-022	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-015
IN 3056-006	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-003
IN 2760-014	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-015
IN 3450-027	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-019
IN 2577-028-001	2x3	7	3.0	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0057-H-000
IN 2456-023	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-000
IN 3252-002	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-004
IN 3349-053	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-014
IN 3348-083	2x3	7	3.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 2755-016	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-014
IN 3153-026	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-050
IN 2853-017	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-006
IN 3353-036	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-008
IN 3352-015	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-031
IN 2860-039	3x3	9	3.1	1.0	Greater than 1%	9.0	1-CTY-BM03-A-0339-H-004
IN 2860-018	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0340-H-001
IN 2854-024	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-040
IN 3352-011	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-005
IN 3151-053	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-042
Orthophoto4 2x3	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-006
IN 3349-013	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-091
IN 3348-069	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-000
IN 3450-035	2x6	10	3.1	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0044-A-005
IN 3252-022	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-006
IN 3356-040	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-008
IN 2556-009	2x3	7	3.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-002
IN 3252-024	2x3	7	3.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-006
IN 3248-014	2x3	7	3.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-011
IN 2459-026	2x3	7	3.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-002
IN 2858-030	2x3	7	3.2	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-009
IN 3152-019	2x3	7	3.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-076

*City inlets from GIS database (source "stm_structures_updated_DANE.shp)
*Stucture size from CITY GIS data
*Equivalent wier leng prior to clogging assuming three sides of the inlet
*Slope calculated from DEM

Storm Stru	structure s	Equivalent Weir Length	Slope (%)	Clog Facto	Notes	Adjusted weir length	Assigned Weir
IN 3348-04	2x6	10	3.2	1.0	Greater th	10.0	1-CTY-ME02-A-0042-A-009
IN 3348-05	3x3	9	3.2	1.0	Greater th	9.0	1-CTY-ME02-A-0043-A-025
IN 3353-05	3x3	9	3.2	1.0	Greater th	9.0	1-CTY-ME02-A-0045-A-025
IN 3153-02	3x3	9	3.2	1.0	Greater th	9.0	1-CTY-ME02-A-0043-A-051
IN 3246-04	2x3	7	3.2	1.0	Greater th	7.0	1-CTY-ME03-C-0041-A-008
IN 2555-01	2x3	7	3.2	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-002
IN 2656-02	2x3	7	3.2	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-010
IN 3353-02	2x3	7	3.2	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-024
IN 3348-08	2x3	7	3.2	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-007
IN 2860-01	2x3	7	3.2	1.0	Greater th	7.0	1-CTY-BM03-A-0340-H-001
IN 3348-03	2x3	7	3.2	1.0	Greater th	7.0	1-CTY-ME02-A-0042-A-010
IN 3349-01	2x3	7	3.3	1.0	Greater th	7.0	1-CTY-ME02-A-0046-H-006
IN 3350-02	2x3	7	3.3	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-098
IN 3348-04	2x6	10	3.3	1.0	Greater th	10.0	1-CTY-ME02-A-0042-A-009
IN 3252-02	2x3	7	3.3	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-006
IN 3153-00	2x6	10	3.3	1.0	Greater th	10.0	1-CTY-ME02-A-0043-A-051
IN 2359-01	2x3	7	3.3	1.0	Greater th	7.0	1-CTY-ME02-A-0271-H-004
IN 3350-01	2x3	7	3.3	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-094
IN 3248-00	2x3	7	3.3	1.0	Greater th	7.0	1-CTY-ME02-A-0042-A-012
IN 2759-01	2x3	7	3.3	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-006
IN 2852-00	2x3	7	3.3	1.0	Greater th	7.0	1-CTY-ME02-A-0274-H-009
IN 2577-02	2x3	7	3.3	1.0	Greater th	7.0	1-CTY-ME02-A-0053-A-009
IN 3350-02	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-099
IN 2854-03	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0048-A-028
IN 3250-02	4x4	12	3.4	1.0	Greater th	12.0	1-CTY-ME02-A-0043-A-039
IN 3151-03	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-073
IN 2855-00	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0052-H-001
IN 3353-04	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-011
IN 2952-01	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0049-H-003
IN 3347-01	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-000
IN 3350-00	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-094
IN 2660-01	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-017
IN 3250-00	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-057
IN 2577-02	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0050-H-009
IN 2755-02	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0052-H-001
IN 2577-02	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME03-U-0295-A-000
IN 2958-00	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0066-H-007
IN 2853-01	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME02-A-0048-A-006
IN 3246-04	2x3	7	3.4	1.0	Greater th	7.0	1-CTY-ME03-C-0041-A-008
IN 3151-04	2x3	7	3.4	1.0	Greater th	7.0	2-CTY-ME02-A-0043-A-072
IN 3251-02	4x4	12	3.5	1.0	Greater th	12.0	1-CTY-ME02-A-0043-A-034
IN 3054-01	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0048-A-025
IN 2657-00	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-024
IN 2656-02	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-007
IN 3354-01	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0046-H-006
IN 3355-00	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0047-H-000
IN 3352-00	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-035
IN 2654-01	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0051-A-004
IN 3352-00	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-035
IN 2755-01	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-014
IN 3252-02	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-045
IN 3349-06	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0044-A-007
IN 3252-01	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-010
IN 3153-01	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-037
IN 2459-01	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0271-H-007
IN 3352-00	3x3	9	3.5	1.0	Greater th	9.0	1-CTY-ME02-A-0045-A-033
IN 3054-00	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0048-A-015
IN 3154-00	2x3	7	3.5	1.0	Greater th	7.0	1-CTY-ME02-A-0046-H-005
IN 3457-02	4x4	12	3.5	1.0	Greater th	12.0	1-CTY-ME02-A-0275-H-003
IN 3247-03	2x3	7	3.6	1.0	Greater th	7.0	1-CTY-ME02-A-0042-A-003
IN 3450-00	2x3	7	3.6	1.0	Greater th	7.0	1-CTY-ME02-A-0044-A-016
IN 3252-01	2x3	7	3.6	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-010
IN 3348-06	4x4	12	3.6	1.0	Greater th	12.0	1-CTY-ME02-A-0043-A-011
IN 3249-00	2x3	7	3.6	1.0	Greater th	7.0	1-CTY-ME02-A-0042-A-011
IN 2956-02	2x6	10	3.6	1.0	Greater th	10.0	1-CTY-ME02-A-0068-H-002
IN 3346-00	2x3	7	3.6	1.0	Greater th	7.0	1-CTY-ME03-C-0041-A-000
IN 3352-04	2x3	7	3.6	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-029
IN 3150-04	2x3	7	3.6	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-068
IN 2657-00	3x3	9	3.6	1.0	Greater th	9.0	1-CTY-ME02-A-0050-H-009
IN 2577-02	2x3	7	3.6	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-033
IN 3352-03	2x3	7	3.6	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-027
IN 3353-05	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-025
IN 3450-00	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0044-A-016
Orthophot	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-006
IN 2657-00	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-024
IN 3350-04	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0044-A-012
IN 2757-04	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0050-H-007
IN 2753-00	2x3	7	3.7	1.0	Greater th	7.0	2-CTY-ME02-A-0051-A-009
IN 3055-01	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0067-H-005
IN 2760-01	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-015
IN 2860-03	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-BM03-A-0339-H-001
IN 2958-03	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0066-H-006
IN 3449-02	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0044-A-018
IN 3151-04	2x3	7	3.7	1.0	Greater th	7.0	2-CTY-ME02-A-0043-A-072
IN 2660-01	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-014
IN 2854-00	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0048-A-028
IN 3356-04	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0047-H-008
IN 2752-00	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0053-A-003
IN 3348-01	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0042-A-008
IN 3449-03	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-014
IN 3354-03	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0046-H-007
IN 3148-00	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME03-U-0037-Q-000
IN 2758-01	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-022
IN 2660-03	3x3	9	3.7	1.0	Greater th	9.0	1-CTY-ME02-A-0057-H-021
IN 2555-01	3x3	9	3.7	1.0	Greater th	9.0	1-CTY-ME02-A-0054-H-001
IN 3348-09	7x7 *updat	14	3.7	1.0	Greater th	14.0	1-CTY-ME02-A-0043-A-007
IN 2660-00	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-015
IN 3247-00	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0042-A-005
IN 3151-03	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-073
IN 3251-01	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-040
IN 3355-01	2x3	7	3.7	1.0	Greater th	7.0	1-CTY-ME02-A-0046-H-008
IN 2557-00	3x3	9	3.7	1.0	Greater th	9.0	1-CTY-ME02-A-0057-H-000
IN 3348-05	3x3	9	3.7	1.0	Greater th	9.0	1-CTY-ME02-A-0043-A-024
IN 2957-00	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0068-H-004
IN 2755-02	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-012
IN 3349-02	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-003
IN 3247-03	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0042-A-003
IN 3450-00	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0044-A-016
IN 3053-02	2x6	10	3.8	1.0	Greater th	10.0	2-CTY-ME02-A-0048-A-005
IN 2860-03	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-BM03-A-0339-H-001
IN 3252-00	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-004
IN 3250-03	2x3	7	3.8	1.0	Greater th	7.0	2-CTY-ME02-A-0043-A-006
IN 3450-02	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0044-A-005
IN 3153-02	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-050
IN 2456-01	4x4	12	3.8	1.0	Greater th	12.0	1-CTY-ME02-A-0060-H-004
IN 3349-06	4x4	12	3.8	1.0	Greater th	12.0	1-CTY-ME02-A-0044-A-017
IN 2360-00	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0271-H-014
IN 2855-01	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0052-H-001
IN 2852-00	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0274-H-000
IN 3151-05	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-042
IN 2457-00	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0060-H-001
IN 2952-01	2x3	7	3.8	1.0	Greater th	7.0	2-CTY-ME02-A-0049-H-003
IN 2955-00	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-BM03-A-0068-H-000
IN 2461-02	2x3	7	3.8	1.0	Greater th	7.0	1-CTY-ME02-A-0271-H-010

Storm Stru	structure s	Equivalent Weir Length	Slope (%)	Clog Facto	Notes	Adjusted weir length	Assigned Weir
IN 3349-02	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-003
IN 3053-02	2x6	10	3.9	1.0	Greater th	10.0	1-CTY-ME02-A-0043-A-079
IN 3252-02	3x3	9	3.9	1.0	Greater th	9.0	1-CTY-ME02-A-0043-A-046
IN 3246-04	4x4	12	3.9	1.0	Greater th	12.0	1-CTY-ME03-C-0041-A-007
IN 2860-01	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-BM03-A-0339-H-000
IN 3251-02	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-034
IN 3350-01	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-096
IN 2758-01	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-022
IN 2555-00	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-003
IN 2959-00	2x3	7	3.9	1.0	Greater th	7.0	not modeled
IN 2556-00	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-001
IN 3349-01	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-095
IN 2459-02	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0271-H-001
IN 2755-02	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0052-H-001
IN 3348-09	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-047
IN 2759-00	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-006
IN 2577-02	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-001
IN 2855-01	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0048-A-041
IN 3349-02	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-005
IN 2359-02	4x4	12	3.9	1.0	Greater th	12.0	1-CTY-ME02-A-0271-H-006
Yellowst18	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0274-H-004
IN 2957-00	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0068-H-004
IN 2958-00	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0066-H-007
IN 2577-02	2x3	7	3.9	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-000
IN 2856-01	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0052-H-001
IN 3348-10	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-019
IN 3358-01	3x3	9	4.0	1.0	Greater th	9.0	1-CTY-ME02-A-0275-H-004
IN 3054-02	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0048-A-015
IN 3450-02	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0044-A-005
IN 2759-00	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-009
IN 3352-00	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-033
IN 2853-00	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0048-A-008
IN 3348-10	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-019
IN 3358-00	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0275-H-004
IN 3354-00	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-034
IN 2756-03	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0050-H-010
IN 2853-00	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0048-A-008
IN 2860-00	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-BM03-A-0339-H-001
IN 2956-00	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0068-H-002
IN 3153-01	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-037
IN 3150-04	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-067
IN 2577-02	2x3	7	4.0	1.0	Greater th	7.0	1-CTY-ME02-A-0273-H-002
IN 3349-02	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-019
IN 3350-03	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-004
IN 2856-01	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0052-H-001
IN 3247-01	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0042-A-005
IN 2856-02	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0052-H-000
IN 3150-03	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-068
IN 2960-00	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-BM03-A-0340-H-002
IN 2455-00	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-000
IN 3353-02	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-013
IN 2359-01	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0271-H-001
IN 2555-01	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-003
IN 2852-00	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0274-H-001
IN 2857-01	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0050-H-002
IN 3353-01	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-024
IN 3349-05	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0044-A-014
IN 2458-00	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0272-H-002
IN 2852-02	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0274-H-007
IN 3348-03	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0042-A-009
IN 3246-04	3.14x4.56	10.84	4.1	1.0	Greater th	10.8	1-CTY-ME03-C-0041-A-008
IN 3053-02	2x6	10	4.1	1.0	Greater th	10.0	2-CTY-ME02-A-0048-A-005
IN 2658-00	2x3	7	4.1	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-005
IN 2956-02	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0068-H-000
IN 3252-00	5x5 *upda	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-004
Orthophot	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-006
Orthophot	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-006
IN 3154-00	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0046-H-005
IN 2758-00	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-002
IN 2760-01	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-BM03-A-0339-H-003
IN 2360-00	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0271-H-014
IN 2658-01	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-005
IN 2660-02	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-021
IN 2555-02	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-003
Yellowst16	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0274-H-002
IN 3154-01	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0046-H-004
IN 3356-02	2x6	10	4.2	1.0	Greater th	10.0	1-CTY-ME02-A-0047-H-010
IN 3447-01	3x3	9	4.2	1.0	Greater th	9.0	1-CTY-ME03-U-0295-A-000
IN 2459-02	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0271-H-002
IN 2957-00	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0068-H-004
IN 2656-02	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-010
IN 3354-03	2x3	7	4.2	1.0	Greater th	7.0	1-CTY-ME02-A-0046-H-007
IN 2358-02	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME02-A-0272-H-002
IN 3152-00	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-049
IN 3354-02	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME02-A-0046-H-007
IN 2958-01	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME02-A-0066-H-003
IN 3449-01	2x3	7	4.3	1.0	Greater th	7.0	2-CTY-ME02-A-0044-A-018
IN 3447-01	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME03-U-0295-A-000
IN 3253-00	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-018
IN 2752-00	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME02-A-0053-A-000
IN 2758-00	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-003
IN 3252-01	4x4	12	4.3	1.0	Greater th	12.0	1-CTY-ME02-A-0045-A-003
IN 2656-00	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME02-A-0050-H-010
IN 3447-01	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME03-U-0295-A-000
IN 3056-01	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME02-A-0067-H-003
IN 3449-02	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME02-A-0044-A-018
IN 2577-02	2x3	7	4.3	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-022
IN 2860-01	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-BM03-A-0339-H-000
IN 3353-02	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-013
IN 2757-02	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0057-H-024
IN 2760-00	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-BM03-A-0339-H-002
IN 2851-00	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0274-H-005
IN 3348-05	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-024
IN 3350-02	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-099
IN 2457-01	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0060-H-003
IN 3349-04	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-017
IN 3353-04	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-011
IN 2459-02	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0271-H-001
IN 2459-02	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0271-H-002
IN 3250-02	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-039
IN 3252-00	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-004
IN 2854-01	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0048-A-039
IN 2655-02	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-012
IN 3354-01	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0046-H-006
IN 3353-05	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0045-A-023
IN 2560-00	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0273-H-003
IN 2655-00	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-008
IN 3450-01	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0044-A-006
IN 2556-00	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-001
IN 2853-02	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0048-A-006
IN 3246-04	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME03-C-0041-A-008
IN 3250-02	2x3	7	4.4	1.0	Greater th	7.0	1-CTY-ME02-A-0043-A-039
IN 2860-04	2x3	7	4.5	1.0	Greater th	7.0	1-CTY-BM03-A-0339-H-004
IN 2455-02	2x3	7	4.5	1.0	Greater th	7.0	1-CTY-ME02-A-0054-H-000

*City inlets from GIS database (source "stm_structures_updated_DANE.shp)
*Stucture size from CITY GIS data
*Equivalent wier leng prior to clogging assuming three sides of the inlet
*Slope calculated from DEM

Storm Structure ID	structure size (ftxft)	Equivalent Weir Length prior to adding Clogging	Slope (%)	Clog Factor	Notes	Adjusted weir length after Clogging (ft)	Assigned Weir
IN 3247-006	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-005
IN 2457-008	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-003
IN 3353-023	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-013
IN 3356-026	3x3	9	4.5	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0047-H-002
IN 2958-027	2x6	10	4.5	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0066-H-004
IN 2860-031	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0340-H-000
IN 3250-022	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-039
IN 3350-027	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-098
IN 2660-018	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-014
IN 3251-016	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-035
IN 3353-016	3x3	9	4.5	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0045-A-022
IN 3354-005	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-034
IN 3452-003	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-025
IN 2858-041	2x9	10	4.5	1.0	Greater than 1%	10.0	1-CTY-BM03-A-0339-H-009
IN 2958-009	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-006
IN 3056-011	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-005
IN 3150-033	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-084
IN 3246-043	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-008
IN 3452-004	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-025
IN 3356-036	2x6	10	4.5	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0047-H-007
IN 2577-028-037	2x3	7	4.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-002
IN 3255-003	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-005
Masthead5 2x3	2x3	7	4.6	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0048-A-019
IN 3450-034	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-005
IN 2657-006	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-024
IN 2957-011	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0068-H-004
IN 3053-009	2x3	7	4.6	1.0	Greater than 1%	7.0	not modeled
IN 3348-065	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-000
IN 2359-028	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-001
IN 2655-020	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-008
IN 2560-004	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0273-H-003
IN 3153-017	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-037
IN 3252-015	4x4	12	4.6	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0045-A-003
IN 3348-079	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 3352-006	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-035
IN 2660-010	2x3	7	4.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-014
IN 3353-013	2x3	7	4.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-021
IN 2856-016	2x6	10	4.7	1.0	Greater than 1%	10.0	2-CTY-ME02-A-0052-H-000
Hawser4 2x3	2x3	7	4.7	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0048-A-017
IN 2856-008	2x3	7	4.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0052-H-001
IN 3347-018	2x3	7	4.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-000
IN 3350-012	2x3	7	4.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-094
IN 3348-015	2x6	10	4.7	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0042-A-007
IN 2954-004	2x3	7	4.7	1.0	Greater than 1%	7.0	not modeled
IN 2459-023	2x3	7	4.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-001
IN 3353-050	2x3	7	4.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-025
IN 3348-084	2x3	7	4.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 3449-034	2x3	7	4.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-015
IN 3246-031	4x4	12	4.7	1.0	Greater than 1%	12.0	1-CTY-ME03-C-0041-A-005
IN 2956-001	2x3	7	4.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0068-H-002
IN 2860-032	2x3	7	4.8	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0340-H-000
IN 3251-023	2x3	7	4.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-034
IN 3354-022	2x3	7	4.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-006
IN 3154-014	2x3	7	4.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-004
IN 2657-010	2x6	10	4.8	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0050-H-007
IN 2577-028-032	2x3	7	4.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-046
IN 2760-007	2x3	7	4.8	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-003
IN 2359-029	2x3	7	4.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-001
IN 2754-002	2x3	7	4.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-004
IN 3150-011	2x3	7	4.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-087
IN 2955-010	2x3	7	4.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-027
IN 3053-027	2x6	10	4.8	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0043-A-079
IN 3056-003	2x3	7	4.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-002
IN 3350-004	2x6	10	4.8	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0043-A-092
IN 3151-055	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-041
IN 3054-025	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-015
IN 2853-012	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-007
IN 2955-008	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0068-H-000
IN 3353-001	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-012
IN 3353-037	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-008
IN 2952-020	2x6	10	4.9	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0049-H-003
IN 2560-006	3x3	9	4.9	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0273-H-002
IN 3347-023	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-030
IN 3353-045	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-011
IN 3350-026	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-098
IN 2852-016	2x6	10	4.9	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0274-H-010
IN 2555-026	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-004
IN 3348-076	3.17x4.56	10.9	4.9	1.0	Greater than 1%	10.9	1-CTY-ME02-A-0043-A-011
IN 3054-011	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-029
IN 3151-044	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-043
IN 3350-048	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-000
IN 3349-012	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-091
IN 2653-002	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-009
IN 3457-010	2x3	7	4.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0275-H-002
IN 3054-029	2x3	7	5.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-029
IN 3353-055	2x3	7	5.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-014
IN 3356-030	2x6	10	5.0	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0047-H-010
IN 3450-017	2x6	10	5.0	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0044-A-013
IN 2860-021	3x3	9	5.0	1.0	Greater than 1%	9.0	1-CTY-BM03-A-0339-H-000
IN 2660-028	2x3	7	5.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0273-H-002
IN 3355-020	2x3	7	5.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-008
IN 3053-025	2x3	7	5.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-005
IN 2459-017	2x3	7	5.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-007
Yellowst11 2x3	2x3	7	5.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-002
IN 3251-014	4x4	12	5.0	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0043-A-035
IN 2658-008	2x3	7	5.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-005
IN 2860-008	2x3	7	5.0	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-002
IN 3354-015	2x3	7	5.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-006
IN 3353-009	2x3	7	5.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-021
IN 2958-012	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-006
IN 2456-020	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-004
IN 3349-042	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-017
IN 3449-036	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-014
IN 3250-014	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-036
IN 3349-054	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-014
IN 3452-001	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-025
IN 2660-031	3x3	9	5.1	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0273-H-002
IN 3247-015	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-005
Yellowst7 2x3	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-003
IN 3349-023	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-005
IN 3252-010	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-003
IN 2856-014	2x3	7	5.1	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0052-H-000
IN 3251-046	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-033
IN 3349-034	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-018
IN 3450-023	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-013
IN 3348-062	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-022
IN 3449-031	2x3	7	5.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-015
IN 3449-030	2x3	7	5.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-015
IN 3348-107	2x3	7	5.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-019
IN 2660-026	2x3	7	5.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0273-H-002
IN 2656-020	2x3	7	5.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-007
IN 3348-080	3.17x4.56	10.9	5.2	1.0	Greater than 1%	10.9	1-CTY-ME02-A-0043-A-011
IN 2952-002	2x3	7	5.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0049-H-011
IN 3350-037	2x3	7	5.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-004

*City inlets from GIS database (source "stm_structures_updated_DANE.shp)
*Stucture size from CITY GIS data
*Equivalent wier leng prior to clogging assuming three sides of the inlet
*Slope calculated from DEM

Storm Structure ID	structure size (ftxft)	Equivalent Weir Length prior to adding Clogging	Slope (%)	Clog Factor	Notes	Adjusted weir length after Clogging (ft)	Assigned Weir
IN 3054-026	2x3	7	5.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-015
IN 3357-010	2x3	7	5.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-009
IN 2457-014	2x3	7	5.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-003
IN 2358-025	2x3	7	5.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0272-H-002
IN 2860-038	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-000
IN 2952-004	2x6	10	5.3	1.0	Greater than 1%	10.0	2-CTY-ME02-A-0049-H-011
IN 2760-009	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-003
IN 2359-021	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-005
IN 3247-022	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-005
IN 3349-033	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-018
IN 3457-011	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0275-H-002
IN 3352-034	3x3	9	5.3	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0045-A-026
Yellowst13 2x3	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-002
IN 2760-004	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-003
Yellowst2 2x3	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-004
IN 2858-019	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-001
IN 2855-007	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-039
IN 3349-063	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-015
IN 3354-019	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-006
IN 3251-022	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-034
IN 3354-014	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-006
IN 2852-025	2x3	7	5.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-007
IN 3457-013	2x6	10	5.3	1.0	Greater than 1%	10.0	2-CTY-ME02-A-0275-H-003
IN 3148-003	3x3	9	5.3	1.0	Greater than 1%	9.0	1-CTY-ME03-U-0037-Q-000
IN 3253-015	2x3	7	5.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-014
IN 3347-035	2x3	7	5.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-001
IN 3350-032	2x3	7	5.4	1.0	Greater than 1%	7.0	Not modeled
IN 3156-002	2x3	7	5.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-007
IN 2753-011	2x3	7	5.4	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0051-A-009
IN 2577-028-004	2x3	7	5.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-024
IN 2577-028-017	2x3	7	5.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0273-H-002
IN 3447-019	2x3	7	5.4	1.0	Greater than 1%	7.0	2-CTY-ME03-U-0295-A-003
IN 2860-033	2x3	7	5.4	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0340-H-000
IN 2555-024	2x3	7	5.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-004
IN 3450-031	2x6	10	5.4	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0044-A-005
IN 2956-028	2x3	7	5.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0068-H-000
IN 2655-022	2x3	7	5.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-011
IN 3356-034	2x6	10	5.4	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0047-H-007
IN 2754-008	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-004
IN 2555-018	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-002
IN 3149-007	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-061
IN 3347-007	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-001
IN 3054-004	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-015
IN 2656-024	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-008
IN 3350-024	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-097
IN 3352-049	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-032
IN 3453-003	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-024
IN 3350-049	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-020
IN 2656-017	2x3	7	5.5	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0054-H-007
IN 3247-029	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-003
IN 2756-065	2x6	10	5.5	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0054-H-014
IN 3348-078	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 2855-005	2x3	7	5.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0052-H-001
IN 2653-009	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-002
IN 2752-013	2x6	10	5.6	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0053-A-005
IN 2655-021	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-008
IN 3347-022	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-030
IN 3149-006	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-061
Orthophoto8 2x3	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-011
IN 2457-011	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-003
IN 2960-001	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0340-H-002
IN 2660-020	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-021
IN 2854-023	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-040
IN 3449-019	2x3	7	5.6	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0044-A-018
IN 3154-010	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-004
IN 2852-026	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-007
IN 3348-010	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-008
IN 2755-017	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-014
IN 3250-040	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-092
IN 3348-085	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-011
IN 3151-034	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-073
IN 2457-010	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-003
IN 3256-011	2x3	7	5.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-005
IN 2555-025	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-004
IN 2560-002	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0273-H-002
IN 3251-019	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-034
IN 3153-030	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-100
IN 2760-008	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-003
IN 3251-012	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-040
IN 3253-003	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-009
IN 3353-012	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-021
IN 3352-033	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-028
IN 3453-004	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-024
IN 3349-031	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-018
IN 3450-030	2x6	10	5.7	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0044-A-005
IN 3247-027	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-002
IN 3452-008	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-028
IN 2952-003	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0049-H-011
IN 2956-020	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0068-H-000
IN 3457-014	2x6	10	5.7	1.0	Greater than 1%	10.0	2-CTY-ME02-A-0275-H-003
IN 2956-005	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0068-H-002
IN 3349-032	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-018
IN 3151-033	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-073
IN 3352-037	2x3	7	5.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-027
IN 2577-028-005	2x3	7	5.7	1.0	Greater than 1%	7.0	Not modeled
IN 3052-001	3x3	9	5.7	1.0	Greater than 1%	9.0	not modeled
IN 3247-025	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-002
IN 3053-026	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-005
IN 3156-003	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-007
IN 3252-040	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-048
IN 2854-002	2x3	7	5.8	1.0	Greater than 1%	7.0	not modeled
IN 2660-019	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-021
IN 3348-066	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-000
IN 3450-011	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-006
IN 2660-017	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-014
IN 2655-014	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-005
IN 3449-024	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-018
IN 3354-008	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-034
IN 3354-012	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-034
IN 2853-019	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-006
IN 3348-032	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-047
IN 3348-060	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-022
IN 3152-004	2x3	7	5.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-049
IN 2657-005	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-024
IN 3350-045	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-012
IN 3352-017	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-031
IN 2852-028	3.17x4.56	10.9	5.9	1.0	Greater than 1%	10.9	1-CTY-ME02-A-0274-H-010
IN 2458-002	3x3	9	5.9	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0060-H-008
IN 2457-012	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-003
IN 3450-019	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-013
IN 2752-004	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0053-A-003
IN 3353-043	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-011
IN 3358-004	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0275-H-004
IN 3346-007	2x3	7	5.9	1.0	Greater than 1%	7.0	Not modeled

*City inlets from GIS database (source "stm_structures_updated_DANE.shp)
*Stucture size from CITY GIS data
*Equivalent wier leng prior to clogging assuming three sides of the inlet
*Slope calculated from DEM

Storm Structure ID	structure size (ftxft)	Equivalent Weir Length prior to adding Clogging	Slope (%)	Clog Factor	Notes	Adjusted weir length after Clogging (ft)	Assigned Weir
IN 2657-001	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0050-H-007
IN 3250-045	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-010
IN 3247-008	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-005
IN 3449-022	2x3	7	5.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-016
IN 2854-020	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-038
IN 3251-021	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-034
IN 3357-012	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-009
IN 3154-013	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-004
IN 3053-008	2x3	7	6.0	1.0	Greater than 1%	7.0	not modeled
IN 3347-040	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-001
IN 3253-002	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-009
IN 2952-010	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0049-H-006
IN 3252-041	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-044
IN 3350-005	2x6	10	6.0	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0043-A-092
IN 2952-008	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0049-H-006
IN 2854-039	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-030
IN 2577-028-026	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-017
IN 2660-035	3x3	9	6.0	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0057-H-017
IN 2660-009	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-015
IN 2754-004	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-004
IN 3151-043	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-072
IN 2455-011	3x3	9	6.0	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0054-H-000
IN 3150-043	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-068
IN 2857-022	2x3	7	6.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-000
IN 2461-019	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-012
IN 3355-007	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-000
IN 3151-040	3x3	9	6.1	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-072
IN 2956-023	2x6	10	6.1	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0068-H-002
IN 2757-039	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0050-H-007
IN 3349-020	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-003
IN 3153-018	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-037
IN 3353-052	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-025
IN 2757-024	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-024
IN 3352-050	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-032
IN 3150-032	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-084
IN 3153-031	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-051
IN 3151-049	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-043
IN 3450-018	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-013
IN 3355-021	2x3	7	6.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-008
IN 3256-015	2x3	7	6.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-004
IN 2577-028-027	2x3	7	6.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-000
IN 2957-002	2x3	7	6.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0068-H-004
Yellowst20 2x3	2x3	7	6.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-004
IN 2958-006	2x3	7	6.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-007
IN 3253-007	2x3	7	6.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-018
IN 3151-035	2x3	7	6.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-073
IN 2659-021	2x3	7	6.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-008
IN 3355-014	2x3	7	6.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-003
IN 2560-005	2x3	7	6.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0273-H-003
IN 2757-058	2x3	7	6.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-001
IN 2957-009	2x6	10	6.3	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0066-H-005
IN 3054-015	2x3	7	6.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-025
IN 3056-005	2x3	7	6.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-002
IN 3054-028	2x3	7	6.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-029
IN 2957-001	2x3	7	6.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0068-H-004
IN 2758-012	3x3	9	6.3	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0057-H-022
IN 3348-058	2x3	7	6.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-024
IN 3252-030	2x3	7	6.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-046
IN 2660-033	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-021
IN 3349-044	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-017
IN 3450-010	2x6	10	6.4	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0044-A-006
Hawser2 2x3	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-017
IN 2955-007	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0068-H-000
IN 3349-035	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-018
IN 3349-043	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-017
IN 3253-009	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-016
IN 2555-017	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-002
IN 2860-030	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0340-H-000
IN 3155-005	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-007
IN 3349-009	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-095
IN 3350-028	2x3	7	6.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-098
IN 3452-007	2x3	7	6.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-028
Yellowst1 2x3	2x3	7	6.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-004
IN 3356-046	2x6	10	6.5	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0047-H-010
IN 2860-007	2x3	7	6.5	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-002
IN 3347-039	2x3	7	6.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-001
IN 3352-046	2x3	7	6.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-030
IN 2577-028-018	2x3	7	6.5	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-005
IN 2658-005	2x3	7	6.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-003
IN 3149-002	2x6	10	6.5	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0043-A-060
IN 3450-041	2x3	7	6.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-013
IN 2956-024	2x6	10	6.5	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0068-H-002
IN 3253-005	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-007
IN 3349-051	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-014
IN 3150-046	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-067
IN 3253-014	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-014
IN 2851-001	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-007
IN 3449-001	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-012
IN 3256-014	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-004
IN 3353-020	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-024
IN 3251-013	3x3	9	6.6	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-040
Orthophoto1 2x3	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-006
IN 2560-001	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0273-H-002
IN 3253-001	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-009
IN 3056-008	2x3	7	6.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-003
IN 2758-005	2x3	7	6.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-022
IN 3248-008	2x3	7	6.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-012
IN 3347-019	3x3	9	6.7	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-000
IN 3453-001	2x3	7	6.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-024
IN 3353-044	2x3	7	6.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-011
IN 2952-014	2x3	7	6.7	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0049-H-003
IN 2660-015	2x3	7	6.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-017
IN 3450-046	2x3	7	6.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-002
IN 3055-015	2x3	7	6.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-005
IN 3449-003	2x3	7	6.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-012
IN 2557-010	2x3	7	6.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-000
IN 3358-003	2x3	7	6.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0275-H-004
IN 2359-024	2x3	7	6.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-006
IN 3149-001	2x6	10	6.8	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0043-A-060
IN 3054-005	2x3	7	6.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-015
IN 2855-004	2x3	7	6.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0052-H-001
IN 2656-029	2x3	7	6.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-013
Yellowst5 2x3	2x3	7	6.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-004
IN 2753-012	2x3	7	6.8	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0051-A-009
IN 2497-006	3x3	9	6.8	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0060-H-003
IN 2757-046	2x3	7	6.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-024
IN 3248-007	2x3	7	6.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-012
IN 3352-051	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-032
Orthophoto6 2x3	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-006
IN 3348-054	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-025
IN 3449-029	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-015
IN 2754-014	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-004
IN 3450-020	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-013
IN 2752-007	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0053-A-005

*City inlets from GIS database (source "stm_structures_updated_DANE.shp)
*Stucture size from CITY GIS data
*Equivalent wier leng prior to clogging assuming three sides of the inlet
*Slope calculated from DEM

Storm Structure ID	structure size (ftxft)	Equivalent Weir Length prior to adding Clogging factor (ft)	Slope (%)	Clog Factor	Notes	Adjusted weir length after Clogging (ft)	Assigned Weir
IN 3151-056	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-041
IN 2456-024	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-001
IN 2756-059	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-014
IN 3348-061	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-022
IN 3347-037	2x3	7	6.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-001
IN 2656-026	2x3	7	7.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-010
IN 3450-008	2x3	7	7.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-016
IN 2359-022	2x3	7	7.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-005
IN 3349-045	2x3	7	7.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-017
Orthophoto5 2x3	2x3	7	7.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-006
IN 3246-037	3.14x4.56	10.84	7.0	1.0	Greater than 1%	10.8	1-CTY-ME03-C-0041-A-009
IN 2658-001	2x3	7	7.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-002
IN 2555-016	2x3	7	7.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-002
IN 2577-028-021	2x3	7	7.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-066
IN 2455-022	2x3	7	7.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-000
IN 3255-006	2x3	7	7.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-004
IN 3353-046	2x3	7	7.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-011
IN 3246-038	3.14x4.56	10.84	7.1	1.0	Greater than 1%	10.8	1-CTY-ME03-C-0041-A-009
Orthophoto2 2x3	2x3	7	7.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-006
IN 3348-053	2x3	7	7.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-025
IN 3153-014	2x6	10	7.1	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0043-A-049
IN 3151-052	2x3	7	7.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-042
IN 2457-007	2x3	7	7.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-003
IN 2655-023	2x3	7	7.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-009
IN 3250-046	5.58x4.56	14.7	7.2	1.0	Greater than 1%	14.7	1-CTY-ME02-A-0043-A-052
IN 2556-001	2x3	7	7.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-003
IN 3353-011	2x3	7	7.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-021
IN 2760-005	2x3	7	7.2	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-003
IN 2752-002	2x3	7	7.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0053-A-003
IN 3150-029	2x3	7	7.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-088
IN 3247-012	2x3	7	7.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-005
IN 3352-035	2x3	7	7.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-026
IN 3450-038	3x3	9	7.3	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0044-A-013
IN 2359-019	4x4	12	7.3	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0271-H-005
IN 3353-014	2x3	7	7.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-021
IN 2577-028-011	2x3	7	7.3	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-006
IN 2952-011	2x3	7	7.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0049-H-006
IN 3151-048	2x3	7	7.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-043
IN 2577-028-034	2x3	7	7.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-002
IN 3347-029	2x3	7	7.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-028
IN 3449-028	2x3	7	7.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-015
IN 2858-031	2x3	7	7.4	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-009
IN 2556-002	2x3	7	7.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-002
IN 3450-049	2x3	7	7.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-002
IN 2654-012	2x3	7	7.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-009
IN 2359-018	2x3	7	7.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-015
IN 3355-015	2x3	7	7.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-003
IN 2852-004	2x3	7	7.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-009
IN 2857-014	2x3	7	7.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0050-H-002
IN 2657-009	3x3	9	7.5	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0057-H-024
IN 2361-016	2x3	7	7.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-012
IN 3356-041	2x3	7	7.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-008
IN 2958-004	2x3	7	7.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-007
Yellowstone8 2x3	2x3	7	7.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-019
IN 3449-007	2x3	7	7.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-012
IN 2577-028-042	2x3	7	7.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-013
IN 2457-003	2x3	7	7.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-001
IN 2852-005	2x3	7	7.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-001
IN 3349-062	4x4	12	7.6	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0044-A-015
IN 3252-025	2x3	7	7.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-006
IN 3347-008	2x6	10	7.6	1.0	Greater than 1%	10.0	1-CTY-ME03-C-0041-A-001
IN 3354-001	2x3	7	7.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-034
IN 3356-044	2x3	7	7.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-003
IN 3348-068	2x3	7	7.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-000
IN 2758-004	2x3	7	7.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-022
IN 2857-018	2x3	7	7.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-000
IN 3248-013	2x3	7	7.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-011
IN 3449-002	2x3	7	7.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-012
IN 2958-001	2x3	7	7.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-007
IN 2577-028-008	2x3	7	7.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-000
IN 2960-002	2x3	7	7.8	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0340-H-002
IN 3350-023	2x3	7	7.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-097
IN 3353-039	2x3	7	7.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-008
IN 3353-022	2x3	7	7.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-013
IN 3354-006	2x3	7	7.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-034
IN 3450-040	2x3	7	7.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-013
IN 3150-010	2x6	10	7.8	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0043-A-087
IN 3056-009	2x3	7	7.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-003
IN 3353-042	2x3	7	7.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-011
IN 3451-005	2x3	7	7.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-002
IN 3450-050	2x3	7	7.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-002
IN 2755-020	2x3	7	7.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0052-H-001
IN 2658-012	2x3	7	7.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-003
IN 2859-001	7x7	28	7.9	1.0	Greater than 1%	28.0	1-CTY-BM03-A-0339-H-006
IN 3253-010	2x3	7	7.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-016
Yellowst22 2x3	2x3	7	7.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-004
IN 2851-005	2x3	7	7.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-005
IN 3252-003	2x3	7	8.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-004
IN 3347-038	2x3	7	8.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-001
IN 3355-019	2x3	7	8.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-008
IN 2656-009	2x3	7	8.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-008
IN 2858-014	2x3	7	8.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-003
IN 2460-006	2x3	7	8.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-007
IN 3054-002	2x3	7	8.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-018
IN 2654-009	2x3	7	8.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-004
IN 2855-009	2x3	7	8.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-041
IN 2656-021	2x3	7	8.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-007
IN 2659-001	2x3	7	8.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-010
IN 3348-036	2x3	7	8.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-010
IN 3252-026	2x3	7	8.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-006
IN 3350-030	2x3	7	8.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-098
Yellowst12 2x3	2x3	7	8.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-002
IN 2853-014	2x3	7	8.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-007
IN 2660-037	2x3	7	8.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-021
IN 2952-005	2x6	10	8.2	1.0	Greater than 1%	10.0	2-CTY-ME02-A-0049-H-011
Masthead4 2x3	2x3	7	8.2	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0048-A-019
IN 2656-019	2x3	7	8.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-005
IN 2959-010	2x3	7	8.3	1.0	Greater than 1%	7.0	not modeled
IN 2760-003	2x3	7	8.3	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-003
Yellowst21 2x3	2x3	7	8.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-004
IN 3248-009	2x3	7	8.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-012
IN 3355-013	2x3	7	8.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-003
Masthead1 2x3	2x3	7	8.4	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0048-A-019
IN 2361-017	2x3	7	8.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-012
IN 3350-039	2x3	7	8.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-004
IN 3153-024	2x3	7	8.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-051
IN 3354-034	2x3	7	8.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-007
IN 3449-015	3x3	9	8.5	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-012
IN 2658-011	2x3	7	8.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-005
IN 3050-009	3x3	9	8.5	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-066
IN 2858-038	2x3	7	8.5	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-009
IN 3251-017	2x3	7	8.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-035
IN 3356-039	2x3	7	8.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-008
IN 3252-012	3x3	9	8.6	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0045-A-003

*City inlets from GIS database (source "stm_structures_updated_DANE.shp)
*Stucture size from CITY GIS data
*Equivalent wier leng prior to clogging assuming three sides of the inlet
*Slope calculated from DEM

Storm Structure ID	structure size (ftxft)	Equivalent Weir Length prior to adding Clogging factor (ft)	Slope (%)	Clog Factor	Notes	Adjusted weir length after Clogging (ft)	Assigned Weir
IN 2960-006	2x3	7	8.6	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0340-H-002
IN 3248-004	2x3	7	8.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-012
IN 2660-025	2x3	7	8.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0273-H-002
Yellowst9 2x3	2x3	7	8.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-003
IN 3354-027	2x3	7	8.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-006
IN 2459-001	2x3	7	8.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0272-H-008
IN 2757-042	2x6	10	8.7	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0050-H-007
IN 3450-048	2x3	7	8.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-002
IN 3356-035	2x6	10	8.7	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0047-H-007
IN 2658-014	2x3	7	8.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-005
IN 2853-011	3x6	12	8.7	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0048-A-007
IN 2359-020	2x3	7	8.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-005
Yellowst17 2x3	2x3	7	8.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-002
IN 2760-002	2x3	7	8.8	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-003
IN 2757-057	2x3	7	8.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-001
Yellowst10 2x3	2x3	7	8.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-003
IN 3150-028	2x3	7	8.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-063
Yellowst8 2x3	2x3	7	8.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-003
Yellowst14 2x3	2x3	7	8.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-002
Yellowst15 2x3	2x3	7	8.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-002
IN 3449-004	2x3	7	8.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-012
IN 2860-005	2x3	7	8.9	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-001
IN 2456-021	2x3	7	8.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-004
IN 2654-005	2x3	7	9.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-004
IN 2660-022	2x3	7	9.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-021
IN 2655-018	2x3	7	9.0	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0054-H-007
IN 2457-009	2x3	7	9.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-003
IN 3152-005	2x3	7	9.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-049
Yellowst6 2x3	2x3	7	9.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-003
IN 2555-012	2x3	7	9.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-002
IN 3252-013	2x3	7	9.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-003
IN 2854-003	2x3	7	9.1	1.0	Greater than 1%	7.0	not modeled
IN 3350-036	2x3	7	9.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-004
IN 3357-011	2x3	7	9.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-009
IN 3250-043	2x3	7	9.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-092
IN 3055-001	2x3	7	9.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0067-H-002
IN 3347-030	2x3	7	9.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-028
IN 2656-016	2x3	7	9.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-005
IN 2853-001	2x3	7	9.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-008
IN 3447-001	2x3	7	9.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-029
IN 3347-005	2x3	7	9.4	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-001
IN 2460-004	2x3	7	9.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-008
IN 3250-007	2x6	10	9.4	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0043-A-055
IN 3352-009	2x3	7	9.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-005
IN 3149-010	2x3	7	9.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-062
IN 3254-002	3x3	9	9.5	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0046-H-002
Hawser3 2x3	2x3	7	9.5	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0048-A-017
Yellowst19 2x3	2x3	7	9.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-004
IN 2653-004	2x3	7	9.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-009
IN 2655-025	2x3	7	9.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-012
IN 2958-003	2x3	7	9.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-007
IN 3252-007	3x3	9	9.7	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0045-A-004
IN 2759-015	3x3	9	9.7	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0057-H-006
IN 2654-011	2x3	7	9.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-009
IN 2456-014	2x3	7	9.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-001
IN 2361-015	2x3	7	9.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-012
IN 3248-005	2x3	7	9.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-012
IN 3246-029	2x3	7	9.7	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-004
IN 3152-018	2x3	7	9.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-044
IN 2855-006	2x3	7	9.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0052-H-001
IN 3256-012	2x3	7	9.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-005
IN 2856-022	2x3	7	9.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0052-H-000
IN 3450-039	3x3	9	9.9	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0044-A-013
IN 3347-006	2x3	7	9.9	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-001
IN 2851-006	2x3	7	9.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-005
IN 3152-013	2x3	7	10.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-048
IN 3155-007	2x3	7	10.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-005
IN 3150-035	2x3	7	10.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-084
IN 2658-002	2x3	7	10.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-002
IN 3357-009	2x3	7	10.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-009
Masthead2 2x3	2x3	7	10.2	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0048-A-019
IN 2456-011	2x3	7	10.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-000
IN 2459-002	2x3	7	10.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0272-H-008
IN 2360-001	2x3	7	10.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-009
IN 3246-030	2x3	7	10.3	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-004
Masthead3 2x3	2x3	7	10.3	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0048-A-019
Yellowst3 2x3	2x3	7	10.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-004
IN 2851-008	2x3	7	10.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-005
IN 2860-022	3x3	9	10.4	1.0	Greater than 1%	9.0	1-CTY-BM03-A-0339-H-000
IN 2755-023	2x3	7	10.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-012
IN 3350-019	3x3	9	10.5	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-096
Yellowst4 2x3	2x3	7	10.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0274-H-004
IN 2361-014	2x3	7	10.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-012
IN 3150-025	2x3	7	10.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-062
IN 3347-024	2x3	7	10.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-029
IN 2858-039	2x3	7	10.6	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-009
IN 3054-020	4x4	12	10.7	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0048-A-018
IN 2952-009	2x3	7	10.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0049-H-006
IN 3150-003	3x3	9	10.9	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-066
IN 2660-034	2x3	7	10.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-021
IN 2957-008	2x6	10	10.9	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0066-H-005
IN 3149-005	2x3	7	11.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-061
IN 2759-001	2x3	7	11.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-009
IN 2854-033	2x3	7	11.1	1.0	Greater than 1%	7.0	not modeled
IN 3356-037	2x6	10	11.2	1.0	Greater than 1%	10.0	1-CTY-ME02-A-0047-H-007
IN 2858-040	2x3	7	11.3	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-009
Hawser5 2x3	2x3	7	11.3	1.0	Greater than 1%	7.0	3-CTY-ME02-A-0048-A-017
IN 3152-016	2x3	7	11.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-044
IN 2653-003	2x3	7	11.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-009
Orthophoto7 4x4	2x3	7	11.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0060-H-011
IN 3253-016	2x3	7	11.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-014
IN 3148-005	2x3	7	11.6	1.0	Greater than 1%	7.0	1-CTY-ME03-U-0037-Q-000
IN 2360-002	2x3	7	11.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-008
IN 3348-051	2x3	7	11.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-027
IN 3152-014	2x3	7	11.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-048
IN 3352-010	2x3	7	11.8	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-005
IN 2577-028-031	2x3	7	12.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-004
IN 3347-041	2x3	7	12.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-001
IN 2460-002	2x3	7	12.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-009
IN 3349-060	2x3	7	12.1	1.0	Greater than 1%	7.0	Not modeled
IN 3255-002	2x3	7	12.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-003
IN 2853-018	3x6	12	12.1	1.0	Greater than 1%	12.0	1-CTY-ME02-A-0048-A-006
IN 2577-028-043	2x3	7	12.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0044-A-013
IN 2656-004	2x3	7	12.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0054-H-013
IN 2654-013	2x3	7	12.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0051-A-004
IN 3449-005	2x3	7	12.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-012
IN 2658-004	2x3	7	12.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-003
IN 3255-005	2x3	7	12.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-004
Yellowstone7 2x3	2x3	7	12.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-019
IN 3251-025	2x3	7	13.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-034
IN 2360-003	2x3	7	13.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0271-H-008
IN 3348-012	2x3	7	13.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-008
IN 2658-003	2x3	7	13.7	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-002
IN 3254-001	3x3	9	13.8	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0046-H-003

*City inlets from GIS database (source "stm_structures_updated_DANE.shp)
*Stucture size from CITY GIS data
*Equivalent wier leng prior to clogging assuming three sides of the inlet
*Slope calculated from DEM

Storm Structure ID	structure size (ftxft)	Equivalent Weir Length prior to adding Clogging	Slope (%)	Clog Factor	Notes	Adjusted weir length after Clogging (ft)	Assigned Weir
IN 3250-006	2x3	7	13.9	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-055
IN 3348-103	3.14x4.56	10.84	14.0	1.0	Greater than 1%	10.8	1-CTY-ME02-A-0043-A-021
IN 3246-028	7x7 *updated from ortho	7	14.2	1.0	Greater than 1%	7.0	1-CTY-ME03-C-0041-A-004
IN 2857-019	2x3	7	14.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0066-H-000
IN 3149-011	2x3	7	14.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-063
IN 2577-028-012	2x3	7	14.5	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-005
IN 2577-028-013	2x3	7	14.7	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-000
IN 2577-028-033	2x3	7	15.0	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-003
IN 3352-001	2x3	7	15.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-033
IN 3053-028	2x6	10	15.1	1.0	Greater than 1%	10.0	2-CTY-ME02-A-0043-A-079
IN 3447-016	2x3	7	15.6	1.0	Greater than 1%	7.0	1-CTY-ME03-U-0295-A-000
IN 3352-043	2x3	7	16.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-030
IN 2758-014	2x3	7	16.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0057-H-022
Hawser1 2x3	2x3	7	16.4	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0048-A-017
IN 3347-034	2x3	7	16.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-030
IN 3348-104	3.14x4.56	10.84	16.8	1.0	Greater than 1%	10.8	1-CTY-ME02-A-0043-A-021
IN 3356-025	2x3	7	17.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-002
IN 2577-028-036	2x3	7	17.2	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-002
IN 3255-004	2x3	7	17.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0047-H-005
IN 3250-037	2x3	7	17.8	1.0	Greater than 1%	7.0	2-CTY-ME02-A-0043-A-006
IN 2577-028-014	2x3	7	18.4	1.0	Greater than 1%	7.0	1-CTY-BM03-A-0339-H-000
IN 3348-011	2x3	7	19.1	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0042-A-008
IN 3354-002	2x3	7	19.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0045-A-034
IN 3250-005	2x3	7	20.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-053
IN 3350-018	3x3	9	22.9	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-096
IN 2577-028-035	2x3	7	23.6	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0046-H-001
IN 3447-020	2x3	7	27.1	1.0	Greater than 1%	7.0	2-CTY-ME03-U-0295-A-003
IN 2958-028	4x4	12	28.0	1.0	Greater than 1%	12.0	1-CTY-BM03-A-0339-H-009
IN 2577-028-030	2x3	7	28.3	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-032
IN 3254-003	3x3	9	28.4	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0046-H-001
IN 2577-028-006	2x3	7	29.3	1.0	Greater than 1%	7.0	not
IN 3052-002	3x3	9	29.3	1.0	Greater than 1%	9.0	not modeled
IN 3447-002	2x3	7	29.5	1.0	Greater than 1%	7.0	1-CTY-ME02-A-0043-A-029
IN 2959-012	4x4	12	29.6	1.0	Greater than 1%	12.0	not modeled
IN 3250-032	3x3	9	29.8	1.0	Greater than 1%	9.0	1-CTY-ME02-A-0043-A-032
IN 3447-006	2x3	7	31.9	1.0	Greater than 1%	7.0	2-CTY-ME03-U-0295-A-003
IN 3547-001	2x3	7	46.2	1.0	Greater than 1%	7.0	1-CTY-ME03-U-0295-A-000
IN 2755-014	2x3	7	0.5	0.75	Less than 1%	5.3	1-CTY-ME02-A-0054-H-009
IN 2577-028-025	2x3	7	0.6	0.75	Less than 1%	5.3	1-CTY-ME02-A-0066-H-002
IN 2958-026	3x3	9	0.9	0.75	Less than 1%	6.8	1-CTY-ME02-A-0066-H-002
IN 2755-019	2x3	7	0.6	0.5	sag	3.5	1-CTY-ME02-A-0050-H-003
IN 2459-030	2x3	7	1.8	0.5	sag	3.5	1-CTY-ME02-A-0271-H-000
IN 2660-004	2x3	7	1.9	0.5	sag	3.5	1-CTY-ME02-A-0057-H-012
IN 2660-001	2x3	7	2.2	0.5	sag	3.5	1-CTY-ME02-A-0057-H-012
IN 2359-014	2x3	7	2.8	0.5	sag	3.5	1-CTY-ME02-A-0271-H-004
IN 3547-003	2x3	7	2.9	0.5	sag	3.5	1-CTY-ME03-U-0295-A-001
IN 2955-003	2x3	7	2.9	0.5	sag	3.5	1-CTY-ME02-A-0067-H-008
IN 2955-020	2x3	7	3.3	0.5	sag	3.5	1-CTY-ME02-A-0067-H-008
IN 2359-016	2x3	7	3.4	0.5	sag	3.5	1-CTY-ME02-A-0271-H-004
IN 2756-061	2x3	7	3.6	0.5	sag	3.5	1-CTY-ME02-A-0050-H-003
IN 3356-045	2x3	7	3.8	0.5	sag	3.5	1-CTY-ME02-A-0047-H-002
IN 2955-019	2x3	7	3.8	0.5	sag	3.5	1-CTY-ME02-A-0067-H-008
IN 2660-036	2x3	7	3.8	0.5	sag	3.5	1-CTY-ME02-A-0057-H-012
IN 2459-031	2x3	7	4.3	0.5	sag	3.5	1-CTY-ME02-A-0271-H-000
IN 2956-029	2x6	10	4.4	0.5	sag	5.0	1-CTY-ME02-A-0067-H-008
IN 2459-008	2x3	7	4.5	0.5	sag	3.5	1-CTY-ME02-A-0271-H-000
IN 2956-018	2x3	7	4.7	0.5	sag	3.5	1-CTY-ME02-A-0067-H-008
IN 2459-032	2x3	7	5.4	0.5	sag	3.5	1-CTY-ME02-A-0271-H-000
IN 3250-011	2x6	10	5.5	0.5	sag	5.0	1-CTY-ME02-A-0043-A-038
IN 2459-010	2x3	7	5.7	0.5	sag	3.5	1-CTY-ME02-A-0271-H-000
IN 2955-018	2x3	7	5.9	0.5	sag	3.5	1-CTY-ME02-A-0067-H-008
IN 2756-060	2x3	7	6.3	0.5	sag	3.5	1-CTY-ME02-A-0050-H-003
IN 2660-002	2x3	7	6.4	0.5	sag	3.5	1-CTY-ME02-A-0057-H-012
IN 2757-059	2x6	10	6.5	0.5	sag	5.0	1-CTY-BM03-A-0339-H-010
IN 2859-003	7x7	28	6.5	0.5	sag	14.0	1-CTY-BM03-A-0339-H-005
IN 3250-012	2x6	10	6.6	0.5	sag	5.0	1-CTY-ME02-A-0043-A-038
IN 2755-018	2x3	7	7.8	0.5	sag	3.5	1-CTY-ME02-A-0050-H-003
IN 3356-027	2x3	7	7.9	0.5	sag	3.5	1-CTY-ME02-A-0047-H-002
IN 3250-048	2x3	7	8.0	0.5	sag	3.5	1-CTY-ME02-A-0043-A-038
IN 3355-009	2x3	7	8.0	0.5	sag	3.5	1-CTY-ME02-A-0047-H-002
IN 2859-013	2x3	7	8.2	0.5	sag	3.5	1-CTY-BM03-A-0339-H-005
IN 2459-009	2x3	7	8.4	0.5	sag	3.5	1-CTY-ME02-A-0271-H-000
IN 2359-017	4x4	12	8.7	0.5	sag	6.0	1-CTY-ME02-A-0271-H-015
IN 2859-014	2x3	7	8.8	0.5	sag	3.5	1-CTY-BM03-A-0339-H-005
IN 2359-010	4x4	12	9.8	0.5	sag	6.0	1-CTY-ME02-A-0271-H-004
IN 2757-045	2x6	10	10.5	0.5	sag	5.0	1-CTY-BM03-A-0339-H-010
IN 3355-010	2x3	7	11.1	0.5	sag	3.5	1-CTY-ME02-A-0047-H-002
IN 3548-001	2x3	7	14.4	0.5	sag	3.5	1-CTY-ME03-U-0295-A-001
IN 2859-006	3x3	9	14.5	0.5	sag	4.5	1-CTY-BM03-A-0339-H-005
IN 3547-002	2x3	7	31.4	0.5	sag	3.5	1-CTY-ME03-U-0295-A-001

*City inlets from GIS database (source "stm_structures_updated_DANE.shp)
*Stucture size from CITY GIS data
*Equivalent wier leng prior to clogging assuming three sides of the inlet
*Slope calculated from DEM

Receiving Weir	Weir Length
1-PVT-T-BM03-A-0340-003	12
1-PVT-ME02-A-0272-H-008	24
1-PVT-ME02-A-0271-H-008	60
1-PVT-ME02-A-0271-H-000	28
1-PVT-ME02-A-0067-H-007	56
1-PVT-ME02-A-0067-H-001	48
1-PVT-ME02-A-0066-H-006	24
1-PVT-ME02-A-0066-H-001	68
1-PVT-ME02-A-0063-H-003	12
1-PVT-ME02-A-0063-H-002	20
1-PVT-ME02-A-0063-H-001	20
1-PVT-ME02-A-0063-H-000	28
1-PVT-ME02-A-0062-H-005	20
1-PVT-ME02-A-0062-H-004	20
1-PVT-ME02-A-0062-H-003	16
1-PVT-ME02-A-0062-H-002	72
1-PVT-ME02-A-0062-H-001	32
1-PVT-ME02-A-0062-H-000	24
1-PVT-ME02-A-0061-H-001	36
1-PVT-ME02-A-0061-H-000	56
1-PVT-ME02-A-0060-H-010	28
1-PVT-ME02-A-0060-H-006	48
1-PVT-ME02-A-0060-H-005	14
1-PVT-ME02-A-0060-H-001	36
1-PVT-ME02-A-0060-H-000	44
1-PVT-ME02-A-0058-H-003	8
1-PVT-ME02-A-0058-H-002	20
1-PVT-ME02-A-0058-H-001	4
1-PVT-ME02-A-0058-H-000	44
1-PVT-ME02-A-0057-H-002	24
1-PVT-ME02-A-0057-H-000	56
1-PVT-ME02-A-0054-H-011	44
1-PVT-ME02-A-0053-A-013	10
1-PVT-ME02-A-0053-A-011	17
1-PVT-ME02-A-0053-A-010	17
1-PVT-ME02-A-0050-H-008	20
1-PVT-ME02-A-0050-H-004	28
1-PVT-ME02-A-0048-A-039	20
1-PVT-ME02-A-0048-A-038	60
1-PVT-ME02-A-0048-A-027	60
1-PVT-ME02-A-0047-H-001	20
1-PVT-ME02-A-0046-H-005	100
1-PVT-ME02-A-0044-A-014	20
1-PVT-ME02-A-0044-A-007	20
1-PVT-ME02-A-0044-A-001	20
1-PVT-ME02-A-0043-A-093	8
1-PVT-ME02-A-0043-A-063	28
1-PVT-ME02-A-0043-A-047	20
1-PVT-ME02-A-0043-A-002	8
1-PVT-ME02-A-0043-A-001	8
1-PVT-ME02-A-0042-A-011	68
1-PVT-BM03-A-0340-H-004	12
1-PVT-BM03-A-0339-H-010	28
2-PVT-ME02-A-0066-H-002	52
2-PVT-ME02-A-0057-H-000	20
2-PVT-ME02-A-0051-A-004	32

*Private inlets were modeled for subcatchements containing 5 or more inlets or in areas where it was deemed necessary to model connection with the City Stormsewer (source "STO_E_PVT Graphic Cell)
*Since there inlet dimensions are not included in the City GIS layer, each inlet was assumed to be a 1'x1' inlet for an equivalent weir length of 4'
*Total equivalent weir length per subcatchment is included in this table.
*No clooging factors were applied to private inlets

Appendix F – Focus Group Summaries

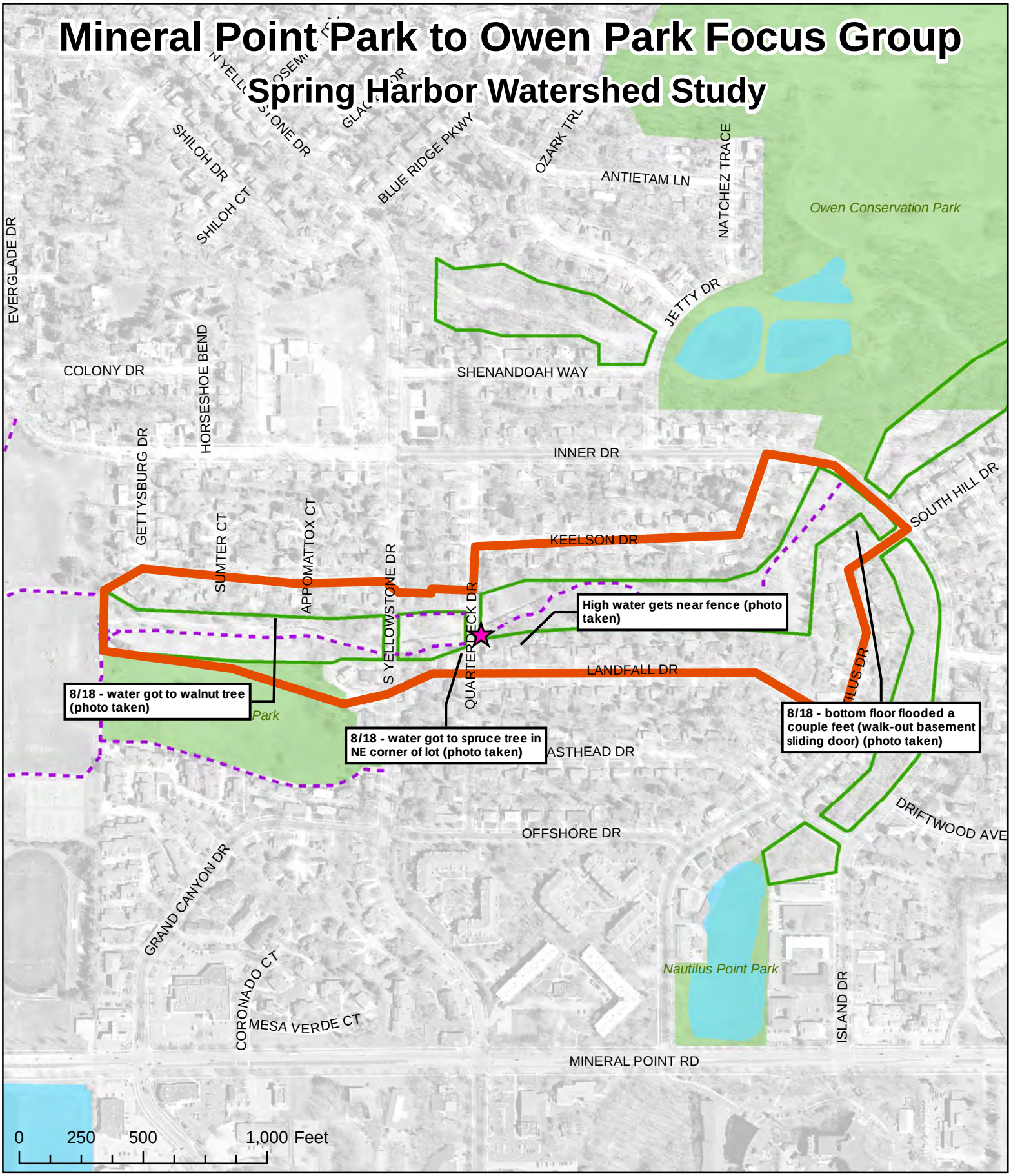
Focus Group 2 #1

Focus Group: Mineral Point to Owen Park

- Date: August 28, 2019
- City Representatives in Attendance
    - Jojo O'Brien, City of Madison Stormwater Engineer
    - Hannah Mohelnitzky, City of Madison Public Information Officer
    - Keith Furman, Alder District 19
    - Amber Lefers, Watershed Study Consultant Project Manager
- Total Resident Attendees (Recorded): 9, 13 attended
- History of Flooding:
    - Quarterdeck and Yellowstone overtop frequently
    - One house was flooded near Inner Drive in August 2018 storm.
- Key Observations
    - August 2018 high water marks were pointed out at three locations:
        - Concrete channel drop structure / storm sewer outlet
        - Upstream of Quarterdeck
        - Upstream of Inner Drive

Mineral Point Park to Owen Park Focus Group

Spring Harbor Watershed Study



Meeting Location

Focus Group Area

Bike Path

Park

Greenway

Stormwater Pond

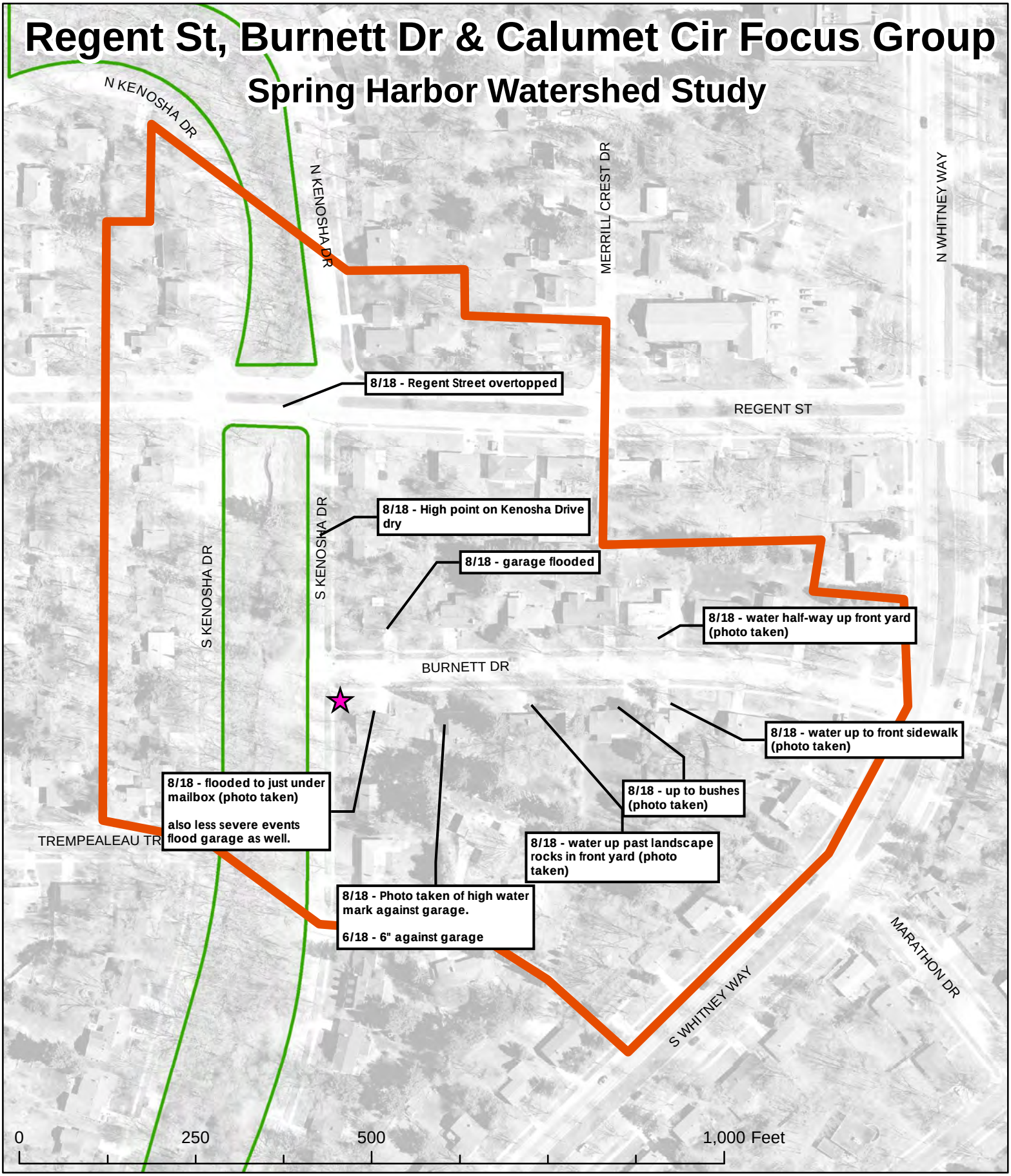
N

Focus Group: Regent St., Burnett Dr., and Calumet Cir.

- Date: August 29, 2019
- City Representatives in Attendance
    - Janet Schmidt, City of Madison Principal Stormwater Engineer
    - Hannah Mohelnitzky, City of Madison Public Information Officer
    - Amber Lefers, Watershed Study Consultant Project Manager
- Total Resident Attendees (Recorded): 19
- History of Flooding:
    - Frequent flooding along western end of Burnett Drive.
    - Several houses flooded in August 2018 Storm
- Key Observations
    - August 2018 high water marks were pointed out at several locations along Burnett Drive that were used in model validation.

Regent St, Burnett Dr & Calumet Cir Focus Group

Spring Harbor Watershed Study



Meeting Location

Focus Group Area

Park

Greenway

Stormwater Pond

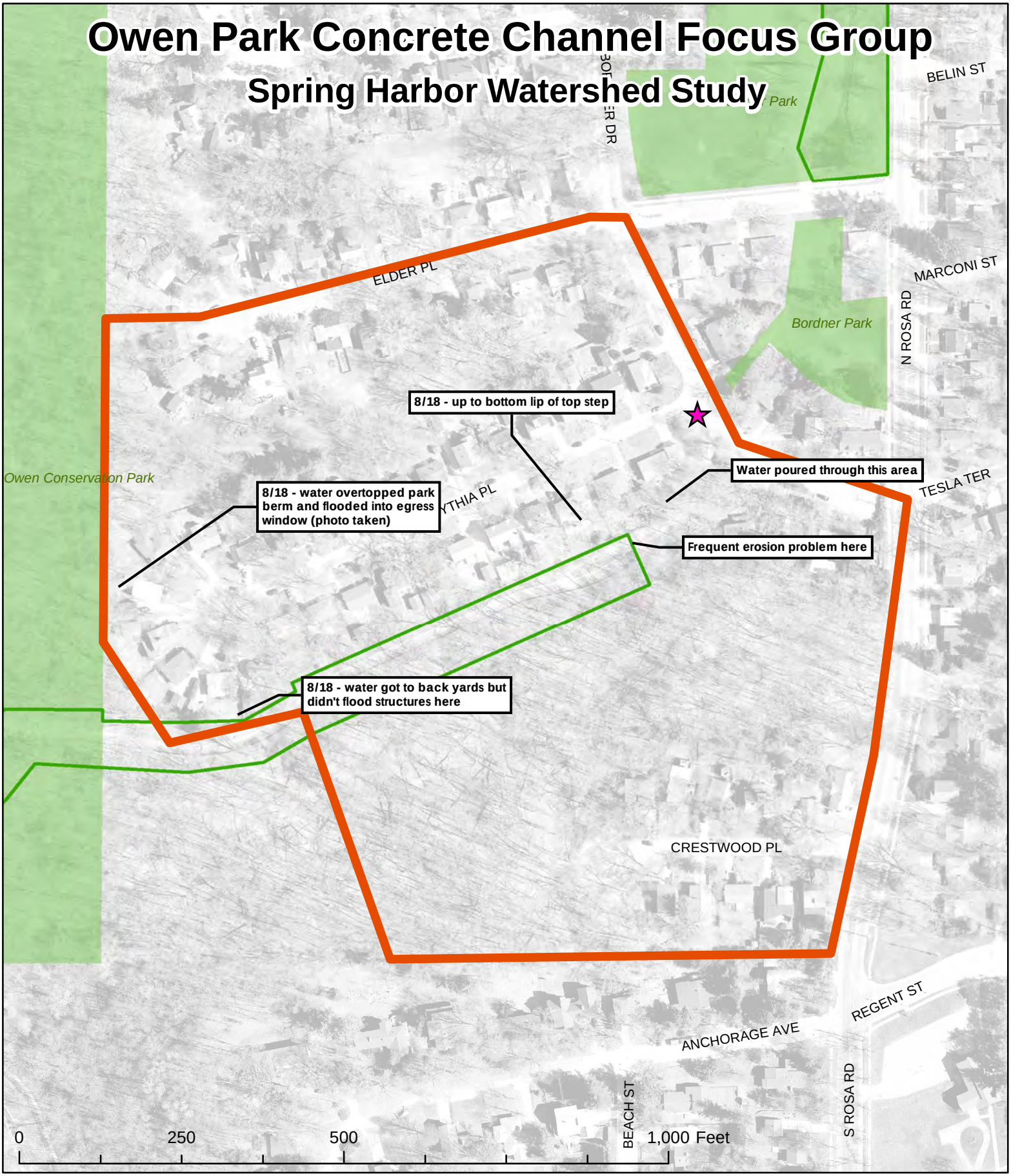
N

Focus Group: Owen Park Cunnette

- Date: August 29, 2019
- City Representatives in Attendance
    - Janet Schmidt, City of Madison Principal Stormwater Engineer
    - Hannah Mohelnitzky, City of Madison Public Information Officer
    - Amber Lefers, Watershed Study Consultant Project Manager
- Total Resident Attendees (Recorded): 18
- History of Flooding:
    - Concrete channel frequently has rapidly moving water
    - Several houses flooded in August 2018
- Key Observations
    - Owen Park Cunnette overflowed, and water ran overland towards Forsythia Place and Bordner Drive.
    - Channel along eastern edge of Owen Park overtopped and sent water towards houses along the western end of Forsythia Place.

Owen Park Concrete Channel Focus Group

Spring Harbor Watershed Study



Meeting Location

Focus Group Area

Park

Greenway

Stormwater Pond

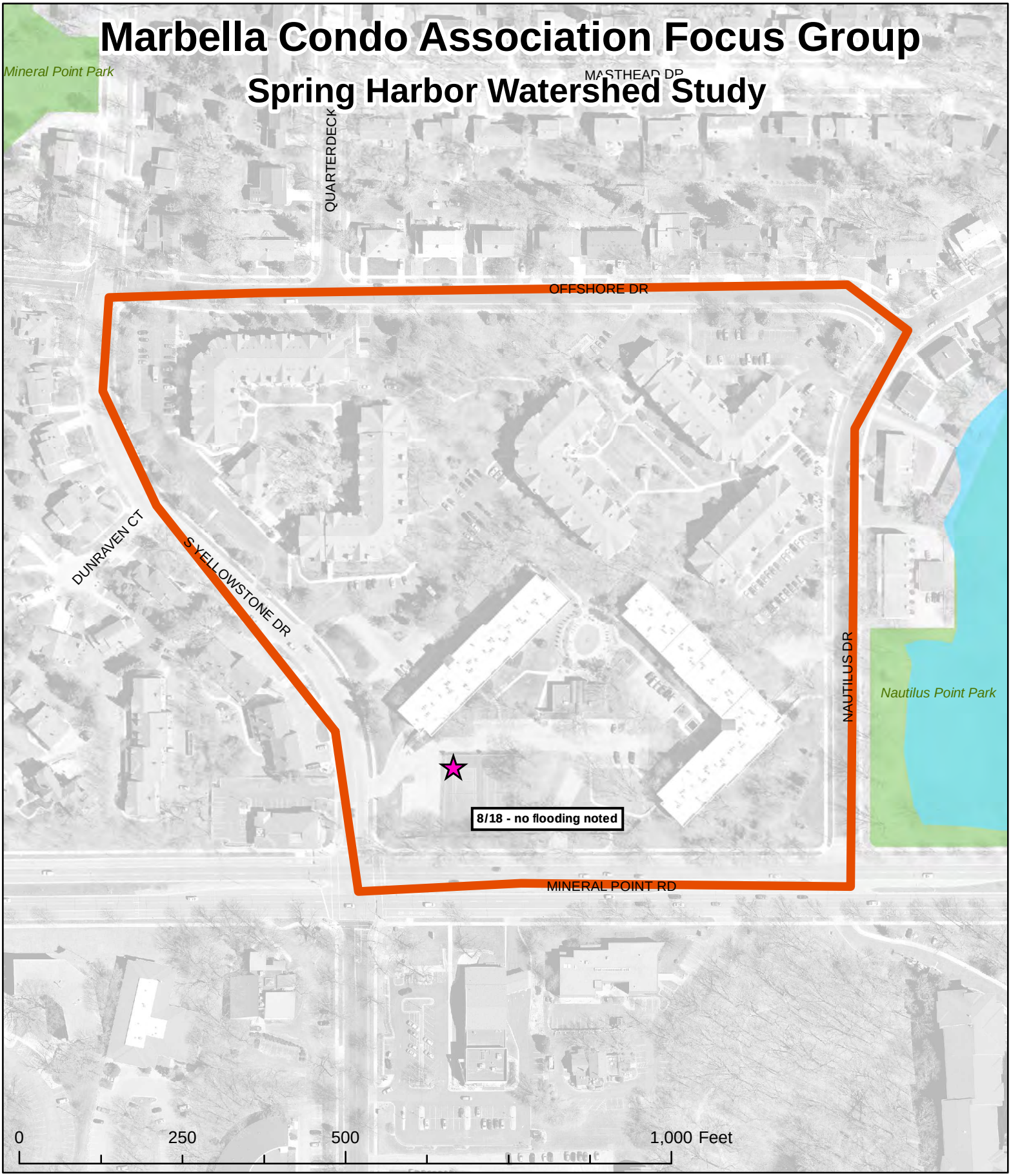
N

Focus Group: Marbella Condo Association

- Date: August 30, 2019
- City Representatives in Attendance
    - Janet Schmidt, City of Madison Principal Stormwater Engineer
    - Amber Lefers, Watershed Study Consultant Project Manager
- Total Resident Attendees (Recorded): 6
- History of Flooding:
    - None
- Key Observations
    - None

Marbella Condo Association Focus Group

Spring Harbor Watershed Study



Meeting Location

Focus Group Area

Park

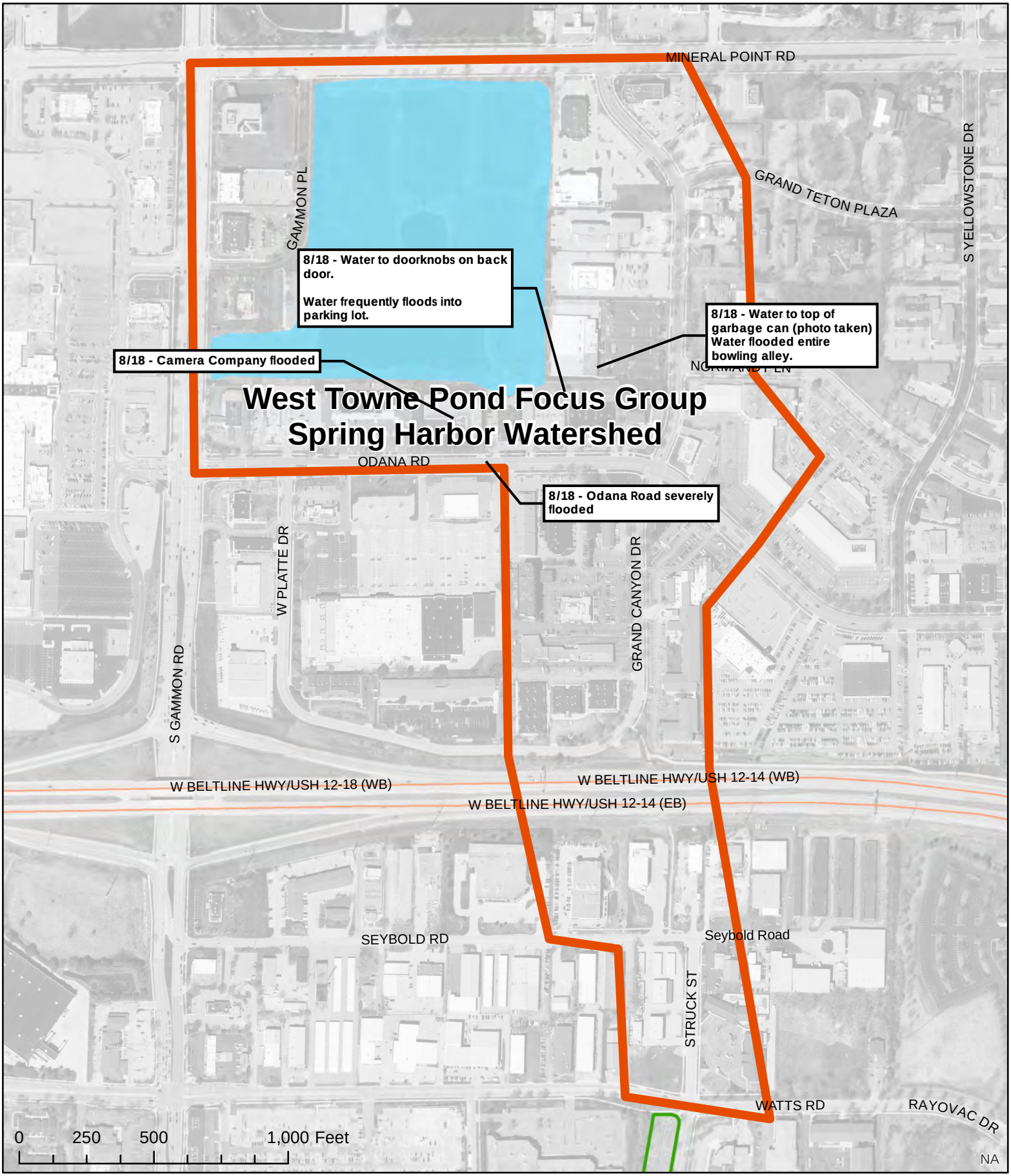
Greenway

Stormwater Pond

N

Focus Group: West Towne Pond

- Date: September 16, 2019
- City Representatives in Attendance
    - Jojo O'Brien, City of Madison Stormwater Engineer
    - Amber Lefers, Watershed Study Consultant Project Manager
- Total Resident Attendees (Recorded): 6
- History of Flooding:
    - Several businesses were flooded significantly in August 2018 Storm
    - Water frequently floods parking lot on southeast corner of pond
- Key Observations
    - Business owners pointed out two high water marks on buildings in the southeast corner of the pond that were used in model validation.
    - One business owner shared a poster board with photos of the impact the flood had on their business.



Focus Group Area

Focus Group Area

Greenway

Park

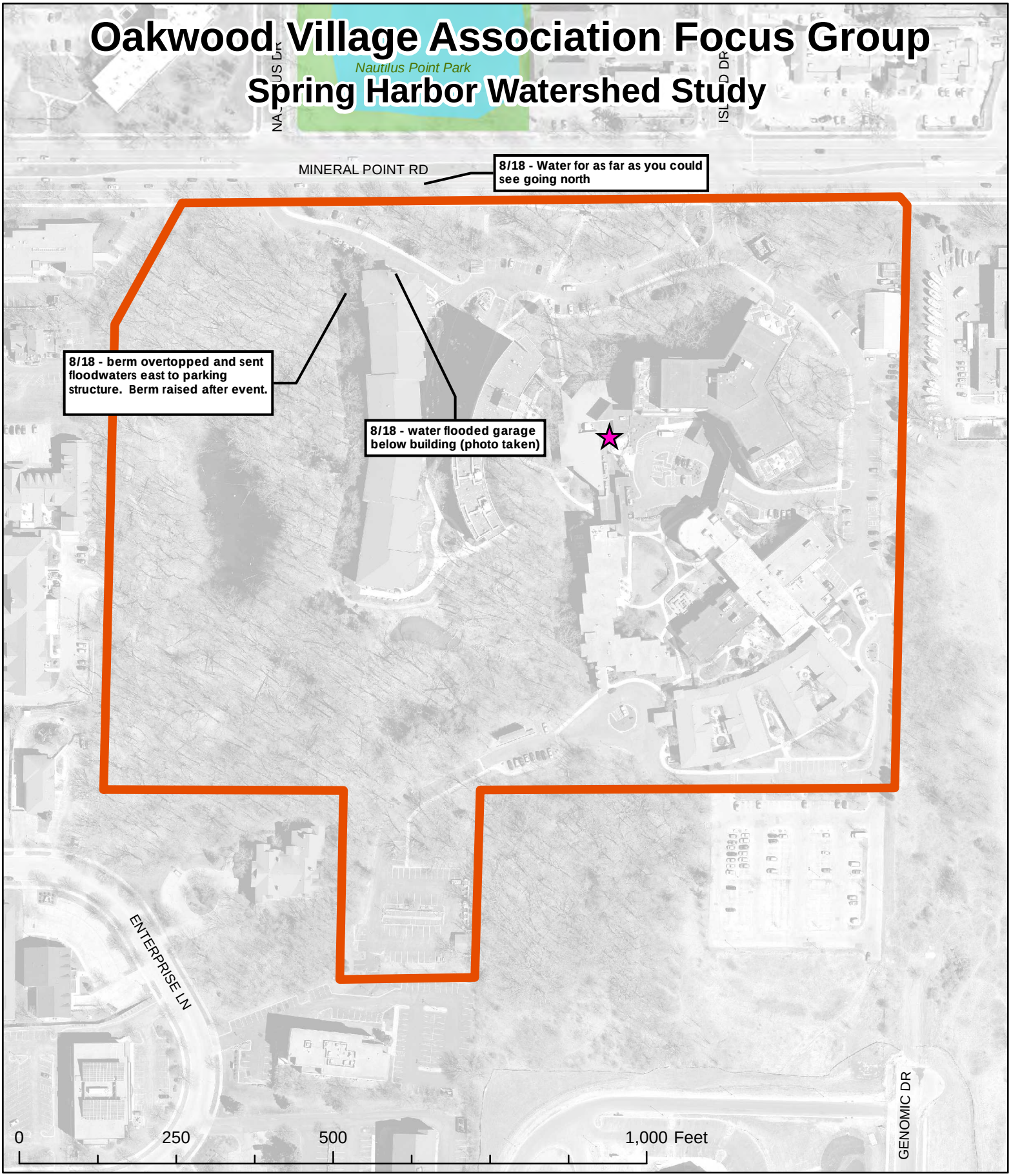
Stormwater Pond

N

Focus Group: Oakwood Village Association

- Date: September 18, 2019
- City Representatives in Attendance
    - Jojo O'Brien, City of Madison Stormwater Engineer
    - Hannah Mohelnitzky, City of Madison Public Information Officer
    - Keith Furman, Alder District 19
    - Amber Lefers, Watershed Study Consultant Project Manager
- Total Resident Attendees (Recorded): 32
- History of Flooding:
    - One of the ground level parking garages had severe flooding in the August 2018 storm.
    - Prior to that, no history of flood damage
- Key Observations
    - The Oakwood Village manager provided a tour of the grounds and the area that flooded, including showing how high flood waters got in the ground level parking garage.
    - Mineral Point Road was also flooded, and there was not any dry ground from Oakwood Village to north of Mineral Point Road (Nautilus Pond).
-

Oakwood Village Association Focus Group
Spring Harbor Watershed Study



Meeting Location
Focus Group Area
Park
Greenway
Stormwater Pond

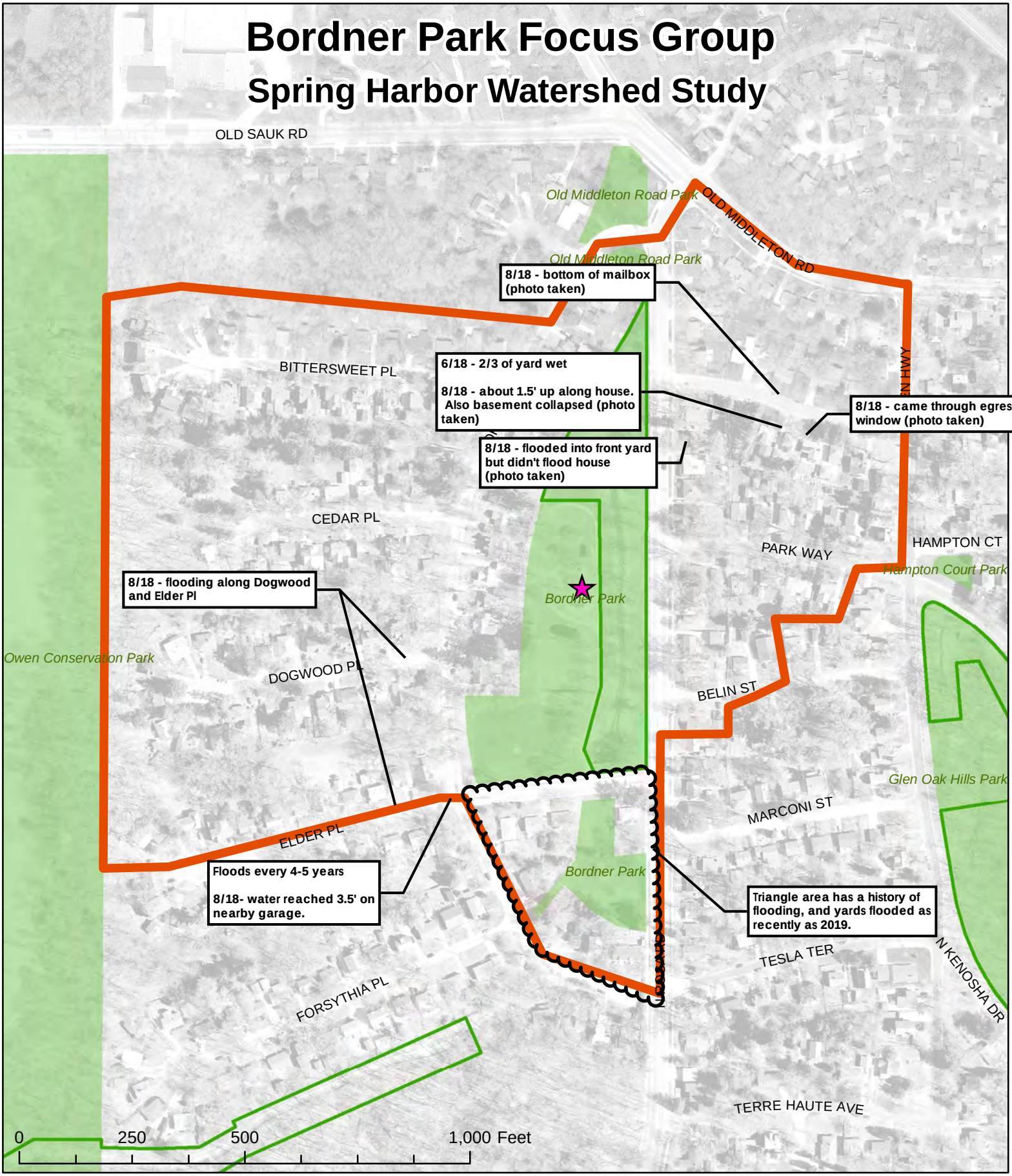
N

Focus Group: Bordner Park

- Date: September 19, 2019
- City Representatives in Attendance
    - Jojo O'Brien, City of Madison Stormwater Engineer
    - Hannah Mohelnitzky, City of Madison Public Information Officer
    - Amber Lefers, Watershed Study Consultant Project Manager
- Total Resident Attendees (Recorded): 21
- History of Flooding:
    - Gettle Avenue east of Bordner Park floods with some frequency.
    - Numerous homes along Gettle Avenue had significant flood damage in the August 2018 storm.
    - August 2018 caused flooding on Elder Place and Dogwood Place.
    - In August 2018 water flowed down Bittersweet Place to Bordner Dr and was as high as the front step on the east side or Bordner Dr, yet didn't flood the home.
    - Houses in the triangular area between N Rosa Rd, Bordner Dr and Elder Pl have historically flooded. Residents recollected their homes flooding in the 1950s, and yards flooded as recently as 2019.
- Key Observations
    - Several high-water marks from the August 2018 storm were provided by residents along Gettle Avenue and Rosa Road that were used in model validation.
    - The August 2018 storm flooded Rosa Road and the water reached near the homes but did not flood the structures themselves.
    - Flooding occurs every 4-5 years at Elder Place and Bordner Dr intersection. Water reached top of fire hydrant at this corner in August 2018, and water reached 3.5' high on a nearby garage.

Bordner Park Focus Group

Spring Harbor Watershed Study



Meeting Location

Focus Group Area

Park

Greenway

Stormwater Pond

N

Focus Group: Spring Harbor Neighborhood Association

- Date: October 3, 2019
- City Representatives in Attendance
  - Jojo O'Brien, City of Madison Stormwater Engineer
  - Hannah Mohelnitzky, City of Madison Public Information Officer
  - Keith Furman, Alder District 19
  - Amber Lefers, Watershed Study Consultant Project Manager
- Total Resident Attendees (Recorded): 17
- History of Flooding:
  - No history of flooding, but Craig Avenue area has consistent groundwater seepage issues that cause severe icing issues in the winter.
  - Large rain garden off Norman Way has supposedly added to frequency of flooding of the neighbor's backyard.
  - Overland flow through yards adjacent to Norman Way has caused flooding/erosion issues to neighbors. No curb/gutter in this area.
- Key Observations
  - None

Spring Harbor NA Focus Group
Spring Harbor Watershed Study

Meeting Location

Focus Group Area

Park

Greenway

Stormwater Pond

N

Focus Group #2 (Held after PIM #2)

-Date: February 24, 2020

-Location: John Muir Elementary School

-City Representatives in Attendance

- Jojo O'Brien, Project Manager, City Stormwater Section
- Caroline Burger, Stormwater Section, City Engineering
- Janet Schmidt, Principal Engineer of Stormwater Section
- Greg Fries, Deputy City Engineer
- Sally Swenson, Stormwater Section, City Engineering
- Richie Breidenbach, Stormwater Section, City Engineering
- Matt Allie, Stormwater Section, City Engineering
- Phil Gaebler, Stormwater Section, City Engineering
- Lauren Striegl, Stormwater Section, City Engineering
- Sarah Lerner, Stormwater Section, City Engineering
- Amber Lefers, AE2S, Consultant completing the modeling
- Linda Severson, AE2S, Consultant completing the modeling
- Steve Gaffield, Emmons & Oliver Resources, Consultant completing the modeling

- General Key Observations
  - Many residents mentioned the maps generally reflected personal flooding experience from small to large storms.
- Detailed Feedback
  - Resident on Bordner Drive north of Bordner Park observed little to no flooding during small rainfall storms. In the 2018 flood they overserved water running past both sides of the house
  - Resident on Gettle Avenue mentioned the 2018 map was very accurate. Resident that lived on the Gettle Drive for 15 years mentioned they have only observed flooding twice in the past: July 2019 and August 2018.
  - A resident mentioned that in 2018, the private pond located at the northwest corner of the intersection of Old Middleton Road and Glen Hollow Road crested the road, but adjacent properties were not impacted. The resident was inquiring about maintenance responsibility.

- A resident located on Marconi Street has had flooding issues associated with the flow from the hill in the backyard but not the street itself.
- A resident located north of Marconi Street mentioned the frequency their raingarden fills has gone from every three years to a few times a year.
- There was concern over the debris that accumulates at the inlet to the flume under Bordner Drive as it creates a safety concern
- A resident mentioned there was no flooding at Yorktown Estates in the August 2018 storm.

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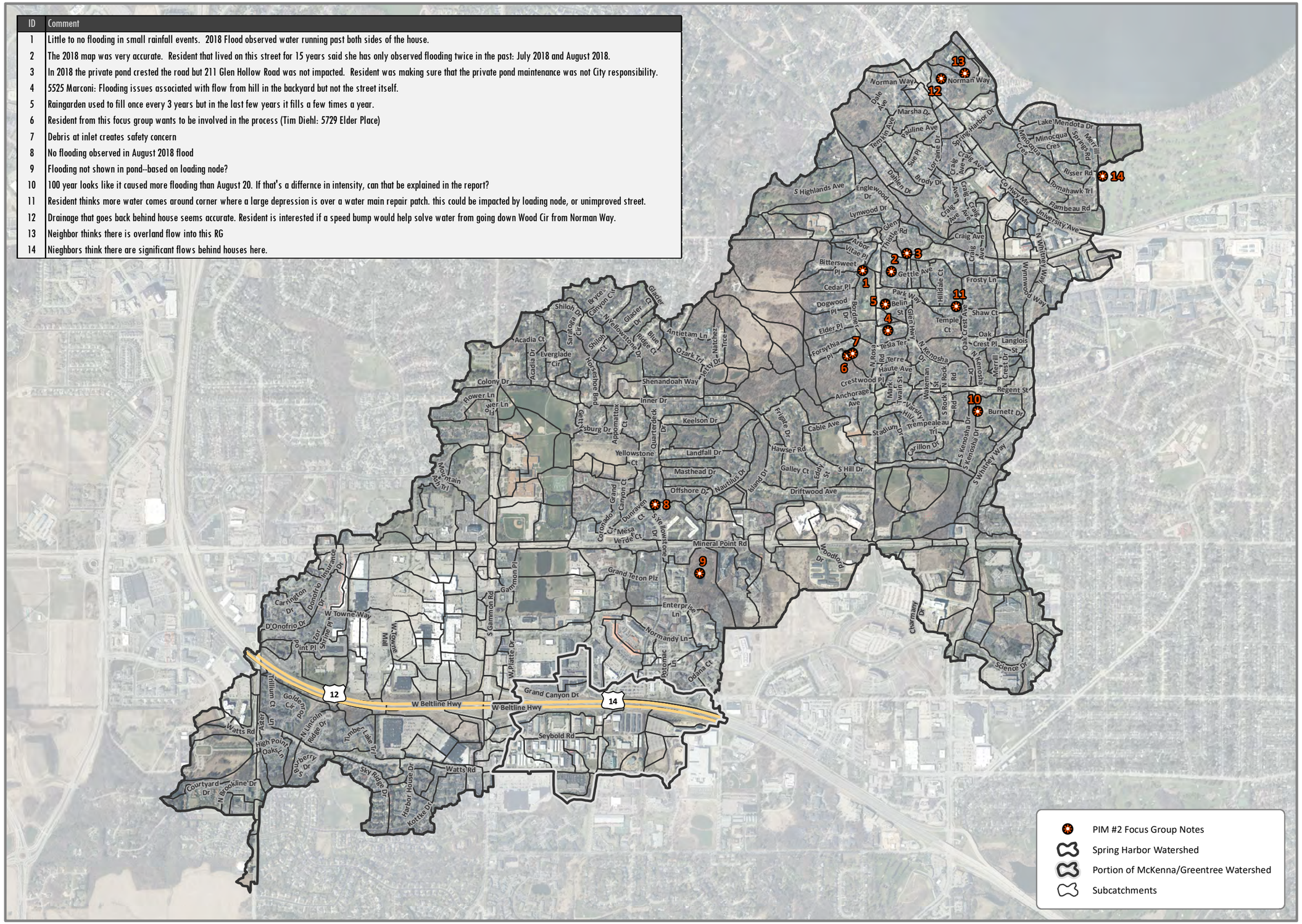
ID	Comment
1	Little to no flooding in small rainfall events. 2018 Flood observed water running past both sides of the house.
2	The 2018 map was very accurate. Resident that lived on this street for 15 years said she has only observed flooding twice in the past: July 2018 and August 2018.
3	In 2018 the private pond crested the road but 211 Glen Hollow Road was not impacted. Resident was making sure that the private pond maintenance was not City responsibility.
4	5525 Marconi: Flooding issues associated with flow from hill in the backyard but not the street itself.
5	Raingarden used to fill once every 3 years but in the last few years it fills a few times a year.
6	Resident from this focus group wants to be involved in the process (Tim Diehl: 5729 Elder Place)
7	Debris at inlet creates safety concern
8	No flooding observed in August 2018 flood
9	Flooding not shown in pond--based on loading node?
10	100 year looks like it caused more flooding than August 20. If that's a differnce in intensity, can that be explained in the report?
11	Resident thinks more water comes around corner where a large depression is over a water main repair patch. this could be impacted by loading node, or unimproved street.
12	Drainage that goes back behind house seems accurate. Resident is interested if a speed bump would help solve water from going down Wood Cir from Norman Way.
13	Neighbor thinks there is overland flow into this RG
14	Nieghbors think there are significant flows behind houses here.



Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Appendix F- PIM 2 Focus Group Notes.mxd

N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Appendix F

PIM #2 FOCUS GROUP NOTES

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 8/3/2021

Focus Groups #3 (Held after PIM #3)

- Date: June 30, 2021
- Location: Zoom
- City Representatives in Attendance
    - Jojo O'Brien, Project Manager, City Stormwater Section
    - Caroline Burger, Stormwater Section, City Engineering
    - Janet Schmidt, Principal Engineer of Stormwater Section
    - Greg Fries, Deputy City Engineer
    - Matt Allie, Stormwater Section, City Engineering
    - Lauren Striegl, Stormwater Section, City Engineering
    - Sarah Lerner, Stormwater Section, City Engineering
    - Amber Lefers, AE2S, Consultant completing the modeling
    - Linda Severson, AE2S, Consultant completing the modeling
    - Steve Gaffield, Emmons & Oliver Resources, Consultant completing the modeling
    - Alder Barbara Harrington-McKinney—District 1
    - Alder Arvina Martin—District 11
    - Alder Nikki Conklin—District 9
    - Alder Keith Furman—District 19
- Focus Groups
    - **West Towne Pond (4 participants)**
        - Mention that there is some reconstruction that is going to occur at Memorial High School and reconstructing the proposed outlet to West Towne Ponds would make sense to do at the same time.
        - Questions on how the proposed West Towne Ponds would affect the discharge of the pipes that leave Memorial High School and drain towards the pond. Response that the City would be in touch so they could find out the extent of the proposed improvements and collaborate where appropriate.
        - Resident stated the proposed solutions make sense
        - MMSD's Memorial High School designer thought that their storm sewer discharges directly into the pond.

- Concern that goldfish as an invasive species have taken over numerous City detention ponds and would become a problem in this pond.

- **Kenosha Greenway and Regent Street Greenway Crossing**
  - Concerns about tree removal in Kenosha Greenway. Resident would prefer to use Garner pond for more stormwater storage instead of needing to regrade the Kenosha Greenway.
  - Request to have Garner Park dredged.
  - Concerns about increased downstream flow/volumes to Spring Harbor.
  - Appreciation from folks on Burnett for the curb cut work that is currently being done.
  - Neighborhood is working hard to remove buckthorn in Kenosha greenway (which also improves conveyance).
  - Concerns of increased flows via Regent Culverts. Questions on what will be done to protect downstream channel from eroding?

- **Glen Oak Hills Park Greenway/ Gettle Avenue Storm Sewer**
  - General discussion on solutions with additional detail on causes of flooding and site constraints.
  - Question on how reliable the modeling approach is for existing modeling and accurately of evaluating solutions. Response that the model framework is built on a tool developed by the EPA called the Stormwater Management Model (SWMM), and that it's been "battle tested" in projects that are much bigger than the solutions proposed in this watershed.
  - How is the Gettle Avenue project prioritized relative to the other studies that are ongoing? Response that the City is working through that process and there's a lot of need. The City started on the west side because of how hard it was hit by rainfall in 2018, but the City is starting to look at the east side as well, which has its own flooding challenges.
  - Has the City looked at naturalized solutions and how those could address flooding? Is the model suited to look at those types of solutions? Response that the modeling framework can look at these types of solutions, and while those solutions haven't been evaluated in Spring Harbor, they have been analyzed in other watersheds. While they can help, they don't address the magnitude of the challenges that need to be addressed. In addition, if we naturalize, or make what used to be

concrete "rougher", that raises the water level, which could make flooding worse on private property, and that's a delicate balance. The City is working on the green infrastructure plan. The City would be happy to sit down and discuss the process and outcomes from that initiative.

- Has engineering identified the priorities around the City and how do you determine how to implement them?

- ***Owen Park Channel and Floodwall (Along Forsythia Cunnette)***
  - Concerns over pedestrian paths across floodwall. Response that the floodwall may be able to be tied in down the slope, preserving the paths. Mention that this would need to be designed with neighborhood input.
  - Concerns over paths within Owen park. Mention of the need for culvert crossings across the channel.
  - Concerns over kids walking north south along dich to get to School. Need to maintain access.

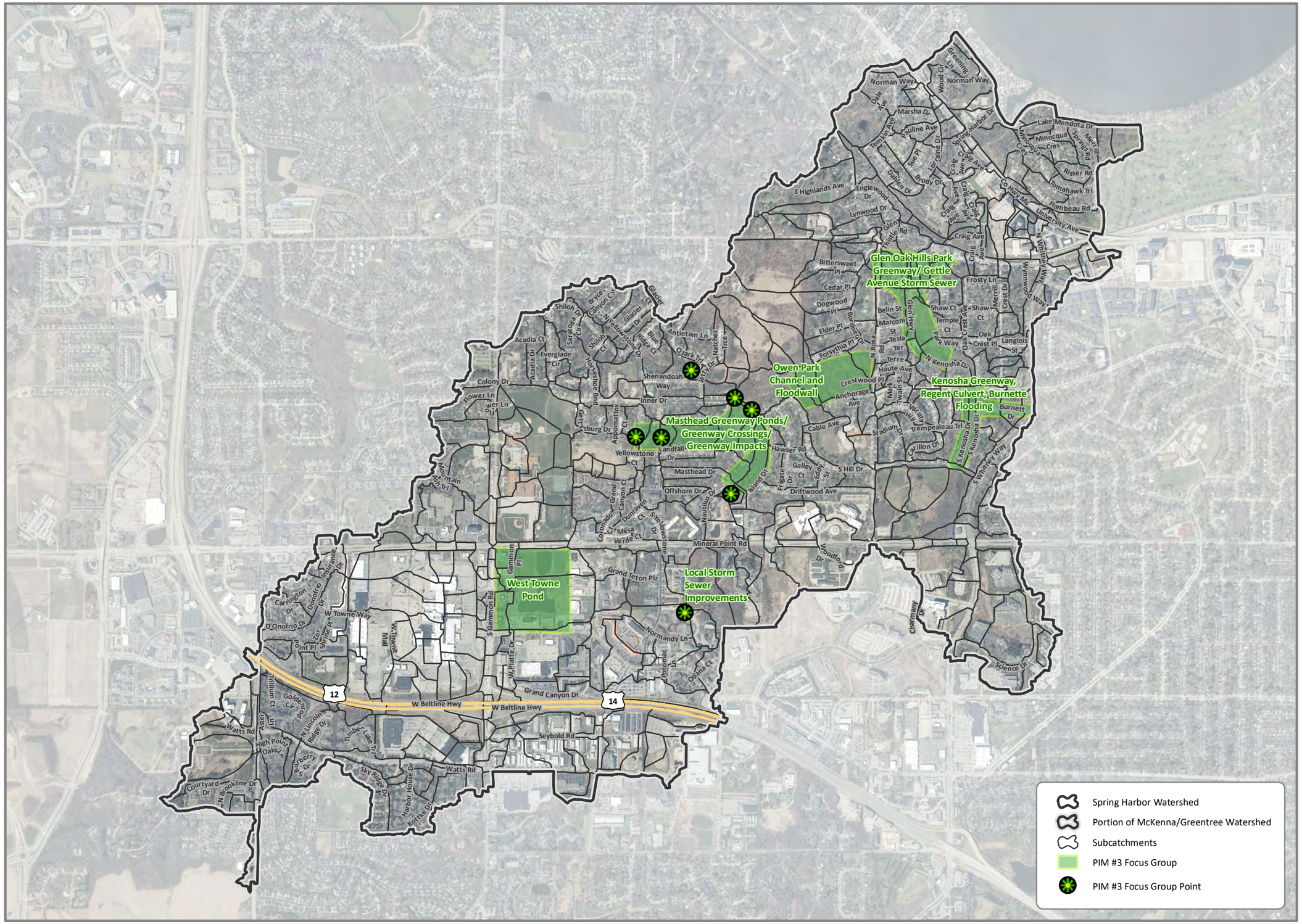
- **Masthead Greenway Ponds/ Greenway Crossings/ Greenway Impacts**
  - Excavating ponds will require lots of tree removal. This will be a drastic change in aesthetics for the neighborhood. A resident pointed to the recent Nautilus Pond work as an example of lots of trees being removed. Three residents had this concern. Requested that there be additional opportunities for public input from additional residents in the decision & design process.
  - Question as to whether the trees could remain between the two ponds. Answered that the final layout of the ponds could change, and preserving trees would be a tradeoff to consider with flood storage creation.
  - Question whether Masthead ponds would have permanent pools. Response that they do not.
  - Resident said flooding in that area hasn't been severe, and it's been possible to drive through all street flooding since 1989. We talked about impacts of smaller storms vs. large floods & showed the 100-yr existing conditions model results showing 1-3 ft water depth at several street crossings around the Masthead Ponds.
  - Resident noted existing scour problems undermining trees and if this would be addressed . Response that there would be rip rap scour protection at culvert outfalls, and the ponds would slow water and

potentially alleviate scouring. Suggested providing City with these observations now or during the design process.

- Is Oakwood Village contributing much water to this area, and have redevelopment plans there been considered. It is in this drainage area. The modeling has not considered future land use changes, but redevelopment projects must meet City ordinance requirements.
- Is there an opportunity to improve conditions with redevelopment projects in the watershed? Yes, but going beyond the ordinance is voluntary, and incentives (financial and other) would be needed.
- Question about if CUNA is building a stormwater pond as part of their redevelopment.
- Question about City process - once a project is selected, what happens to implement it? Response describing City budgeting, design, and public input process.
- There was general concern, over the number of trees that would be lost in this section of the greenway where ponds are proposed in this concept. There were discussions about the balance between space required for trees and for flood storage. The City would select native plantings for stormwater features and greenways even though that's not direct replacement of trees.
- One of the questions related to tree removal was about how this proposal would compare to previous greenway maintenance that was being discussed. Another attendee mentioned that there is a lot of erosion in this section of greenway.
- One attendee wanted clarification on what the process would look like if/when this project is selected. There was discussion on the budget and public involvement process. Attendee emphasized it's important for more area residents to provide input if the project is moving forward (rather than just the 3 or 4 at the meeting).
- One of the residents expressed the feeling that the flooding in this area really hasn't been that bad recently, or since they began living there in the 1980s. They do notice water on the road that cars can drive through. Reply that the solution aim to address City flood goals and that those goals revolve around larger design storms that don't happen as frequently.

o **<u>Local Storm Sewer Improvements/ Main Group-All Other Questions</u>**

- No Concerns



N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Appendix F

PIM 3 FOCUS GROUP LOCATIONS

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 7/27/2021

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\Nasuni\M\Madison WI\13937-2018-001\GIS\Final Report Appendix F- PIM 3 Focus Group Locations.mxd

Appendix G – Peer Review #1 Summary

Brown and Caldwell Peer Review #1
Non-Calibrated Existing Conditions Model
Date: 12/4/2019
Watershed: Spring Harbor
Client: City of Madison

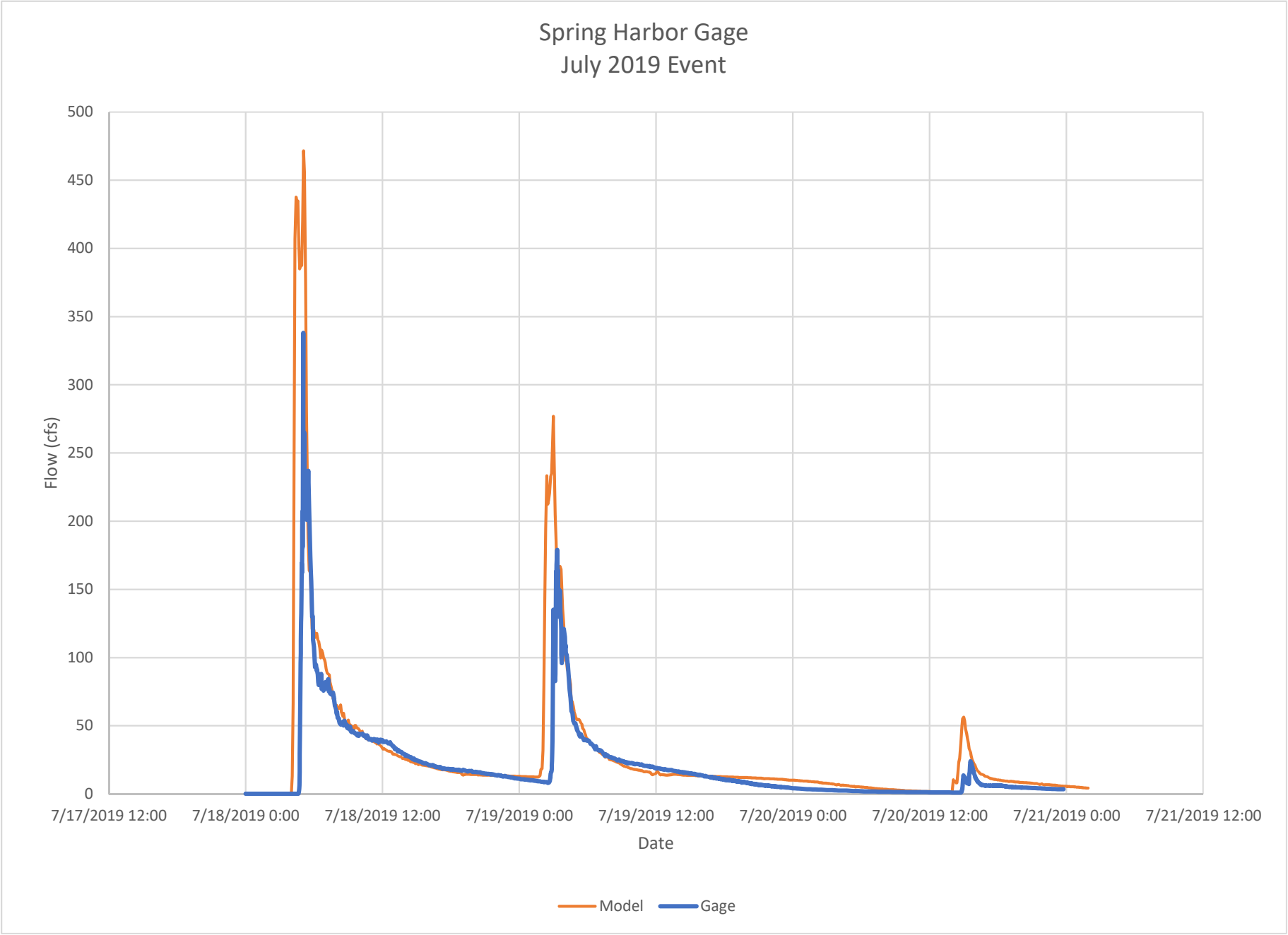
Comment Number	Comment	AE2S Response
Hydrology		
1	The width for the DCIA, non-DCIA, and pervious areas of each subbasin are the same. The current modeling guidance indicates that the width for the non-DCIA and pervious areas should be different from the DCIA width.	Response: No Action Needed. Justification: Update if need be for model calibration.
2	There are subbasins that are input into runoff nodes that are outside of the subbasin boundary. The following locations were identified where this occurs: ME02-A-0053-A-008, ME02-A-0053-A-006, ME02-A-0057-H-021, ME02-A-0057-H-012, ME02-A-0053-A-011, ME02-A-0274-H-001, ME02-A-0043-A-056, ME03-C-0041-A-006, ME02-A-0044-A-016, ME02-A-0045-A-009, ME02-A-0050-H-007. This may not be a complete list.	Response: No Action Needed Justification: In these areas subcatchments were later determined they could be combined. Rather than combining the subcachments, these runoff nodes were located next to the runoff node of the adjacent subcatchment-typically on the road surface just upstream of the storm sewer
3	There appears to be no runoff node connected to Catchment 230.	Response: This has been added. Reason: This was missed in the import process.
4	In the July 2019 storm event there is very little rainfall and runoff from the Memorial rain gage (total rain depth 0.04 inches). The other rain gages varied between 2.35- and 2.73-inches. It appears further investigation is warranted.	Response: This has been corrected. Reason: The rainfall depth at this gage is 2.5 inches. The values are entered correctly; however "intensity" rather that "Absolute Depth" was selcted.
5	Two methodologies are used for inputting runoff into the hydraulic model. It is unclear why two separate approaches are used. The approaches are described below. 1) Runoff is entered at nodes representing groups of inlets. These nodes are then connected to the storm sewer system by a weir to represent the inlets. 2) Runoff from subbasins are entered at nodes that are not connected to the conveyance system. Runoff from these areas must travel across the 2D surface to a node connected to the storm sewer system in order to enter a storm sewer.	Response: No Action Needed. Justification: Runoff draining to "orphan" nodes connected to 2D surface are to determine if streets are currently meeting criteria upstream of current storm sewer extents. Runoff draining to node connected to weir is to approximate inlets and runoff draining to street.
1D Hydraulics		
6	There were locations where the entrance/exit losses for the storm sewer system did not appear to match the modeling guidance. Various areas were spot-checked as part of the review. The following locations are identified. There may be additional locations not identified in the spot check process.	
	AS2955-001_AE2955-016 – Appears there should be an entrance loss of 0.25 for a bend.	Response: Updated
	AS3335-033_AS3356-023 – Appears there should be an exit loss of 0.5 for where the pipe enters a manhole with pipes entering from both sides.	Response: No Action Needed Justification: This Link does not exist
	AS3355-002_MI3355-003 – Appears there should be an exit loss of 0.25 for a bend	Response: Updated
	AS3350-015_AS3350-0015 – Appears the entrance loss should be 0.05 (straight-thru manhole) and the exit loss should be 0.5 (tee intersection).	Response: Updated
	A review of entrance/exit losses in XP Tables showed conduits with a entrance and/or exit loss of 0.75 in various locations. This value is not specified in the modeling guidance. A couple of these locations were spot checked (AS3348-041_AS3348-042 and AS3347-004_AS3346-011) and it was unclear that a higher loss was warranted.	Response: Updated Reason: Per guidance.
7	It appears there may be elliptical (or other "Special") pipe shapes entered as circular pipe. For example: Link WTP_FOREBAY_TO_COLLAR is input as a 3.167-foot diameter circular pipe. The City's GTviewer indicates this is a 38-inch by 60-inch HERCP. A review of other pipes sizes in XP Tables showed other circular conduits with unusual diameters which indicates the pipes may not be round.	Response: Updated Reason: This appears elliptical pipes don't import properly from InfoSWMM-this has been updated
8	Pond areas were spot-checked to identify if inlet/outlets seemed to make sense. Pond data was not provided. The model input was compared to GTviewer for the spot check.	Response: No Action Needed Justification: No discussion at meeting and pond outlets already QC'ed.
	The Nautilus Park Pond pipe connecting the upper and lower ponds did not seem to match GTviewer. It appears there may have been a recent project in this area and this may explain the difference.	Response: No Action Needed. Justification: Pond reflects ongoing project.
	Node ME02-A-0050-H-006 has a ponding type of "Sealed." This node is part of the "West Towne Ponds" system. It appears that a ponding type of "Link Invert to 2D" may be more appropriate/consistent with the modeling approach.	Response: No Action Needed Justification: This is the junction in the berm between the forebay and the southern pond with a sealed lid.
9	There are warning messages for links that read "Weir length is zero." A spot check of these links showed that there is both a "Conduit" and "Weir" selected in line 1 of the multi-link dialog box.	Response: Updated
10	There are two circular conduits with Manning's roughness values that appear to be outside the normally accepted range of values.	
	AE3357-014-003_AE3357-014-004 has a roughness value of 0.13.	Response: Updated to 0.013
	MHS_CB1_MHS_CB2 has a roughness value of 0.12	Response: Updated to 0.012
11	Various pipe profiles throughout the model were viewed. There were locations where pipes have a back-slope, or look otherwise atypical. It is understood that this may be accurate. These locations are pointed out for verification purposes. This may not be a complete list.	
	Between Nodes CB3348-097 and AS3348-045: Link AS3348-095_TP3348-027 is at a higher elevation than the upstream and downstream links.	Response: Updated
	Between Nodes ME02-A-0043-A-074 and TP3150-014-000: Link HD3150-021_TP3150-01-001 is back-sloped.	Response: No Action Needed Justification: Correct based on survey and GIS data
	Between Nodes IN3246-041 and IN3246-028: Link IN3246-034_IN3246-033 is back-sloped.	Response: No Action Needed Justification: Inverts confirmed with City GIS data
12	A weir coefficient of 0.5 is used for a number of weirs in the model. This value is inconsistent with the Modeling Guidance (values were 2.6 or 3.0).	Response: Some were updated but others-No Action Needed. Justification: In areas with "flat" overflow sections, 0.5 is appropriate. (Note that in modeling guidance, engineering judgment can be used.)
13	Inlets, and inlet capacity, are represented in the model as weirs. The weir length for each inlet is generally based on the size of a structure. In a typical 2-foot by 3-foot curb inlet a weir length of 7-feet (assumed to represent three sides of the inlet) is assigned. An overview of the inlet data indicated the majority of the inlets within the watershed are in a slope condition. Flow into inlets in a slope condition are not governed by the weir equation. An initial comparison of the weir equation to methodologies for calculating the flow into a slope inlet (HEC-22 and WisDOT FDM) indicates that the weir equation may under-predict, or over-predict, flow into an inlet.	Response: No Action Needed. Justification: We agree that the weir equation may overpredict or underpredict, but short of modeling every inlet with HEC-22 methodology, the weir equation is a reasonable representation.
2D Hydraulics		
14	A grid size of 15-feet was used within the model. All open channels within the model are analyzed using the 2D grid (there are no 1D open channels in the model). The XPSWMM help file provides guidance that a cell size would preferably have at least three to four cells across major flow-paths. (https://help.innovyze.com/display/xps/Is+a+2D+or+1D-2D+Model+Feasible).	Response: No Action Needed. Justification: We also ran the model with a 5-foot grid and 1-second timestep (and completed as a stable run). However, this takes 30 hours running on the GPU processor. Final inundation mapping will be completed with a finer grid than the 15-foot grid as time allows.

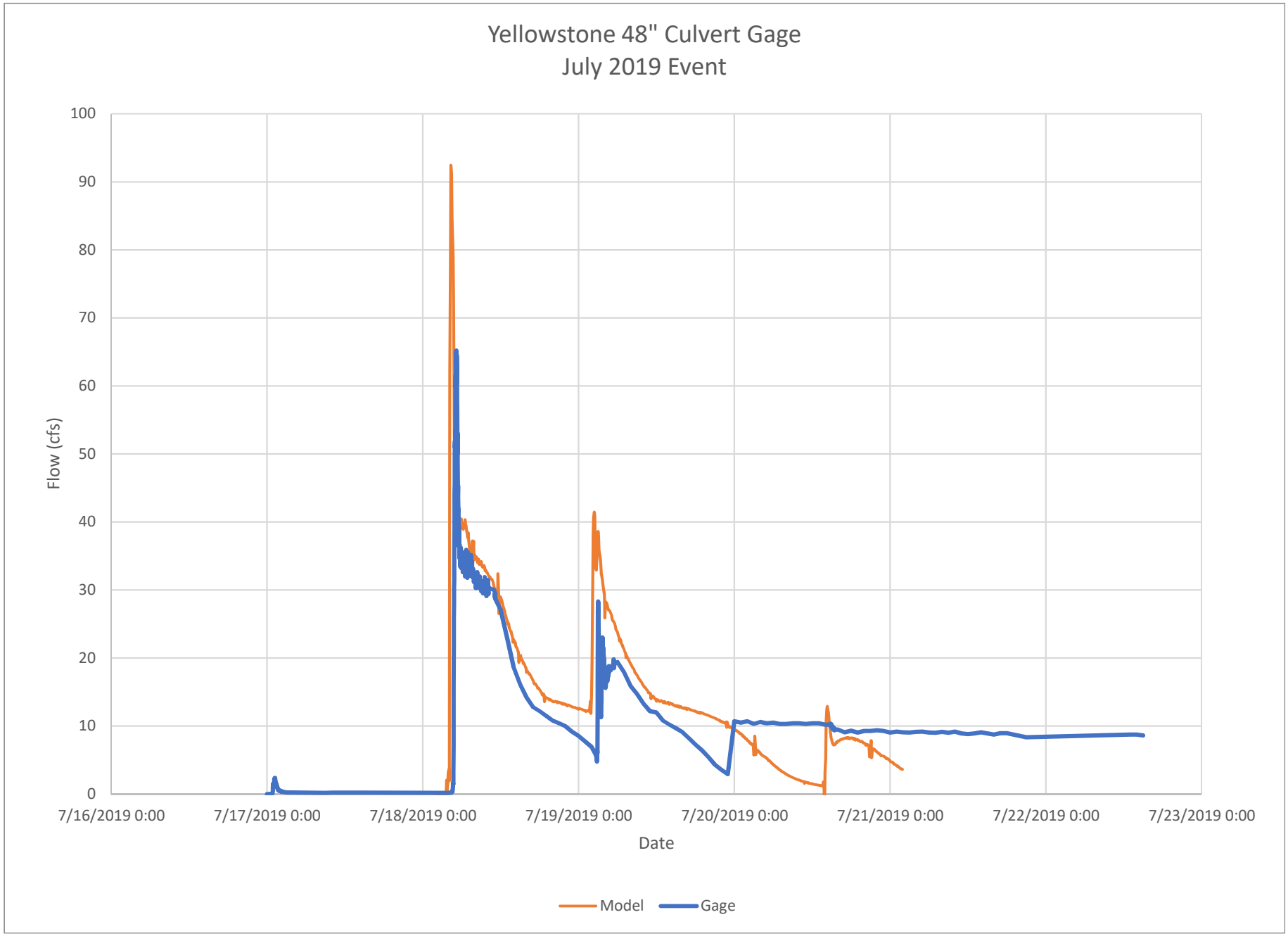
Brown and Caldwell Peer Review #1
Non-Calibrated Existing Conditions Model
Date: 12/4/2019
Watershed: Spring Harbor
Client: City of Madison

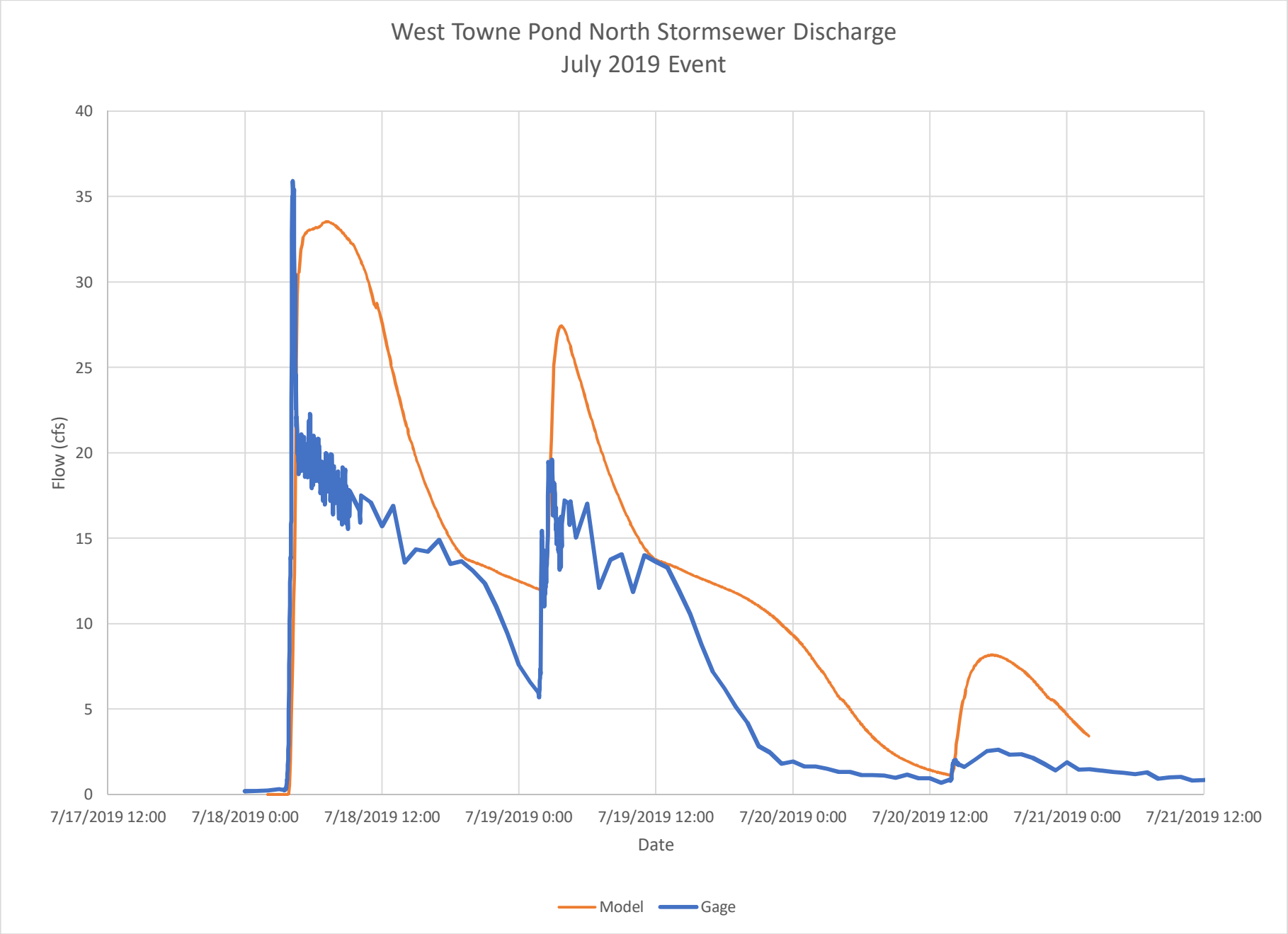
Comment Number	Comment	AE2S Response
15	The 2D surface roughness ranges from 0.016 to 0.1. These values are considerably lower than the roughness values provided in the latest Modeling Guidance document.	Response: No Action Needed. Justification: These values are consistent with open channel flow conditions, which is the focus of this Watershed Study.
16	Buildings are not included as inactive areas. Water is currently allowed to flow through building areas. This is inconsistent with the latest Modeling Guidance document.	Response: Buildings added per City direction.
17	As previously noted, a 15-foot grid size was used for the 2D surface. Consideration should be given to the grid size when defining flow along roads. There are subbasin nodes entered directly onto the 2D surface in the model. Runoff from these subbasins must travel along the surface to enter the storm sewer system. A grid that does not provide adequate definition may result in runoff shown in unexpected locations. If the road curb and gutter is not adequately defined, runoff may flow outside the street in even small storm events.	Response: No Action Needed. Justification: We also ran the model with a 5-foot grid and 1-second timestep (and completed as a stable run). However, this takes 30 hours running on the GPU processor. Final inundation mapping will be completed with a finer grid than the 15-foot grid.

Appendix H – Additional Calibration Information

Figure H1 2018 Model Illustration


Spring Harbor Gage
July 2019 Event
Flow (cfs)
500
450
400
350
300
250
200
150
100
50
0
7/17/2019 12:00
7/18/2019 0:00
7/18/2019 12:00
7/19/2019 0:00
7/19/2019 12:00
7/20/2019 0:00
7/20/2019 12:00
7/21/2019 0:00
7/21/2019 12:00
Date
Model
Gage


Yellowstone 48" Culvert Gage
July 2019 Event
Flow (cfs)
100
90
80
70
60
50
40
30
20
10
0
7/16/2019 0:00
7/17/2019 0:00
7/18/2019 0:00
7/19/2019 0:00
7/20/2019 0:00
7/21/2019 0:00
7/22/2019 0:00
7/23/2019 0:00
Date
Model
Gage


West Towne Pond North Stormsewer Discharge
July 2019 Event
Flow (cfs)
40
35
30
25
20
15
10
5
0
7/17/2019 12:00
7/18/2019 0:00
7/18/2019 12:00
7/19/2019 0:00
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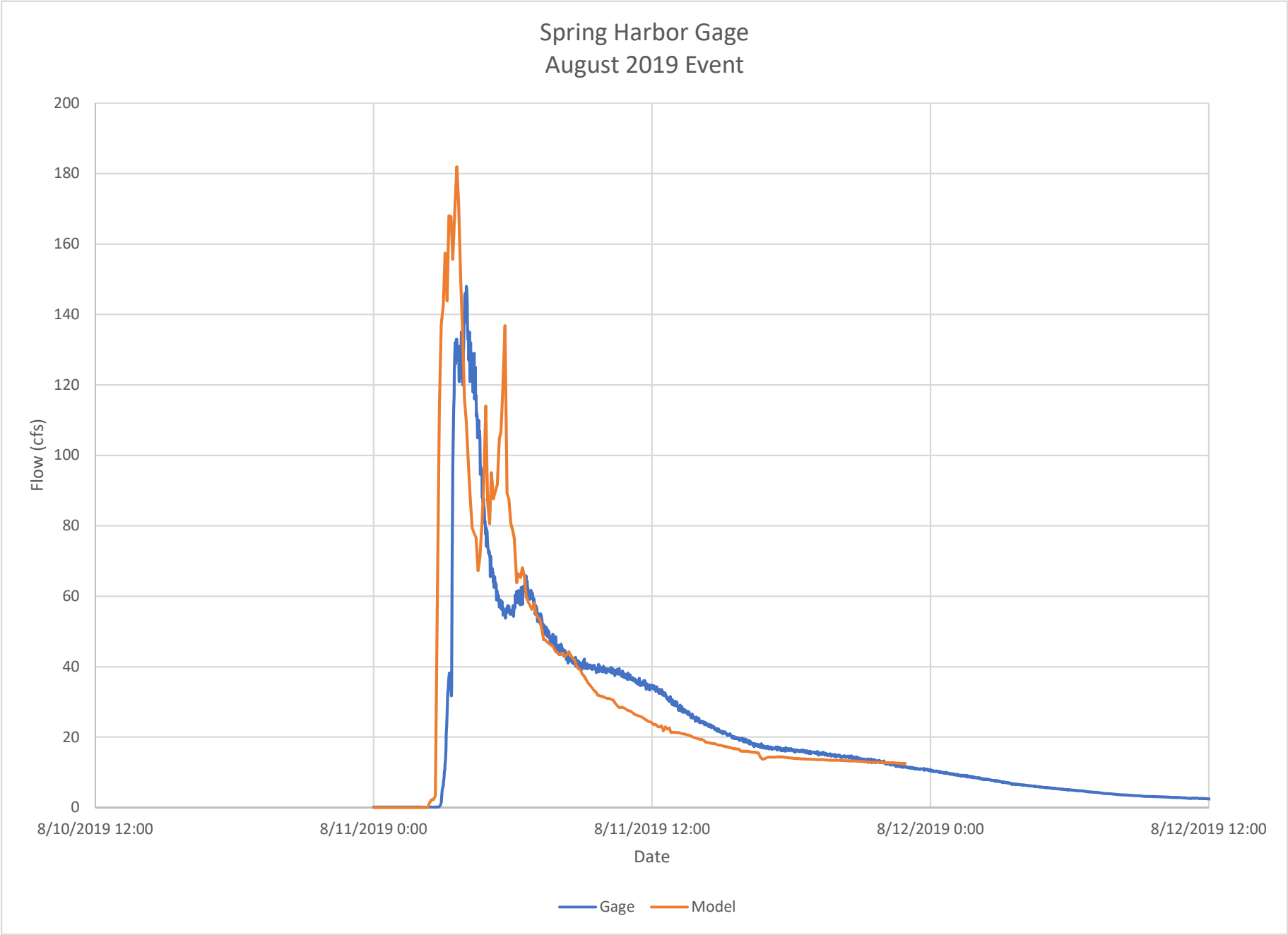
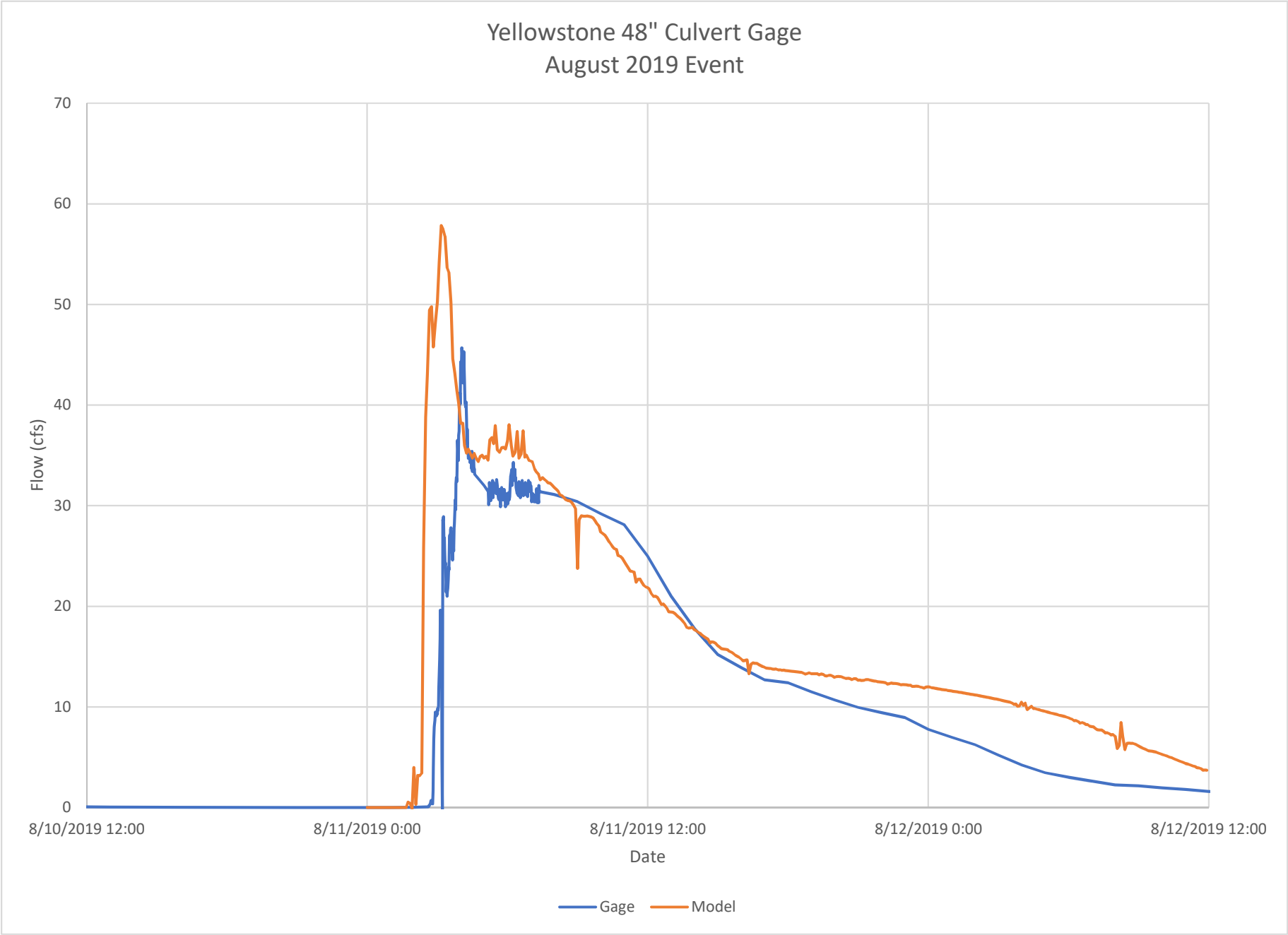
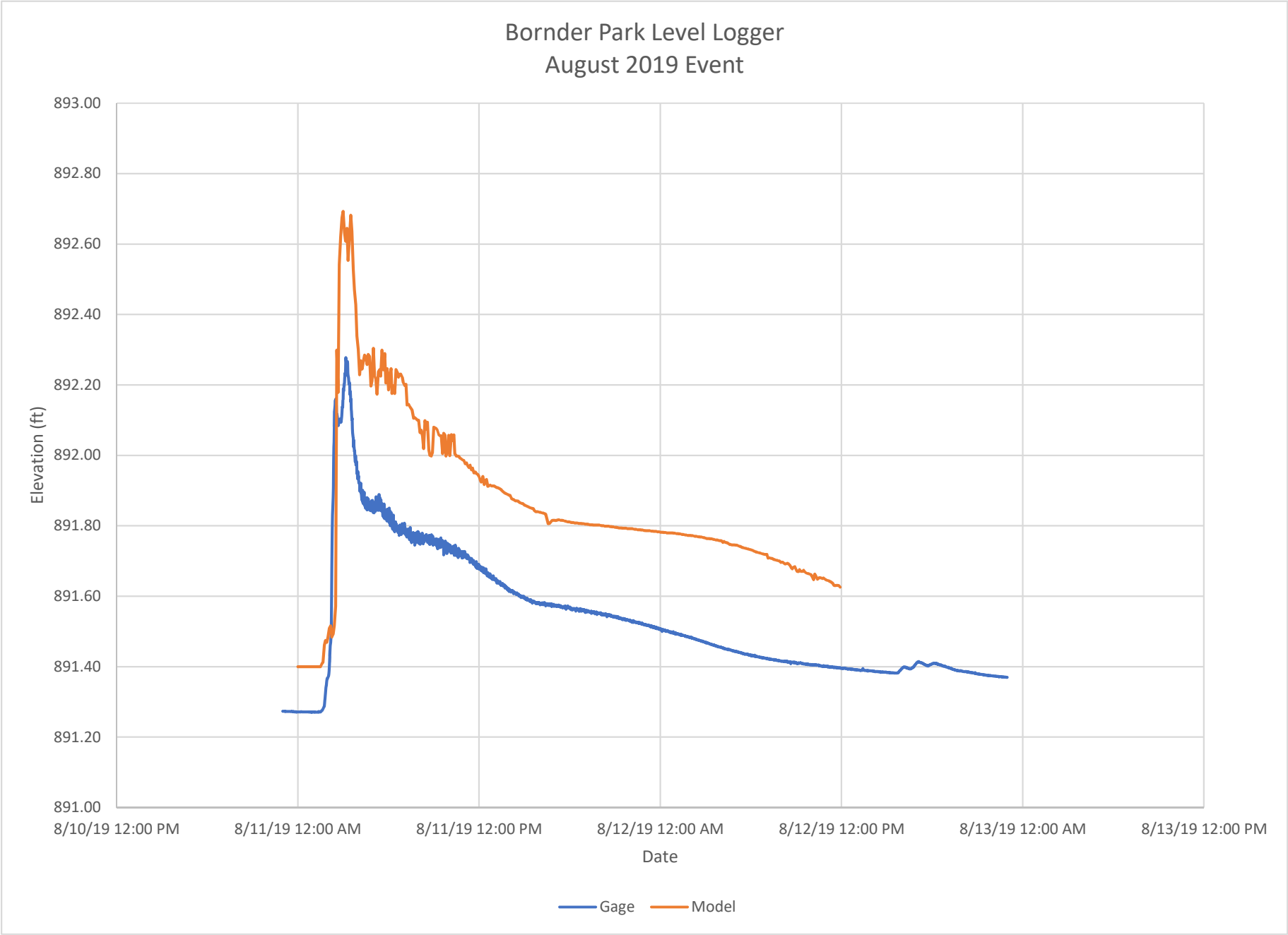
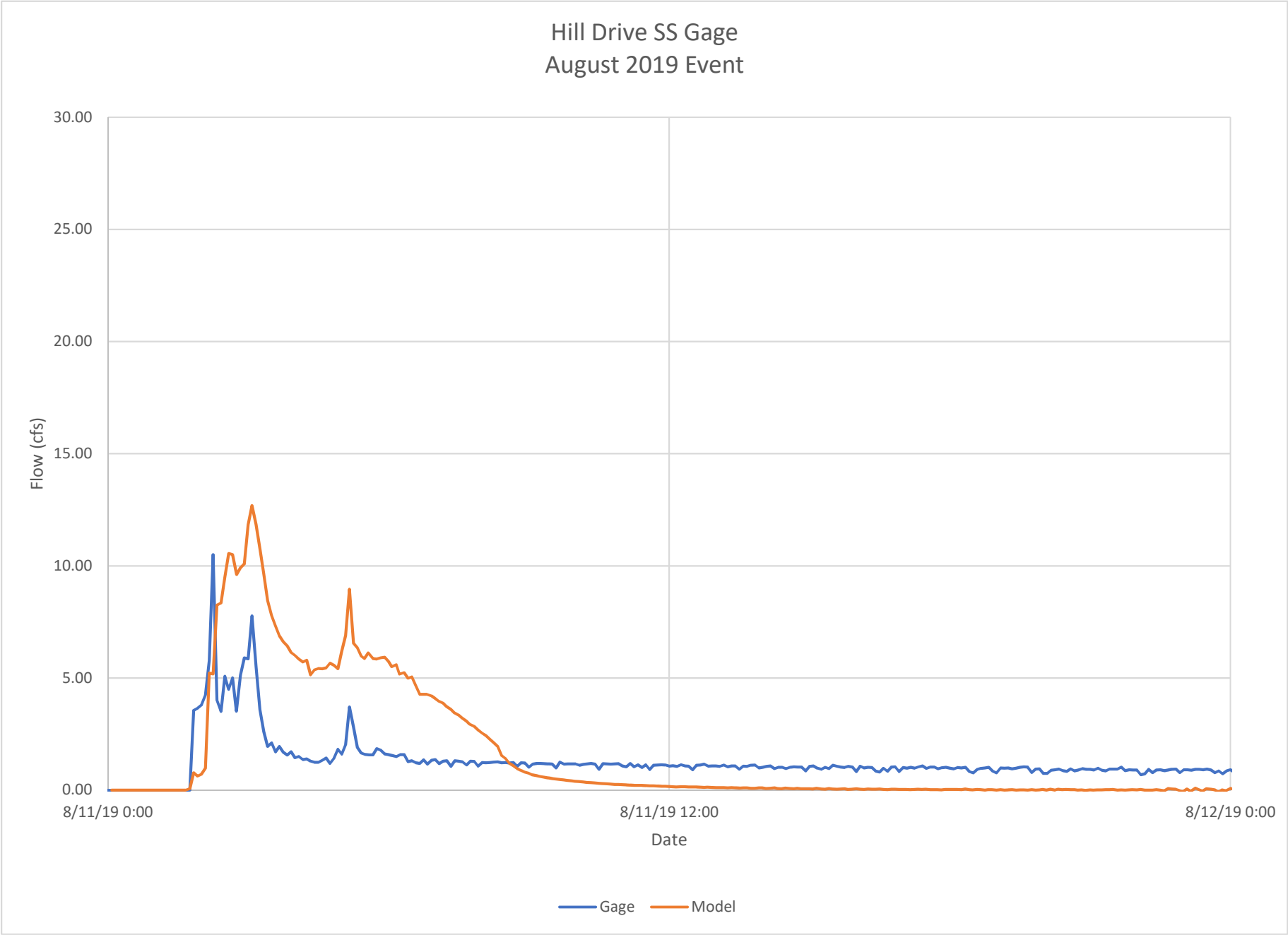
7/21/2019 0:00
7/21/2019 12:00
Date
Model
Gage

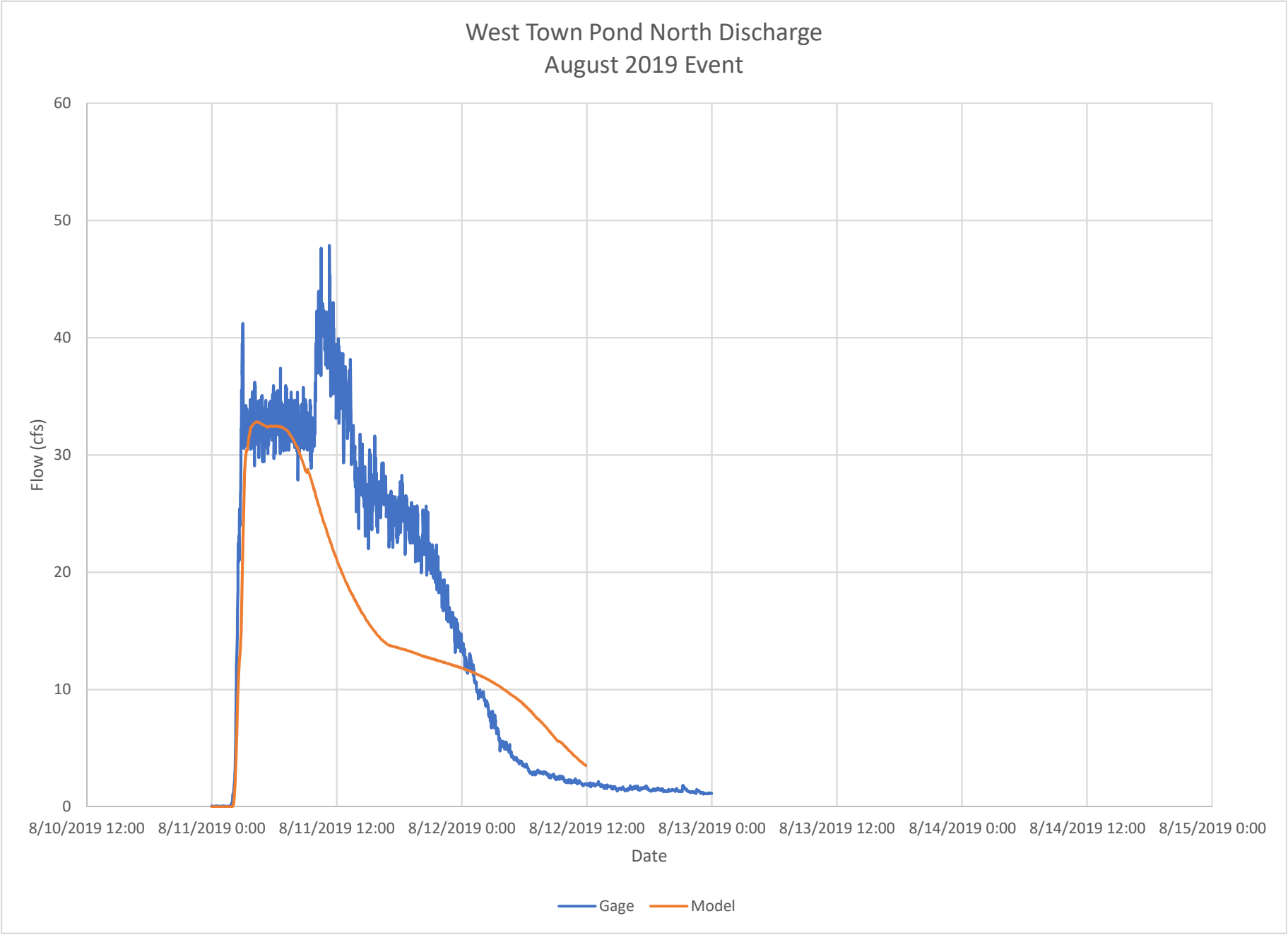

Spring Harbor Gage
August 2019 Event
Flow (cfs)
200
180
160
140
120
100
80
60
40
20
0
8/10/2019 12:00
8/11/2019 0:00
8/11/2019 12:00
8/12/2019 0:00
8/12/2019 12:00
Date
Gage
Model


Yellowstone 48" Culvert Gage
August 2019 Event
70
60
50
40
30
20
10
0
Flow (cfs)
8/10/2019 12:00
8/11/2019 0:00
8/11/2019 12:00
8/12/2019 0:00
8/12/2019 12:00
Date
Gage
Model


Bornder Park Level Logger
August 2019 Event
893.00
892.80
892.60
892.40
892.20
892.00
891.80
891.60
891.40
891.20
891.00
Elevation (ft)
8/10/19 12:00 PM
8/11/19 12:00 AM
8/11/19 12:00 PM
8/12/19 12:00 AM
8/12/19 12:00 PM
8/13/19 12:00 AM
8/13/19 12:00 PM
Date
Gage
Model


Hill Drive SS Gage
August 2019 Event
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Flow (cfs)
8/11/19 0:00
8/11/19 12:00
8/12/19 0:00
Date
Gage
Model

West Towne Pond South Level Logger
August 2019 Event
1031.00
1030.50
1030.00
1029.50
1029.00
1028.50
1028.00
Elevation (ft)
8/10/19 12:00
8/11/19 0:00
8/11/19 12:00
8/12/19 0:00
8/12/19 12:00
8/13/19 0:00
8/13/19 12:00
Date
Gage
Model


West Town Pond North Discharge
August 2019 Event
60
50
40
30
20
10
0
Flow (cfs)
8/10/2019 12:00
8/11/2019 0:00
8/11/2019 12:00
8/12/2019 0:00
8/12/2019 12:00
8/13/2019 0:00
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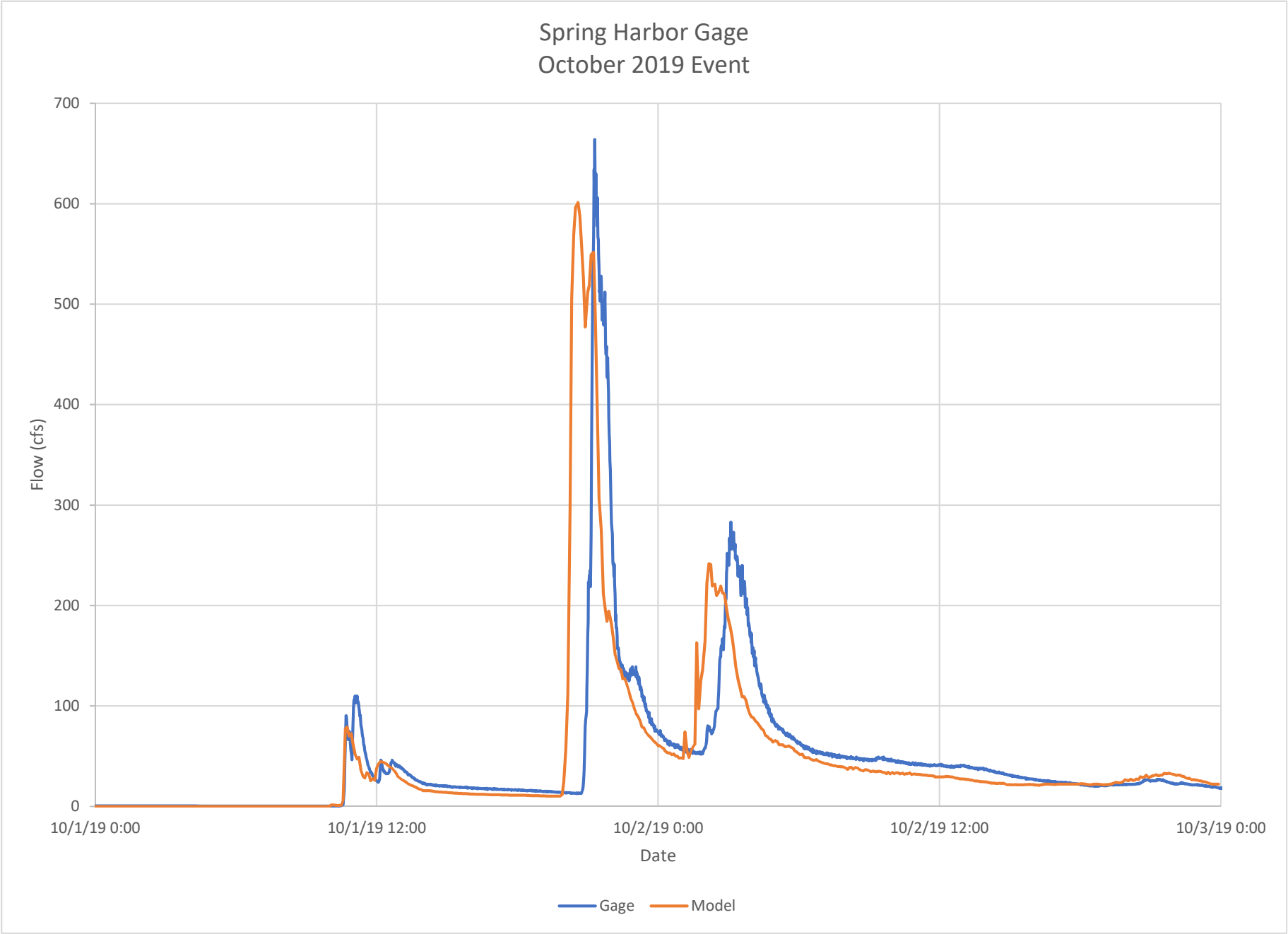
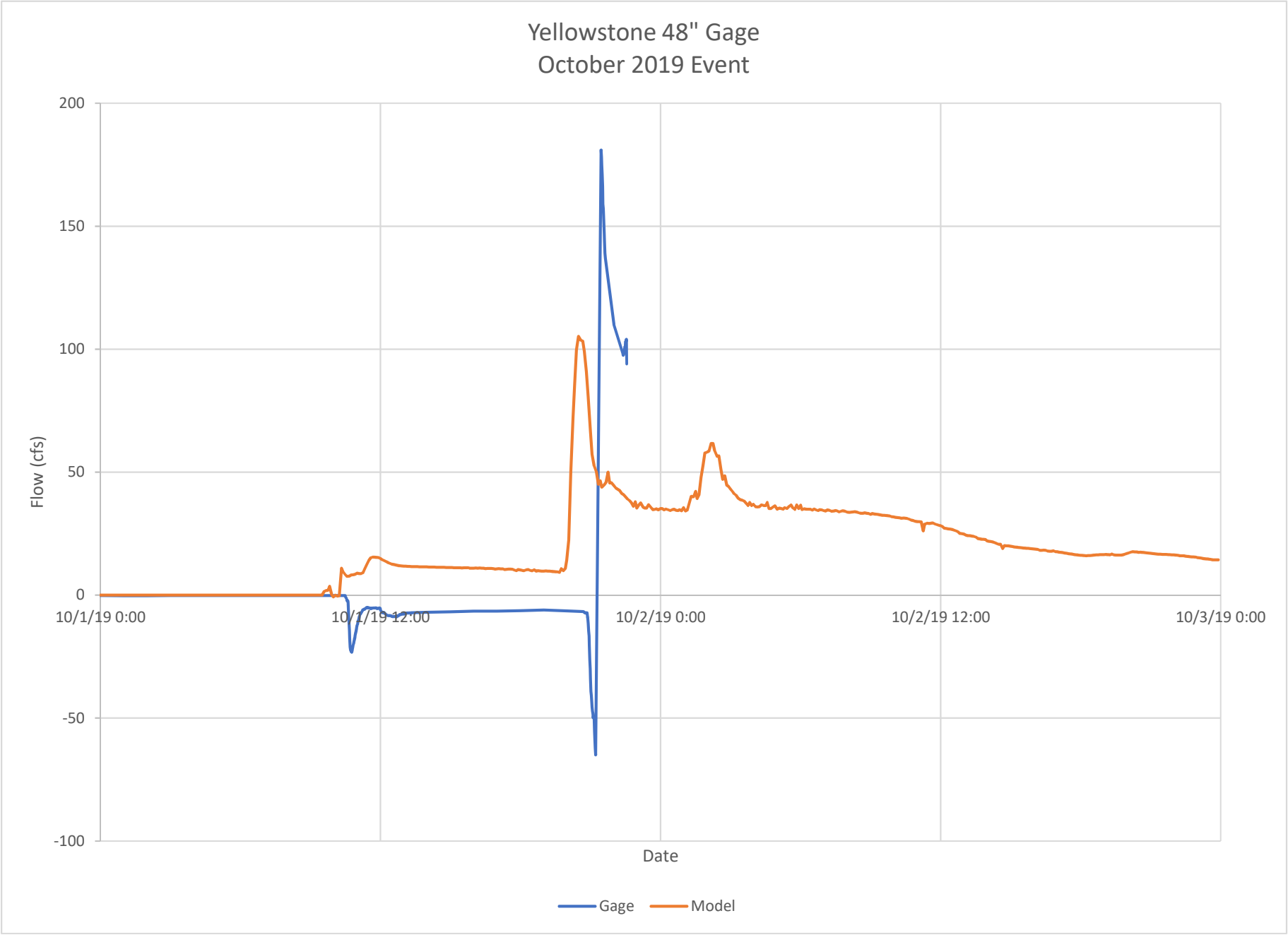
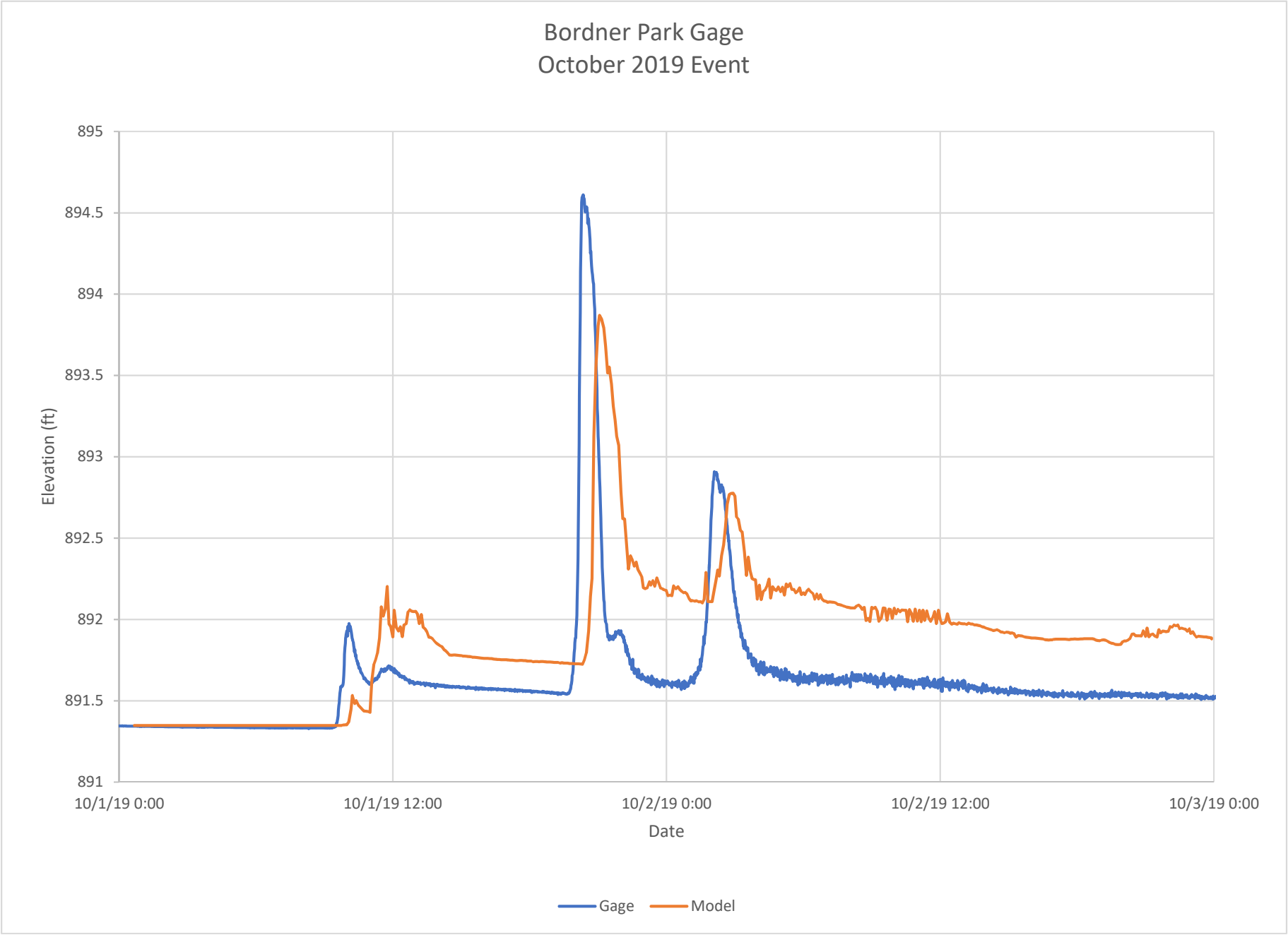
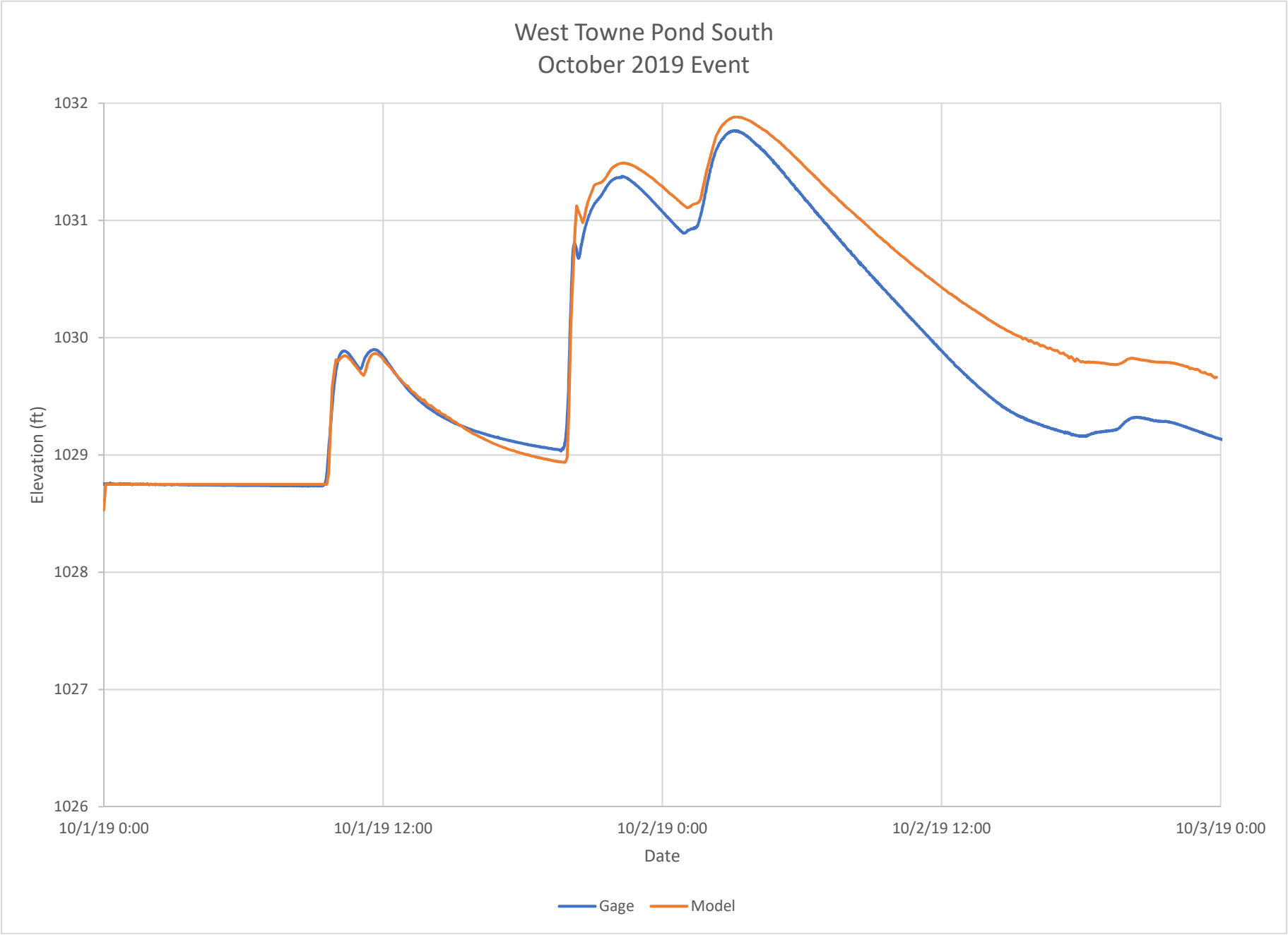
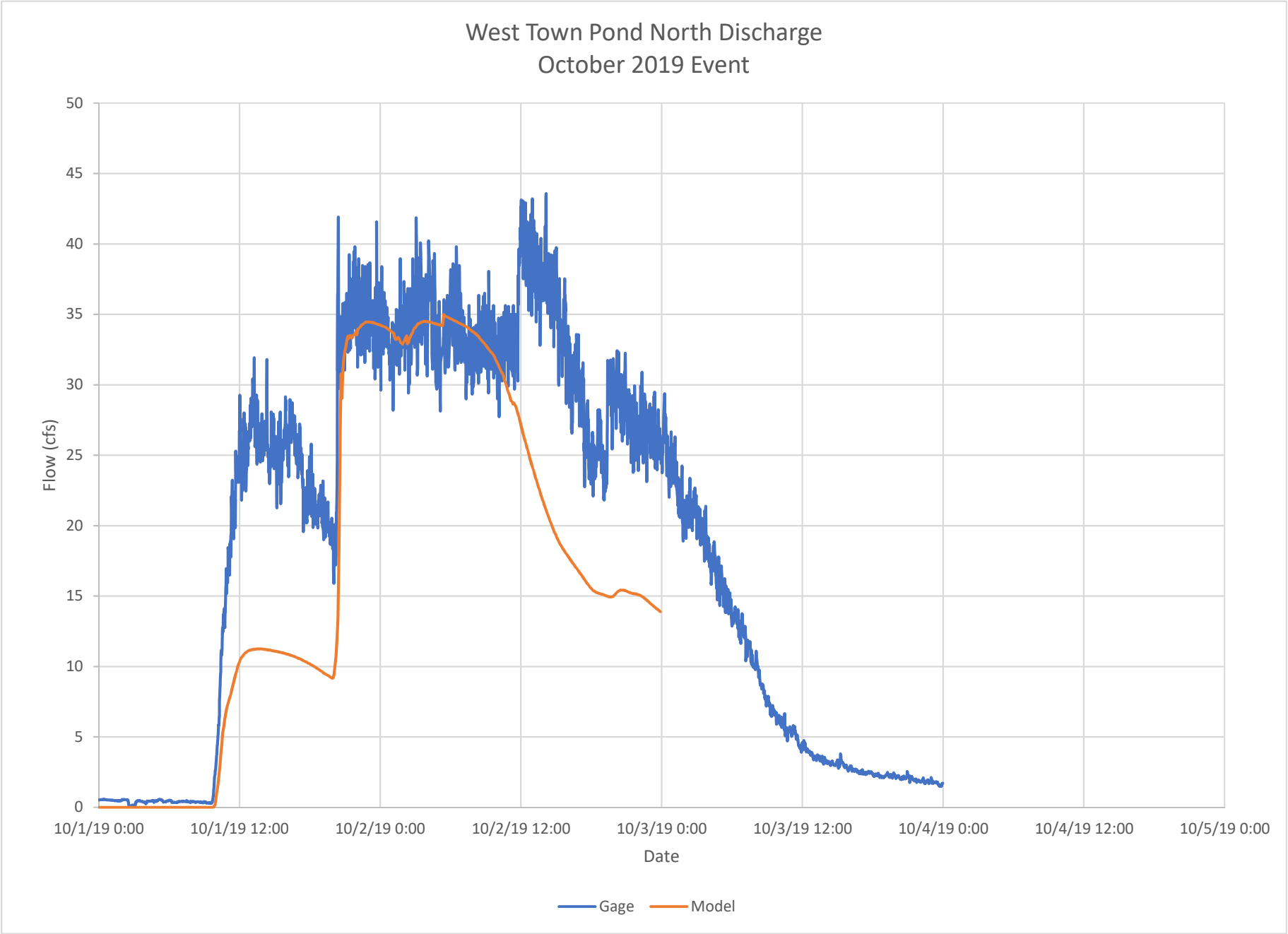
8/14/2019 12:00
8/15/2019 0:00
Date
Gage
Model


Spring Harbor Gage
October 2019 Event
700
600
500
400
300
200
100
0
Flow (cfs)
10/1/19 0:00
10/1/19 12:00
10/2/19 0:00
10/2/19 12:00
10/3/19 0:00
Date
Gage
Model


Yellowstone 48" Gage
October 2019 Event
200
150
100
50
0
-50
-100
Flow (cfs)
10/1/19 0:00
10/1/19 12:00
10/2/19 0:00
10/2/19 12:00
10/3/19 0:00
Date
Gage
Model

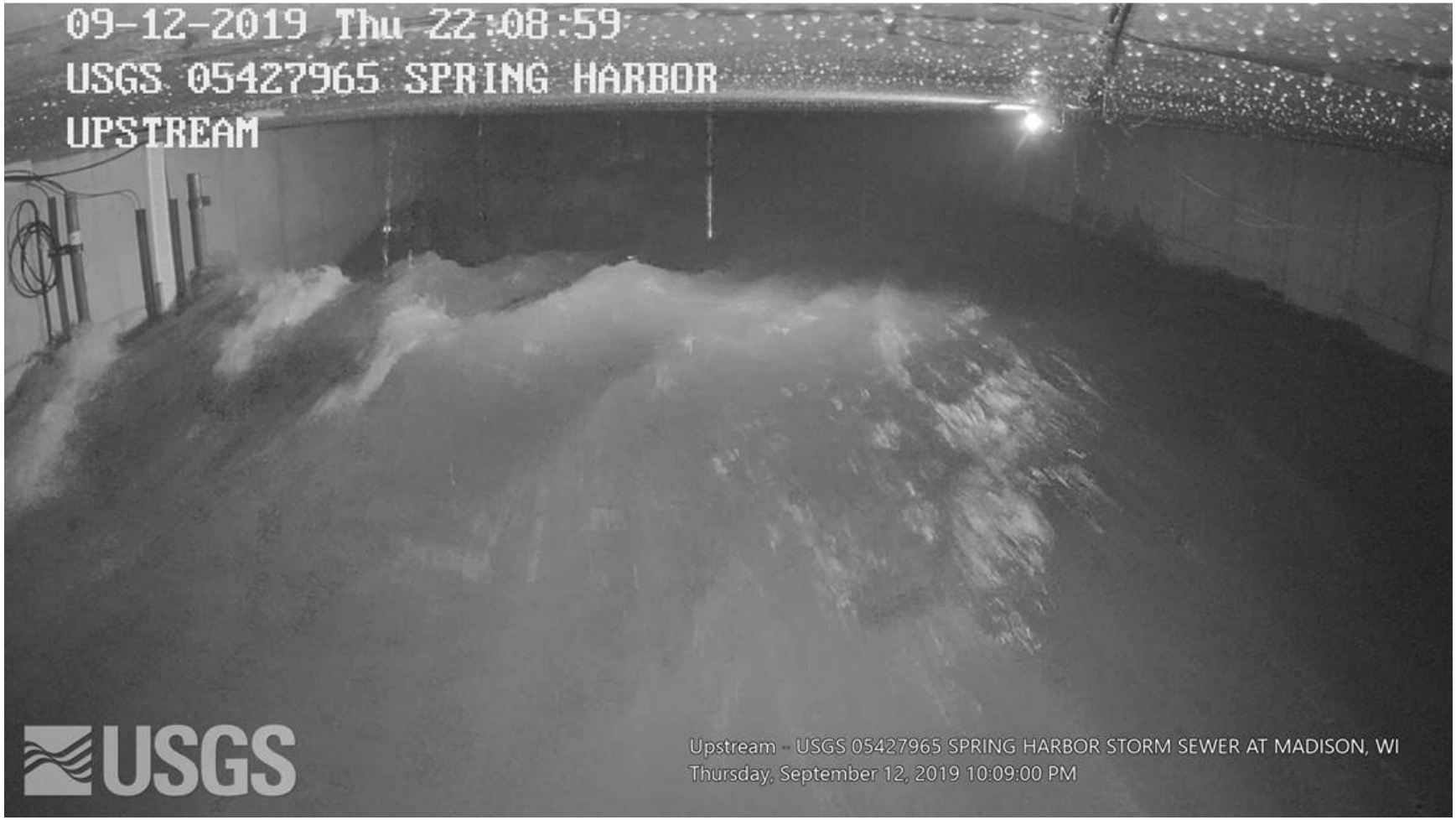

Bordner Park Gage
October 2019 Event
895
894.5
894
893.5
893
892.5
892
891.5
891
Elevation (ft)
10/1/19 0:00
10/1/19 12:00
10/2/19 0:00
10/2/19 12:00
10/3/19 0:00
Date
Gage
Model


West Towne Pond South
October 2019 Event
1032
1031
1030
1029
1028
1027
1026
Elevation (ft)
10/1/19 0:00
10/1/19 12:00
10/2/19 0:00
10/2/19 12:00
10/3/19 0:00
Date
Gage
Model


West Town Pond North Discharge
October 2019 Event
Flow (cfs)
50
45
40
35
30
25
20
15
10
5
0
10/1/19 0:00
10/1/19 12:00
10/2/19 0:00
10/2/19 12:00
10/3/19 0:00
10/3/19 12:00
10/4/19 0:00
10/4/19 12:00
10/5/19 0:00
Date
Gage
Model

Spring Harbor Gage Photos

Hydraulic jump occurring just upstream of gage (shown on the left hand side of the culvert). Photo is looking upstream.



USGS Surveying the weir that is just downstream of the gage, Photo Date August 8, 2019. Photo is looking downstream. Camera that took the photo on 9/12 showing the hydraulic jump is mounted to the ceiling. Chain holds the water quality sensor. Stage gage on the right hand side of the photo.

Watershed	July Gage	August Gage	October Gage
ME02-A-0043-A-004	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-008	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-009	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-033	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-034	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-035	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-037	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-040	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-041	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-042	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-043	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-044	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-045	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-046	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-048	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-049	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-050	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-051	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-069	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-070	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-072	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-073	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-074	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-075	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-076	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-077	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-082	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-083	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-086	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-089	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-090	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0043-A-100	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0044-A-003	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-000	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-001	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-002	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-003	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-004	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-005	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-006	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-007	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-008	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-009	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-010	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-011	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-012	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-013	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-014	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-015	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-016	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-017	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-018	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-019	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-020	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-021	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-022	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-023	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-024	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-025	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-026	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-027	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-028	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-029	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-030	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-031	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-032	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-033	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-034	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0045-A-035	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0046-H-000	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0046-H-001	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0046-H-002	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0046-H-003	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0046-H-004	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0046-H-005	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0046-H-006	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0046-H-007	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0046-H-008	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-000	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-001	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-002	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-003	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-004	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-005	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-006	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-007	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-008	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-009	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-010	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0047-H-011	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0067-H-004	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0067-H-007	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0275-H-000	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0275-H-001	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0275-H-002	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0275-H-003	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0275-H-004	East Kenosha	East Kenosha	Yellowstone*
ME02-A-0275-H-005	East Kenosha	East Kenosha	Yellowstone*
BM03-A-0315-H-000	Memorial High School	Memorial High School	Memorial High School
BM03-A-0315-H-001	Memorial High School	Memorial High School	Memorial High School
BM03-A-0339-H-000	Memorial High School	Memorial High School	Memorial High School
BM03-A-0339-H-001	Memorial High School	Memorial High School	Memorial High School
BM03-A-0339-H-002	Memorial High School	Memorial High School	Memorial High School
BM03-A-0339-H-003	Memorial High School	Memorial High School	Memorial High School
BM03-A-0339-H-004	Memorial High School	Memorial High School	Memorial High School
BM03-A-0339-H-005	Memorial High School	Memorial High School	Memorial High School
BM03-A-0339-H-006	Memorial High School	Memorial High School	Memorial High School
BM03-A-0339-H-007	Memorial High School	Memorial High School	Memorial High School
BM03-A-0339-H-008	Memorial High School	Memorial High School	Memorial High School
BM03-A-0339-H-009	Memorial High School	Memorial High School	Memorial High School
BM03-A-0339-H-010	Memorial High School	Memorial High School	Memorial High School
BM03-A-0340-H-000	Memorial High School	Memorial High School	Memorial High School
BM03-A-0340-H-001	Memorial High School	Memorial High School	Memorial High School
BM03-A-0340-H-002	Memorial High School	Memorial High School	Memorial High School
BM03-A-0340-H-003	Memorial High School	Memorial High School	Memorial High School
BM03-A-0340-H-004	Memorial High School	Memorial High School	Memorial High School
BM03-A-0340-H-005	Memorial High School	Memorial High School	Memorial High School
BM03-A-0340-H-006	Memorial High School	Memorial High School	Memorial High School
ME02-A-0048-A-039	Memorial High School	Memorial High School	Memorial High School
ME02-A-0050-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0050-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0050-H-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0050-H-003	Memorial High School	Memorial High School	Memorial High School

*The East Kenosha Gage was not operational for the October event. The Yellowstone gage was used for these watersheds.

Watershed	July Gage	August Gage	October Gage
ME02-A-0050-H-004	Memorial High School	Memorial High School	Memorial High School
ME02-A-0050-H-005	Memorial High School	Memorial High School	Memorial High School
ME02-A-0050-H-006	Memorial High School	Memorial High School	Memorial High School
ME02-A-0050-H-007	Memorial High School	Memorial High School	Memorial High School
ME02-A-0050-H-008	Memorial High School	Memorial High School	Memorial High School
ME02-A-0050-H-009	Memorial High School	Memorial High School	Memorial High School
ME02-A-0050-H-010	Memorial High School	Memorial High School	Memorial High School
ME02-A-0051-A-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0051-A-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0051-A-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0051-A-003	Memorial High School	Memorial High School	Memorial High School
ME02-A-0051-A-004	Memorial High School	Memorial High School	Memorial High School
ME02-A-0051-A-005	Memorial High School	Memorial High School	Memorial High School
ME02-A-0051-A-006	Memorial High School	Memorial High School	Memorial High School
ME02-A-0051-A-007	Memorial High School	Memorial High School	Memorial High School
ME02-A-0051-A-008	Memorial High School	Memorial High School	Memorial High School
ME02-A-0051-A-009	Memorial High School	Memorial High School	Memorial High School
ME02-A-0052-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0052-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0053-A-008	Memorial High School	Memorial High School	Memorial High School
ME02-A-0053-A-009	Memorial High School	Memorial High School	Memorial High School
ME02-A-0053-A-010	Memorial High School	Memorial High School	Memorial High School
ME02-A-0053-A-011	Memorial High School	Memorial High School	Memorial High School
ME02-A-0053-A-012	Memorial High School	Memorial High School	Memorial High School
ME02-A-0053-A-013	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-003	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-004	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-005	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-006	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-007	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-008	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-009	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-010	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-011	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-012	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-013	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-014	Memorial High School	Memorial High School	Memorial High School
ME02-A-0054-H-015	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-003	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-004	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-005	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-006	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-007	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-008	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-009	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-010	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-011	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-012	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-013	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-014	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-015	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-016	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-017	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-018	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-019	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-020	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-021	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-022	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-023	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-024	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-025	Memorial High School	Memorial High School	Memorial High School
ME02-A-0057-H-026	Memorial High School	Memorial High School	Memorial High School
ME02-A-0058-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0058-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0058-H-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0058-H-003	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-003	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-004	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-005	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-006	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-007	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-008	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-009	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-010	Memorial High School	Memorial High School	Memorial High School
ME02-A-0060-H-011	Memorial High School	Memorial High School	Memorial High School
ME02-A-0061-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0061-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0062-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0062-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0062-H-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0062-H-003	Memorial High School	Memorial High School	Memorial High School
ME02-A-0062-H-004	Memorial High School	Memorial High School	Memorial High School
ME02-A-0062-H-005	Memorial High School	Memorial High School	Memorial High School
ME02-A-0063-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0063-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0063-H-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0063-H-003	Memorial High School	Memorial High School	Memorial High School
ME02-A-0065-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0065-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0066-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0066-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0066-H-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0066-H-003	Memorial High School	Memorial High School	Memorial High School
ME02-A-0066-H-004	Memorial High School	Memorial High School	Memorial High School
ME02-A-0066-H-005	Memorial High School	Memorial High School	Memorial High School
ME02-A-0066-H-006	Memorial High School	Memorial High School	Memorial High School
ME02-A-0068-H-004	Memorial High School	Memorial High School	Memorial High School
ME02-A-0270-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-003	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-004	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-005	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-006	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-007	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-008	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-009	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-010	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-011	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-012	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-013	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-014	Memorial High School	Memorial High School	Memorial High School
ME02-A-0271-H-015	Memorial High School	Memorial High School	Memorial High School

Watershed	July Gage	August Gage	October Gage
ME02-A-0272-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0272-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0272-H-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0272-H-003	Memorial High School	Memorial High School	Memorial High School
ME02-A-0272-H-004	Memorial High School	Memorial High School	Memorial High School
ME02-A-0272-H-005	Memorial High School	Memorial High School	Memorial High School
ME02-A-0272-H-006	Memorial High School	Memorial High School	Memorial High School
ME02-A-0272-H-007	Memorial High School	Memorial High School	Memorial High School
ME02-A-0272-H-008	Memorial High School	Memorial High School	Memorial High School
ME02-A-0273-H-000	Memorial High School	Memorial High School	Memorial High School
ME02-A-0273-H-001	Memorial High School	Memorial High School	Memorial High School
ME02-A-0273-H-002	Memorial High School	Memorial High School	Memorial High School
ME02-A-0273-H-003	Memorial High School	Memorial High School	Memorial High School
ME02-A-0273-H-004	Memorial High School	Memorial High School	Memorial High School
ME02-A-0042-A-000	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-001	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-002	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-003	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-004	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-005	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-006	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-007	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-008	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-009	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-010	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-011	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-012	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-013	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-014	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-015	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0042-A-016	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-000	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-001	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-002	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-003	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-005	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-006	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-007	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-010	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-011	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-012	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-013	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-014	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-015	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-016	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-017	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-018	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-019	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-020	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-021	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-022	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-023	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-024	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-025	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-026	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-027	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-028	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-029	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-030	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-031	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-032	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-036	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-038	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-039	Spring Harbor	Yellowstone	Spring Harbor
ME02-A-0043-A-047	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-052	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-053	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-054	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-055	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-056	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-057	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-058	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-059	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-060	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-061	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-062	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-063	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-064	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-067	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-068	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-084	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-087	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-088	Spring Harbor	Yellowstone	Spring Harbor
ME02-A-0043-A-091	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-092	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-093	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-094	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-095	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-096	Spring Harbor	Spring Harbor	Spring Harbor
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ME02-A-0043-A-098	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0043-A-099	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-000	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-001	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-002	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-004	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-005	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-006	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-007	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-008	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-009	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-010	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-011	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-012	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-013	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-014	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-015	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-016	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-017	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-018	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-019	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0044-A-020	Spring Harbor	Spring Harbor	Spring Harbor
ME03-C-0041-A-000	Spring Harbor	Spring Harbor	Spring Harbor
ME03-C-0041-A-001	Spring Harbor	Spring Harbor	Spring Harbor
ME03-C-0041-A-002	Spring Harbor	Spring Harbor	Spring Harbor
ME03-C-0041-A-003	Spring Harbor	Spring Harbor	Spring Harbor
ME03-C-0041-A-004	Spring Harbor	Spring Harbor	Spring Harbor
ME03-C-0041-A-005	Spring Harbor	Spring Harbor	Spring Harbor
ME03-C-0041-A-006	Spring Harbor	Spring Harbor	Spring Harbor
ME03-C-0041-A-007	Spring Harbor	Spring Harbor	Spring Harbor
ME03-C-0041-A-008	Spring Harbor	Spring Harbor	Spring Harbor
ME03-C-0041-A-009	Spring Harbor	Spring Harbor	Spring Harbor
ME03-C-0041-A-010	Spring Harbor	Spring Harbor	Spring Harbor

Watershed	July Gage	August Gage	October Gage
ME03-U-0037-Q-000	Spring Harbor	Spring Harbor	Spring Harbor
ME03-U-0037-Q-001	Spring Harbor	Spring Harbor	Spring Harbor
ME03-U-0037-Q-002	Spring Harbor	Spring Harbor	Spring Harbor
ME03-U-0295-A-000	Spring Harbor	Spring Harbor	Spring Harbor
ME03-U-0295-A-001	Spring Harbor	Spring Harbor	Spring Harbor
ME03-U-0295-A-002	Spring Harbor	Spring Harbor	Spring Harbor
ME03-U-0295-A-003	Spring Harbor	Spring Harbor	Spring Harbor
ME03-U-0295-A-004	Spring Harbor	Spring Harbor	Spring Harbor
ME02-A-0048-A-014	Spring Harbor	Yellowstone	Yellowstone
ME02-A-0067-H-005	Yellowstone	Yellowstone	Memorial High School
ME02-A-0043-A-065	Yellowstone	Yellowstone	Yellowstone
ME02-A-0043-A-066	Yellowstone	Yellowstone	Yellowstone
ME02-A-0043-A-071	Yellowstone	Yellowstone	Yellowstone
ME02-A-0043-A-078	Yellowstone	Yellowstone	Yellowstone
ME02-A-0043-A-079	Yellowstone	Yellowstone	Yellowstone
ME02-A-0043-A-080	Yellowstone	Yellowstone	Yellowstone
ME02-A-0043-A-081	Yellowstone	Yellowstone	Yellowstone
ME02-A-0043-A-085	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-000	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-001	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-002	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-003	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-004	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-005	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-006	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-007	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-008	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-009	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-010	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-011	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-012	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-013	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-015	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-016	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-017	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-018	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-019	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-020	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-021	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-022	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-023	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-024	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-025	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-026	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-027	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-028	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-029	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-030	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-031	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-032	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-033	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-034	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-035	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-036	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-037	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-038	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-040	Yellowstone	Yellowstone	Yellowstone
ME02-A-0048-A-041	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-000	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-001	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-002	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-003	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-004	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-005	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-006	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-007	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-008	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-009	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-010	Yellowstone	Yellowstone	Yellowstone
ME02-A-0049-H-011	Yellowstone	Yellowstone	Yellowstone
ME02-A-0053-A-000	Yellowstone	Yellowstone	Yellowstone
ME02-A-0053-A-001	Yellowstone	Yellowstone	Yellowstone
ME02-A-0053-A-002	Yellowstone	Yellowstone	Yellowstone
ME02-A-0053-A-003	Yellowstone	Yellowstone	Yellowstone
ME02-A-0053-A-004	Yellowstone	Yellowstone	Yellowstone
ME02-A-0053-A-005	Yellowstone	Yellowstone	Yellowstone
ME02-A-0053-A-006	Yellowstone	Yellowstone	Yellowstone
ME02-A-0053-A-007	Yellowstone	Yellowstone	Yellowstone
ME02-A-0066-H-007	Yellowstone	Yellowstone	Yellowstone
ME02-A-0067-H-000	Yellowstone	Yellowstone	Yellowstone
ME02-A-0067-H-001	Yellowstone	Yellowstone	Yellowstone
ME02-A-0067-H-002	Yellowstone	Yellowstone	Yellowstone
ME02-A-0067-H-003	Yellowstone	Yellowstone	Yellowstone
ME02-A-0067-H-006	Yellowstone	Yellowstone	Yellowstone
ME02-A-0067-H-008	Yellowstone	Yellowstone	Yellowstone
ME02-A-0068-H-000	Yellowstone	Yellowstone	Yellowstone
ME02-A-0068-H-001	Yellowstone	Yellowstone	Yellowstone
ME02-A-0068-H-002	Yellowstone	Yellowstone	Yellowstone
ME02-A-0068-H-003	Yellowstone	Yellowstone	Yellowstone
ME02-A-0068-H-005	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-000	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-001	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-002	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-003	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-004	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-005	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-006	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-007	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-008	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-009	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-010	Yellowstone	Yellowstone	Yellowstone
ME02-A-0274-H-011	Yellowstone	Yellowstone	Yellowstone

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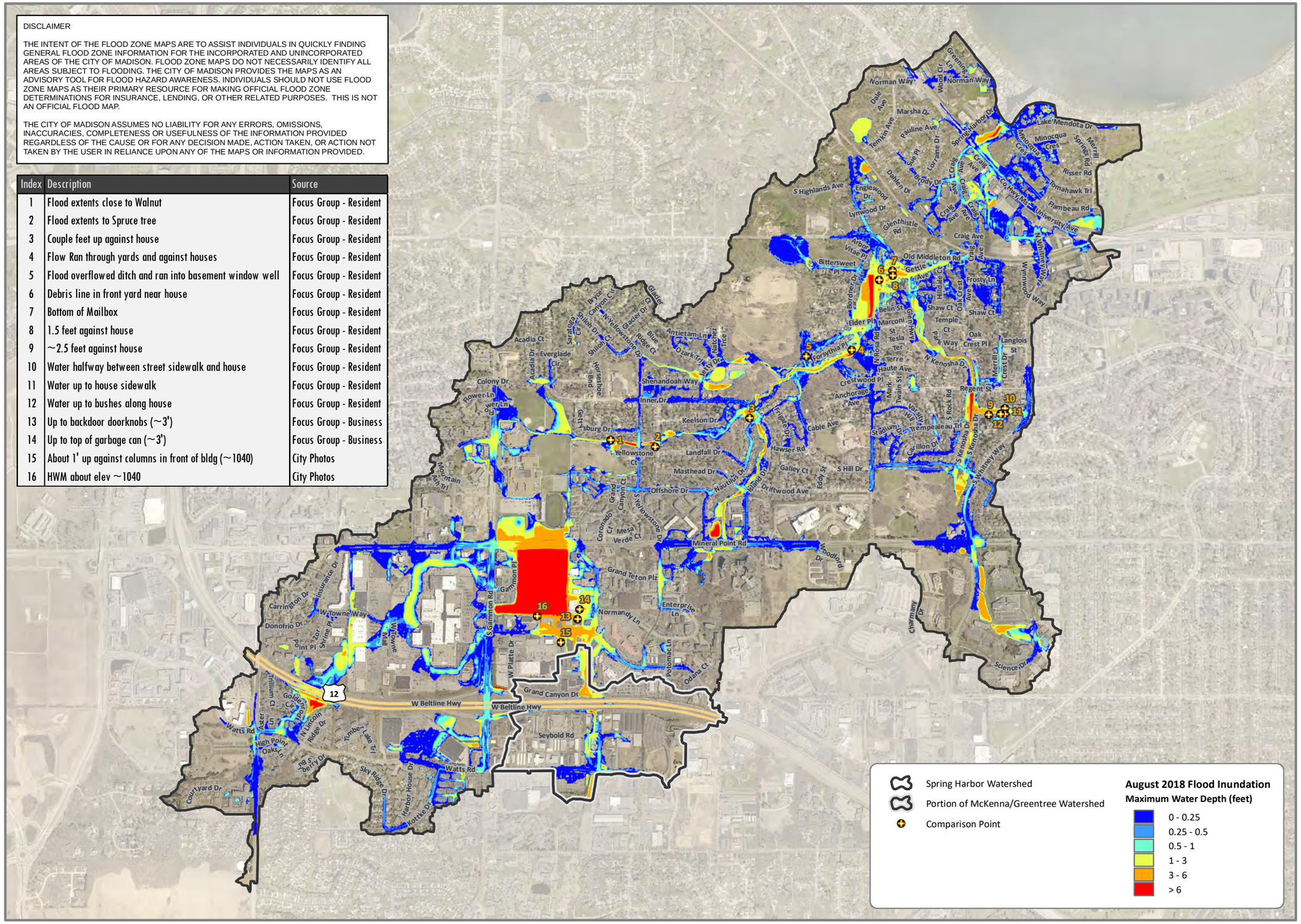
Index	Description	Source
1	Flood extents close to Walnut	Focus Group - Resident
2	Flood extents to Spruce tree	Focus Group - Resident
3	Couple feet up against house	Focus Group - Resident
4	Flow Ran through yards and against houses	Focus Group - Resident
5	Flood overflowed ditch and ran into basement window well	Focus Group - Resident
6	Debris line in front yard near house	Focus Group - Resident
7	Bottom of Mailbox	Focus Group - Resident
8	1.5 feet against house	Focus Group - Resident
9	~2.5 feet against house	Focus Group - Resident
10	Water halfway between street sidewalk and house	Focus Group - Resident
11	Water up to house sidewalk	Focus Group - Resident
12	Water up to bushes along house	Focus Group - Resident
13	Up to backdoor doorknobs (~3')	Focus Group - Business
14	Up to top of garbage can (~3')	Focus Group - Business
15	About 1' up against columns in front of bldg (~1040)	City Photos
16	HWM about elev ~1040	City Photos



N

0 800 1,600

Feet

1 inch = 1,600 feet

Locator Map Not to Scale

City of Madison
Dane County, WI

Figure H1

MODEL COMPARISON TO AUGUST 2018 FLOOD

MADISON
SPRING HARBOR
WATERSHED STUDY

Date: 2/13/2020

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 HARN WISCRS Dane County Feet | Edited by: dlee | C:\Data\Projects\WAFS\M\Madison WI\13937-2018-001\GIS\Report Figure H1- Model Comparison to August 2018 Flood.mxd

Appendix I – Peer Review #2 Summary

Brown and Caldwell Peer Review #2
Calibrated Existing Conditions Model
Date: 2/7/2020
Watershed: Spring Harbor
Client: City of Madison

Comment Number	Comment	AE2S Response
1	The calibration conclusions state that modeling larger events is more important than smaller events. We agree that calibration to the larger events is more critical for the applications of the model. The model underpredicts the largest event (October) and overpredicts the smaller events (July & August). Consideration should be given that the largest monitored event (October 2019) is underpredicted.	Response: No Action Needed Justification: While the October event was underpredicted, one possible explanation is that the antecedent moisture conditions were wetter than "average", which was the condition used for the model. Since the Horton method only adjusts rate based on time during the storm, versus Green-Ampt, which adjusts infiltration rate based on ET and cumulative volume infiltrated, it is more difficult to accurately reflect these types of
2	In the calibration results summary there are references made to the August 2018 storm event and how the model compares to this validation event. Data was not provided about the water surface elevations from the August 2018 event and the comparisons of the observed debris lines to the model inundation extent are qualitative. The comparison of model results to high-water marks for the August 2018 storm event could not be reviewed. Some additional documentation should	Response: Handouts of August 2018 inundation and high water marks / observations were provided in meeting and will be included in the Existing Conditions Report.
3	For the August 2018 modeled event, it is understood from past meeting discussions that the rain data source was from Weather Underground stations and there is no documentation as to the quality of the recorded rains. We suggest comparing this data to the rainfall information provided by Professor Wright.	Response: Weather Underground rainfall data will be provided in the Existing Conditions Report. There was a significant drop off in precipitation as the system moved east, which accounts for some of the lower rainfall totals recorded in one of the gages.
4	Yellowstone Gauge – October 2019 Event: The gauge shows negative flow early in the event and then switches to positive flow. The gauge data also ends during the middle of the event. Was this data discussed with the USGS? Perhaps	Response: No Action Needed Justification: While it is certainly possible that this gage was having issues during this event, no parameters were adjusted because of this gage for this event.
5	Flow Monitoring Locations: Where flow was measured was the monitored volume compared to the model volume? Or was only the flow rate considered?	Response: Only flow rate was compared quantitatively for model bias. However, hydrograph shape was evaluated qualitatively (volume), and also the peak flow rate bias was weighted by runoff volume.
6	It appears the four USGS rain gauges within the Spring Harbor watershed were used as rainfall data. Was consideration given to the City of Madison rain gauges (UW Ag Research Station, Walnut Grove Park, or Owen Park)? The Thiessen polygons generated by the City had portions of the Spring Harbor watershed in the polygons for the City rain gauges.	Response: We reviewed the other gages mentioned, and for the most part, these data sources were either not available (UW Ag Research Station) or had data quality issues.
7	The calibration uses a City of Madison installed level logger for the Memorial Pond South. It is our understanding that there was also a USGS gauge at the outlet of the pond. Was this data considered?	Response: We had requested all relevant data from the USGS, and they had provided us the relevant data. A search of the USGS website only turned up limited water quality data from 2018. City has reached out to the USGS again to determine if additional data exists
8	Timing of Hydrographs: Results at the Memorial Pond South show good comparison of modeled to monitored hydrograph shape and timing for the October event. The Spring Harbor gauge graph (for the October event) shows good comparison for the hydrograph shape and peak flow. In the October event the Spring Harbor model rises approximately 45 minutes earlier that the gauge rises. During the same event, the Bordner Park model rises later than the gauge by about 50 minutes. Both of	Response: No Action Needed Justification: We had noticed the time offset as well, and had double checked the timezone issue as well. For our watershed, the DST and Standard time issue was less problematic as because of data quality issues (see previous comment response), all our rain gages are from the USGS.
9	At the Bordner Park Gauge the model water surface elevation remains elevated at the tail of the event above the gauge elevation (by about 0.5'). Was there consideration given for the reason? It appears this occurs during both the August and October events, but is more prominent in the October event.	Response: No Action Needed Justification: We had noticed this as well, and could be because of debris or other unknown factors. However, peaks still matched, which is the basis for generating inundation mapping and making decisions about which improvements may be needed.
10	The Memorial Pond South and Bordner Park model starts at a higher initial water surface elevation (0.16' and 0.13' respectively) than the gauge for these locations during the August event. Was any consideration given as to the reason for these initial differences (such as verifying structure elevations)?	Response: No Action Needed Justification: The differences are small, and the volume that this small difference accounts for is negligible (i.e. the rise to the peak would be the same regardless). Further, the elevation varied from event to event, so unlikely a structure elevation issue.

Appendix J – Peer Review #3 Summary

Brown and Caldwell Peer Review #3
Proposed Solutions - PFCI Model
Date: 3/30/2021
Watershed: Spring Harbor
Client: City of Madison

Comment Number	Comment	AE2S Comment
1	There is a mismatch between the modeled culvert size (4' x 4' box) at Yellowstone Drive and what is shown in the PowerPoint presentation (4' x 6'). Confirm the modeled culvert size is correct.	Have been updated and are consistent
2	The Greenway Crossing goal is no road overtopping for the 1% chance storm event. Model results show several instances where the goal is not met. There are a number of reasons why it may not be possible to meet the goals, but we want to make sure this is expected.	Have been updated and are consistent
3	At Owen Park/Forsythia Drive, the channel excavation is modeled as a gully breakline. The 2D results do not show water on the 2D surface at this location. We just want to verify this is being modeled correctly. Adding a 2D flow line to measure the flow in the swale could assist in verifying the swale is working appropriately.	Limitation of model when viewing it in model, when export to GIS, does show inundation
3A	At Node ME02-A-0043-A-071 (the upstream end of the swale) the hydraulic results for the node shows that there is no change in the stage of the node during the storm event.	see above
3B	At Node ME02-A-0043-A-085 (towards the downstream end of the swale) the hydraulic results show the stage changes during the storm. Which would indicate there appears to be flow at this point.	see above

Brown and Caldwell Peer Review #3
Proposed Solutions - PFCI Model
Date: 3/30/2021
Watershed: Spring Harbor
Client: City of Madison

Comment Number	Comment	AE2S Comment
4	The Gettle Road box culvert is a proposed 6'x22' box culvert. It is modeled with a Manning's n of 0.011 and there are no entrance/minor losses. It is understood that in this area there were adjustment made to standard values during the calibration process to try to reflect observed conditions. Was a sensitivity analysis considered to determine the impact on the sizing/performance of box culvert improvements?	Started with roughness of 0.013 with standard entrance/exit losses, revisited later and modified to reflect August 2018 event.
4A	A Manning's n of 0.013 is the standard value in the modeling guidance document for concrete pipe.	see above
4B	With large box culverts the minor losses from joining storm sewer segments are typically much smaller than the values in the modeling guidance document. It may be okay to exclude, or reduce, minor losses at these locations, but we want to verify this is intended.	see above
4C	The 22' width is a large box culvert. If the intent is to actually install multiple smaller culverts (such as a 6'x10' and 6'x12') the impact of the side walls (increased friction losses) could affect the results.	existing box is in good condition; leave existing in place and run parellel box given limited ROW and utilities; to do that, need to secure addition ROW so direction was to pursue complete replacement. Exact spacing, # barrels, etc be determined during final design. Because Gettle is curved, some cast-in-place may be needed

Brown and Caldwell Peer Review #3
Proposed Solutions - PFCI Model
Date: 3/30/2021
Watershed: Spring Harbor
Client: City of Madison

Comment Number	Comment	AE2S Comment
4D	There are instabilities in the results graphs for flow through the culvert and the water surface elevation at nodes. Given the rate of flow, overall volume of water, and the lack of overland flow-path it is possible that instabilities cannot be resolved and is not a major concern. Were efforts made to reduce instabilities? Such as decreasing the time-step (current time-step is 3 seconds). See PPT file for example of instabilities.	AE2S did various modifications to increase stability; current stability is what is generally occuring due to complexities of hydraulics
5	There are several pipes with n values from 0.010 to 0.012. The City's standard in the modeling guidance document is 0.013 for concrete pipe. Verify the roughness values used are intended.	Some were adjusted, some are PVC pipes
6	In general, the inundation mapping looks much improved over existing conditions. There are, however, a few locations where the flood goals are not met, such as near West Towne Mall (west of Kohl's / Best Buy) and the Gettle Road area. There may be constraints that result in the flood goals being unachievable, but we wanted to note these areas.	West Towne Mall - modified since model hand-off - main storm sewer under mall needs to be upgraded; Gettle Road - goals not acheivable given current space constraints
7	The overall continuity error for all three design storms is Poor. Overall errors were -20% (10-yr), -15% (25-yr), and -11% (100-yr). We don't believe that the continuity error reveals any major concerns about the proposed improvements and how they were modeled. Has the cause/source of error been evaluated and considered? The Spring Harbor watershed is a large and complex watershed and it may not be feasible to eliminate the error. See the comments #8 and #9 below for a few locations that were identified that may contribute to the overall error.	Model has been revised since hand-off and continuity error has been reduced

Brown and Caldwell Peer Review #3
Proposed Solutions - PFCI Model
Date: 3/30/2021
Watershed: Spring Harbor
Client: City of Madison

Comment Number	Comment	AE2S Comment
8	There are a number of "weirs" connecting the hydrology to the 1D hydraulic network that are seeing numeric issues resulting in spikes of inflow that are likely not realistic. These are unlikely to affect the overall results, but are worth reviewing. It may help to reduce the width of the weirs. In some locations the instabilities continue in the pipes downstream. See the PPT for example locations where this is occurring.	see above
9	A handful of hydrology input locations seem to have errors producing steady-state inflow, which is resulting in overall continuity errors. See the PPT for example locations where this is occurring. It appears this occurs at locations where weirs representing inlets have a crest elevation lower than the invert elevation of one of the connected nodes.	see above

Brown and Caldwell Peer Review #3
Proposed Solutions - PFCI Model
Date: 3/30/2021
Watershed: Spring Harbor
Client: City of Madison

Comment Number	Comment	AE2S Comment
	A secondary request of the City was to identify if any alternative solutions were identified as part of the review. At this time, we do not have any alternative solutions to offer. The improvements include expansion of existing detention, maximizing storage in greenways, and improvements to existing storm sewers / box culverts. These are along the lines of improvements that we would have anticipated considering. Existing greenways and detention areas are expanded as mitigation measures – were any existing open spaces considered for detention?	Big open spaces - West Towne Pond, Old landfill by Memorial High School - not feasible, Gardner Park/Pond - not pursued due to trees, water utility requests, Owen Park - topography, Bordner Park - scale of detention able to provide was not significant to flood reduction. Green space by Walmart/At Home - sits high, would require some earth moving, West Towne Mall area is volume driven, so may not provide significant flood reduction to offset West Towne Pond

Appendix K – Proposed Solutions Table of flood reductions for 25 locations

*Depths listed at road sags Ignore inlet capacity. Blank values mean the storm sewer HGL is below the road elevation.

University Avenue Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE		
10% ACE		
4% ACE		
2% ACE		
1% ACE		
0.2% ACE	0.93	0.8
PFCI Back to Back 100		

Nautilus Pond		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	3.87	44.8
10% ACE	4.53	45.4
4% ACE	4.68	45.8
2% ACE	4.78	45.8
1% ACE	4.87	46.0
0.2% ACE	4.99	46.3
PFCI Back to Back 100	4.88	70.3

Gettle Avenue Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE		
10% ACE		
4% ACE		
2% ACE	1.94	1.1
1% ACE	2.74	1.9
0.2% ACE	3.96	3.0
PFCI Back to Back 100	2.86	3.9

Mineral Point Road West Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE		
10% ACE		
4% ACE		
2% ACE		
1% ACE		
0.2% ACE	0.55	0.2
PFCI Back to Back 100		

Greenway Upstream Park Way		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	2.81	38.1
10% ACE	7.17	39.8
4% ACE	9.61	40.5
2% ACE	9.92	41.0
1% ACE	9.96	41.5
0.2% ACE	10.17	42.3
PFCI Back to Back 100	9.96	65.8

Greenway Upstream of Jetty Drive		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	0.74	46.2
10% ACE	4.24	46.7
4% ACE	5.19	47.3
2% ACE	5.79	47.1
1% ACE	6.49	47.5
0.2% ACE	7.93	47.3
PFCI Back to Back 100	6.50	71.4

Bordner Park Downstream		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	2.84	45.8
10% ACE	5.13	46.5
4% ACE	5.67	46.8
2% ACE	6.27	46.9
1% ACE	6.97	47.3
0.2% ACE	9.22	47.7
PFCI Back to Back 100	7.09	71.4

Greenway Upstream of Quarterdeck		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	3.55	47.5
10% ACE	4.83	47.5
4% ACE	5.28	47.6
2% ACE	5.57	47.6
1% ACE	5.96	47.6
0.2% ACE	7.49	47.7
PFCI Back to Back 100	6.45	47.7

Bordner Park Upstream		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	4.39	47.3
10% ACE	5.27	47.3
4% ACE	5.31	47.3
2% ACE	5.74	47.4
1% ACE	6.57	47.4
0.2% ACE	7.71	47.5
PFCI Back to Back 100	6.65	71.7

Greenway Upstream of Yellowstone		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	4.22	47.6
10% ACE	6.13	47.6
4% ACE	6.87	47.7
2% ACE	7.75	47.7
1% ACE	8.64	47.7
0.2% ACE	9.61	47.7
PFCI Back to Back 100	9.03	71.9

DS Concrete Channel		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	4.60	39.5
10% ACE	5.94	40.9
4% ACE	6.21	41.7
2% ACE	7.10	42.0
1% ACE	8.16	42.5
0.2% ACE	10.46	43.3
PFCI Back to Back 100	8.45	43.3

Intersection of Tree and Gammon		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE		
10% ACE		
4% ACE		
2% ACE		
1% ACE		
0.2% ACE	1.32	0.3
PFCI Back to Back 100		0.3

Upstream Regent Street		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	2.90	42.4
10% ACE	4.34	43.5
4% ACE	5.14	44.3
2% ACE	5.61	45.1
1% ACE	6.37	44.8
0.2% ACE	8.09	45.5
PFCI Back to Back 100	6.51	69.3

Mineral Pt Rd North of West Towne Ponds		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE		
10% ACE		
4% ACE		
2% ACE		
1% ACE	0.70	1.4
0.2% ACE	3.32	16.3
PFCI Back to Back 100	3.94	19.8

Burnett Drive		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE		
10% ACE		
4% ACE	0.85	0.6
2% ACE	1.53	0.8
1% ACE	1.79	0.8
0.2% ACE	3.22	1.5
PFCI Back to Back 100	1.88	2.0

West Towne Pond - South		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	4.88	47.6
10% ACE	7.19	47.6
4% ACE	8.67	47.7
2% ACE	9.80	47.7
1% ACE	11.20	47.7
0.2% ACE	13.84	47.7
PFCI Back to Back 100	14.80	71.9

Garner Pond		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	4.27	43.4
10% ACE	4.52	44.3
4% ACE	4.55	44.6
2% ACE	4.57	44.8
1% ACE	4.59	45.0
0.2% ACE	4.71	45.4
PFCI Back to Back 100	4.60	69.3

Odana Drive Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE		
10% ACE		
4% ACE		
2% ACE	0.56	0.1
1% ACE	0.66	0.3
0.2% ACE	3.04	14.3
PFCI Back to Back 100	3.98	16.3

Mineral Point Road East Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE		
10% ACE		
4% ACE		
2% ACE		
1% ACE	0.06	0.1
0.2% ACE	1.65	1.6
PFCI Back to Back 100	1.12	0.7

Gammon Road Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE		
10% ACE		
4% ACE		
2% ACE		
1% ACE		
0.2% ACE		
PFCI Back to Back 100		

Greenway Upstream of Inner Dr.		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	3.22	47.3
10% ACE	4.39	47.5
4% ACE	5.91	47.5
2% ACE	6.99	47.6
1% ACE	5.47	47.6
0.2% ACE	7.72	47.7
PFCI Back to Back 100	5.67	71.8

West Towne Pond - Upper (South of Beltline)		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	8.35	47.6
10% ACE	8.88	47.6
4% ACE	9.03	47.7
2% ACE	9.11	47.7
1% ACE	9.20	47.7
0.2% ACE	9.57	47.7
PFCI Back to Back 100	9.21	71.9

Greenway Upstream of Nautilus Dr.		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	3.48	45.1
10% ACE	5.25	46.4
4% ACE	11.63	46.8
2% ACE	10.18	47.2
1% ACE	9.86	47.5
0.2% ACE	12.24	47.6
PFCI Back to Back 100	10.00	71.6

Watts Road Sag		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE		
10% ACE		
4% ACE		
2% ACE		
1% ACE		
0.2% ACE	1.37	0.7
Back-to-Back		

Greenway Upstream of Masthead Dr		
Event	Max Depth (ft)	Duration Depth >0 Feet
50% ACE	1.30	47.3
10% ACE	4.20	47.4
4% ACE	5.15	47.5
2% ACE	5.88	47.5
1% ACE	6.43	47.6
0.2% ACE	7.75	47.6
PFCI Back to Back 100	6.48	71.8

*ACE design storms with durations greater than 45 hours have not drained down at the end of the simulation (48-hour simulation). Back to back storms with durations greater than 70 hours have not drained down at the end of simulation (96 hours).

Appendix L – Agency Meeting Notes

Watershed Study Agency Meetings

Round 1

City Engineer (Rob) – 11/4/2020

Mayor's Office (Christie) – 11/19/2020

PWI – 12/3/2020

All Agencies – 12/14/2020

Individual Agencies -

Water Utility – 1/4/2021

- Larson, Alan alarson@madisonwater.org
- Belshaw, Jeff JBelshaw@madisonwater.org
- Braselton, Peter PBraselton@madisonwater.org
- Holmgren, Peter PHolmgren@madisonwater.org
- Miess, Kelly kmiess@madisonwater.org
- Renaud, David DRenaud@madisonwater.org
- Wiederhoeft, Adam awiederhoeft@madisonwater.org

Meeting summary sent 1/6/2020

Follow-up email on 2/9/2021
"Wisconsin Administrative Code, Chapter NR 811.12 (5) (d) 6 requires a minimum setback of 400 feet from a well and storm water retention or detention pond. I request that the contours of the planned pond expansion not encroach on this required 400-foot buffer between the well and pond. This restriction would require an estimated 300' X 200' exclusion in the northeast corner of the parcel. Please note these modifications are being requested in addition to the clay liner already recommended for the expanded pond. These requests are to mitigation potential future water quality impacts (sustained increases in chloride and sodium) that are already observed at Well 16."

City of Madison Parks – 1/12/2021

- Freiwald, Ann AFreiwald@cityofmadison.com
- Knepp, Eric eknepp@cityofmadison.com
- Laschinger, Lisa llaschinger@cityofmadison.com
- Genin, Greg GGenin@cityofmadison.com
- Lerner, Sarah slerner@cityofmadison.com
- Close, Sarah SClose@cityofmadison.com
- Kane, Kathleen kkane@cityofmadison.com
- Stelljes, Corey cstelljes@cityofmadison.com
- Sturm, Michael msturm@cityofmadison.com

Meeting summary sent 1/14/2021

City of Madison Fire Department – 1/12/2021

- Denise DeSerio (sets up meeting – prefers 8:30 am Tuesday briefing time)
- Jerome Buechner
- Tracy Burrus
- Christopher Carbon
- Nicole Marie Hall
- Michael Popovich
- Arthur Price
- Edwin Ruckriegel
- Che Stedman
- Julie Trimbell
- Timothy Mrowiec
- Liza Tatar
- Steven Davis
- Scott Bavery
- Paul Ripp
- Cynthia Schuster

Meeting summary sent 1/12/2021

City of Madison Metro

- Timothy Sobota
- Drew Beck
- Crystal Martin

Email feedback – 12/15/2020

Metro Transit does not have specific concerns or feedback, for the three initial watershed study areas.

Metro Transit does have existing property infrastructure (West Transfer Point bus facility) on the NW corner of S Whitney & Tokay – and may have future infrastructure along the Mineral Point Road corridor, related to Bus Rapid Transit (including parcels near the S Rosa and S Junction intersection areas).

Metro Transit did pilot the use of permeable bus passenger boarding pad surface treatments (i.e. "shall be firm, stable, and slip resistant", between curb and sidewalk), as part of the Toepfer Avenue reconstruction project – and does not foresee any issues at this time with expanded use of this material (versus concrete), as may be needed by storm water terrace treatment demands.

City of Madison Planning – Provided vocal feedback during 12/14/2020 agency meeting; followed up with email 12/17/2020

1. University Research Park: Is there a way that the "Tokay West" stormwater improvements in URP (between 5801 and 5901 Research Park Blvd) could be done to preserve the possibility of a future Rosa Road connection to Tokay? The connection is no longer part of current BRT planning, but we are trying to create more connectivity to and through URP, and that is a major connection. URP is on board with the idea.
2. Odana Golf Course: as the golf course pond expansion is considered can anything be done to, at a minimum, not make it more difficult to create a bike path connection from Whitney Way to the SW path along the north side of the Beltline? Ideally any pond improvements could help facilitate that future connection, but ultimately it will likely take WisDOT involvement and funding to make that connection happen.
3. West Towne ponds: We're looking at a potential bike path extension from the existing Beltline underpass at Grand Canyon north to Mineral Point Road. An option to avoid seven driveways would be to take the path along the border between the West Towne pond property and the businesses to the east. Is there any room to make that option feasible as the improvements to the ponds are considered?

City of Madison Operations – email feedback 12/21/2020

What would OPS be responsible for relating to each reconstruction project (I assume most projects would be performed by contractors,) is this broken down to what OPS would be responsible for vs. contractor? When discussing installing thousands of feet of box culvert near/under high volume roads, expanding ponds, and upsizing large runs of storm pipe, maintenance is always a concern, as well as how this would affect our other utilities.

What would be the maintenance expectations for structures, cleaning, televising, mowing, grate clearing etc. going forward?

City of Madison Streets/Forestry – meeting on 1/27/2021

Marla Eddy
Charlie Romines

Bryan Johnson
Craig Klinke

No comments on proposed solutions.

Transportation Engineering – email feedback 1/12/2021

Yang Tao
Renee Calloway
Thomas Lynch
Thomas Mohr
Mark Winter
Scott Kerr

Traffic Engineering does not have concerns at this time and a meeting is not necessary for now.

One of TE team members discussed with Greg on the potential idea to add storm water management system under bike path and bike lanes, and we do understand that it may or may not be feasible due to added cost and other challenges.

City of Madison Street Design – email feedback 1/13/2021

Chris Petykowski
James Wolf
Christy Bachmann

Only comment I have is to continue coordinating with us to delay our street projects if needed (such as Old Middleton). Janet has been doing a good with that.

Meeting with Water Utility about Proposed Flood Control Projects from Spring Harbor, Stricker's/Mendota, and Wingra West Watershed Studies
January 4, 2021

Engineering and the Water Utility met via Zoom on January 4, 2021 to discuss comments and concerns about the proposed flood control projects for the Spring Harbor, Stricker's/Mendota, and the Wingra West watershed studies.

Attendees included:

- Jeff Belshaw, Water Utility
- Peter Braselton, Water Utility
- Caroline Burger, Engineering
- Greg Fries, Engineering
- Phil Gaebler, Engineering
- Peter Holmgren, Water Utility
- Alan Larson, Water Utility
- Kelly Miess, Water Utility
- Jojo O'Brien, Engineering
- David Renaud, Water Utility
- Janet Schmidt, Engineering
- Lauren Striegl, Engineering
- Adam Wiederhoeft, Water Utility

The following was discussed:

- Currently the Water Utility owns a land asset near Garner Park. The land is being held for a future, potential well. There is a potential the future well may include the reduction of the footprint of the current Garner Park Pond. The proposed watershed study solution for Garner Park Pond was removed from the selected alternatives early in the proposed solutions analysis. Therefore, Engineering has no plans to impact the Water Utility-owned land near Garner Park.
- Engineering will be including the wellhead protection zones on the mapping for the proposed solutions. Engineering understands that any flood control measures within the wellhead protection zones will need to be reviewed by Water Utility for impact on their well. Additionally, stormwater ponds in these areas will need to be lined to prevent infiltration of stormwater into the groundwater.
- Engineering is currently piloting a distributed green infrastructure program. Stormwater measures that purposely infiltrate stormwater (outside wellhead protection zones) create concerns for Water Utility infrastructure. In general:
    - Pervious sidewalks are okay because they are not located above a water main
    - Pervious terraces are okay (for the most part), also, because they are not located above a water main.
    - Pervious pavement causes concern because it is directly above the water mains; water main has clearance requirements that must be met when constructing water main. Water main in these areas may need to be reconstructed, thus adding additional costs to projects in areas where the water main was not planned to be reconstructed.
- Engineering is planning to reconstruct many of the greenway crossings in the watersheds to meet flood program goals. Many times, water main can be near these crossings. Large water main near these crossings can be costly to reconstruct. Engineering will reach out to the Water Utility for cost estimates for these components.
- A spreadsheet is included with this meeting summary listing the flood control measures for Water Utility staff to comment on

Meeting with Madison Fire Department about Proposed Flood Control Projects from Spring Harbor, Stricker's/Mendota, and Wingra West Watershed Studies
January 4, 2021

Engineering and the Madison Fire Department met via Zoom on January 12, 2021 to discuss comments and concerns about the proposed flood control projects for the Spring Harbor, Stricker's/Mendota, and the Wingra West watershed studies.

Invited Attendees:

- Scott Bravery, MFD
- Jerome Buechner, MFD
- Caroline Burger, Engineering
- Tracy Burrus, MFD
- Christopher Carbon, MFD
- Steven Davis, MFD
- Denise DeSerio, MFD
- Greg Fries, Engineering
- Phil Gaebler, Engineering
- Sarah Lerner, Engineering
- Nicole Marie Hall, MFD
- Timothy Mrowiec, MFD
- Jojo O'Brien, Engineering
- Michael Popovich, MFD
- Arthur Price, MFD
- Paul Ripp, MFD
- Edwin Ruckriegel, MFD
- Janet Schmidt, Engineering
- Cynthia Schuster, MFD
- Lauren Striegl, Engineering
- Liza Tatar, MFD
- Julie Trimbell, MFD

The following was discussed:

- Engineering presented the power point presentation describing how the studies are carried out and gave an overview of the proposed solutions for each watershed.
- MFD asked if there are solutions where purchasing of property will be more cost-effective that constructing/reconstructing infrastructure to reduce the property flooding. Engineering has started the process to evaluation that, but the process is in its infancy. Once Engineering has a proposed process, they will share it with interested agencies in the City.
- MFD asked about cooperation with communities that border the City of Madison regarding flooding and flood reduction. As Engineering starts a study, it contacts the adjacent communities that could be affected. To date, the City of Middleton, Town of Middleton, Village of Shorewood Hills, and the City of Fitchburg could be affected by current watershed studies. Engineering has met with City of Middleton representatives and has meetings scheduled with Village of Shorewood representatives. The Town of Middleton has been very cooperative regarding providing data for areas that discharge into the City Madison. No impacts are currently projected for the City of Fitchburg.
- Engineering asked if MFD is okay with pervious pavement being used in the Fire Lanes; recent discussions with Developers indicate they are looking at that to help meet stormwater requirements. Engineering will contact Bill Sullivan from MFD to understand the equipment needs regarding aerial ladder pad loadings.
- MFD asked for an update on marking street signs to indicate water depth during storm events. Engineering has been discussing various approaches. Now that Engineering has a key hire on board, they will be using the inundation mapping generated during the watershed studies to identify areas to pilot a program. Engineering will keep MFD updated on the progress of this effort.

- Engineering asked who handles the contract where cars are towed after flood events. Madison Police Department administers that contract. Engineering will reach out to the contacts given for that information.
- MFD did not raise any red flags during the meeting regarding the proposed solutions presented. MFD should reach out to Engineering if something arises so the concern can be accounted for in the solution(s).

Meeting with Planning about Proposed Flood Control Projects from Spring Harbor, Stricker's/Mendota, and Wingra West Watershed Studies
January 15, 2021

Engineering and the Planning Division met via Zoom on January 14, 2021 to discuss comments and concerns about the proposed flood control projects for the Spring Harbor, Stricker's/Mendota, and the Wingra West watershed studies.

Invited Attendees:

- Heather Bailey, Planning
- Sherry BonDurant, Planning
- Zia Brucaya, Planning
- Caroline Burger, Engineering
- Julie Cleveland, Planning
- Rebecca Cnare, Planning
- Breana Collins, Planning
- Patrick Empey, Planning
- Ruth Ethington, Planning
- Kevin Firchow, Planning
- Greg Fries, Engineering
- William Fruhling, Planning
- Phil Gaebler, Engineering
- Janine Glaeser, Planning
- Brian Grady, Planning
- Jeffrey Greger, Planning
- Lauren Heiser-Ertel, Planning
- Colleen Hoesly, Planning
- William Holloway, Planning
- Linda Horvath, Planning
- Ryan Jonely, Planning
- David Kanning, Planning
- Kirstie Laatsch, Planning
- Sarah Lerner, Engineering
- Benjamin Lyman, Planning
- Urvashi Martin, Planning
- Daniel McAuliffe, Planning
- Jojo O'Brien, Engineering
- Timothy Parks, Planning
- Sydney Prusak, Planning
- Angela Puerta, Planning
- Colin Punt, Planning
- William Schaefer, Planning
- Janet Schmidt, Engineering
- Daniel Seidensticker, Planning
- Heather Stouder, Planning
- Lauren Striegl, Engineering
- Jule Stroick, Planning
- Chris Wells, Planning
- Karin Wolf, Planning
- Benjamin Zellers, Planning

The following was discussed:

- Engineering gave a brief overview of the timing of the studies, the existing conditions inundation mapping, and the draft proposed solutions for the first three watersheds
- An example of project issues and coordination was described regarding the Research Park Southwest Detention pond Improvements and the proposed BRT route.
- Planning asked how areas that are outside the current City of Madison Boundary but may be incorporated into the City or may be impacted by the studies are accounted for. There are generally three main categories and they are accounted for differently:
    - Developed municipalities (e.g. City of Middleton) that discharge stormwater into a City of Madison watershed: For these areas, stormwater is evaluated and routed to City of Madison infrastructure, but inundation mapping is not created for these areas and proposed solutions are not developed
    - Developed municipalities (e.g. Village of Shorewood Hills) where the City of Madison discharges stormwater to them: For these areas, the adjacent communities are brought into the watershed study project team and coordination meetings occur throughout the duration of the watershed study

    - Municipalities that will be annexed: These areas are modeled in the same manner as the areas inside the current City of Madison municipal boundary. Inundation mapping will be created and proposed solutions will be developed.
- One of the outcomes of these studies is to determine where existing developed land needs to be purchased or undeveloped land needs to be reserved for stormwater infrastructure.
- The currently adopted stormwater ordinance and its impact on development was discussed. The ordinance:
    - Allows the City to require developers to meeting watershed-specific goals. Engineering is not going to enforce that, unless a situation necessitates it, at this time.
    - Requires developers account for the existing unintended detention on their site. Engineering is enforcing that at this time.
    - Requires developers to manage up to the 200-year (.5% change) event. Engineering is going to enforce that at this time.
- Engineering is going to start determining where land needs to be reserved for future stormwater infrastructure.
- The inundation mapping will provide target low building openings for areas of infill development (e.g. Westgate Mall)
- A preview of the inundation mapping ArcOnline was given. The tool shows the watershed study schedule, existing conditions inundation mapping, and links the watersheds to the watershed study website for each project.
    - Jojo will work with Pat Empey to determine if additional tools can be added to help make the tool more intuitive.

Meeting with Parks about Proposed Flood Control Projects from Spring Harbor, Stricker's/Mendota, and Wingra West Watershed Studies
January 12, 2021

Engineering and the Parks met via Zoom on January 11, 2021 to discuss comments and concerns about the proposed flood control projects for the Spring Harbor, Stricker's/Mendota, and the Wingra West watershed studies.

Attendees included:

- Caroline Burger, Engineering
- Sarah Close, Parks
- Ann Freidwald, Parks
- Greg Fries, Engineering
- Phil Gaebler, Engineering
- Kathleen Kane, Parks
- Eric Knepp, Parks
- Lisa Laschinger, Parks
- Sarah Lerner, Engineering/Parks
- Jojo O'Brien, Engineering
- Janet Schmidt, Engineering
- Corey Stelljes, Parks
- Lauren Striegl, Engineering
- Michael Sturm, Parks

The following was discussed:

Spring Harbor Watershed

- West Towne Ponds
    - The City has a contract with the 56ers for use of the soccer fields. Loss of any soccer fields in the City is a concern; therefore coordination with stakeholders should occur to understand impacts.
    - Other than the soccer use, Parks did not have concerns
- Owen Park Drainage Swale and Adjacent Flood Wall
    - Parks is supportive of the project
    - There are mature trees along the swale that should be avoided if possible
    - Parks requested that bike path connectivity be explored from Inner Drive through the Southern Park of Owen Park and to the connecting bike paths
    - Eric provided contact names for residents that Engineering could work with in the neighborhood
- Glen Oak Hills Park
    - Parks asked what dry detention would look like and requested that detention be graded to provide more of a natural, meandering channel with areas to explore nature-based play as much as possible
    - There are numerous mature trees in the park and potential detention footprint
    - Parks is not opposed to the project but understands there will be concern regarding mature tree removal

Stricker's/Mendota Watershed

- Stricker's Park
    - Engineering should coordinate with Parks regarding the proposed grading for the project; there may be desires to modify the existing grading over the proposed relief pipe

Wingra West Watershed

- Orchard Ridge Valley Park
    - Park does not have a lot of recreational value and pond expansion could enhance the City of Madison
    - The park is marshy, inaccessible, and has no amenities, therefore it seem like a good fit for a flood control infrastructure
    - The park could benefit from turf walking trails or raised trail/boardwalk
    - Parks has had complaints from neighbors regarding wet pond overtopping
    - Eric: park does not have a high recreational value. Pond could enhance the value of the park (maybe?) or would enhance the City of Madison
- Odana Hills Park & Golf Course
    - Coordination is needed so that the project is mutually beneficial; if the project can be designed to be mutually beneficial, Parks can provide support and help with coordination
    - Eric would like to be involved in the coordination
    - Tree impacts will be minimal
    - The current footprint shown would impact the cross country ski trail
    - The current footprint shown would impact the routing and playability of the golf course
        - Hole 15 (Par 5) is frequently soggy and failing; revised drainage could improve the hole.
        - The 13th green and T box for 16 hole would be impacted
        - Clients need to get to T from each hole to the fairway (without swimming through the pond)
    - The outlet by the channel is an area that is not in play
    - Engineering should set up a meeting with Eric, Theran Steindl, and Ryan Brinza to go over potential grading/pond footprints
- Chippewa Dr/Cherokee Dr Improved Conveyance
    - Parks indicated the plan seems favorable
    - The improved conveyance will help keep the playground in the park from flooding
    - The historic steps in the park are at risk from existing flooding; the conveyance improvements will help protect the stairs by redirecting the runoff
    - Forestry should be coordinated with regarding the street trees

Parks recommended that the improvements for Odana Hills Golf Course should be prioritized first. There is an option for private funding that could cost-share the construction of the improvements.

Prior to public input meetings, it is recommended that Engineering intentionally reach out to the Board of Parks Commissioners (BPC) via email to let them know proposed plan. Indicate we look forward to talking to the public so we can bring all that feedback to BPC.

If Parks has other projects in planning that would mesh well with flood reduction projects, please reach out to Engineering so we can coordinate.

A spreadsheet is included with this meeting summary listing the flood control measures for Parks staff to provide comment on

Meeting with Parks – Golf Course - about Proposed Flood Control Projects from Wingra West Watershed Study – Odana Hills Golf Course Ponds
February 3, 2021

Engineering and the Parks met via Zoom on January 11, 2021 to discuss comments and concerns about the proposed flood control projects for the Spring Harbor, Stricker's/Mendota, and the Wingra West watershed studies.

Attendees included:

- Ryan Brinza, Parks
- Caroline Burger, Engineering
- Ann Freidwald, Parks
- Greg Fries, Engineering
- Phil Gaebler, Engineering
- Eric Knepp, Parks
- Janet Schmidt, Engineering
- Theran Steindl, Parks

The following was discussed:

- Engineering showed proposed solutions
- Golf Course Pond
    - Parks originally thought of increasing Golf Course Pond to shape shown except for west part of pond
    - Need new bridge
    - Move pump station for golf course irrigation
    - Review cart paths and possibly modify
    - Narrow channel so that golfing over the hole is available to most golfer
    - Archaeological site on Hole 5?
    - Could expand pond into wet part of Hole 12
    - Construct forward tee for Hole 16?
- Odana Hills Park & Golf Course
    - Will level be as high in proposed conditions?
    - City pursue removal of weirs
        - Negotiate agreement with WDNR for MG&E infiltration system
    - Shift south side of the pond a little more to the north to not impact fairway as much
- Use excavated material to fill low areas in golf course
    - Build up fairway for Hole 15 – pond level has increased since MGE put in weirs
    - Would want the material scraped off the top for excavation rather than soil deeper in excavation
- Drain area – Golf Course has plans to address drainage to make it more efficient
- Bike path along Beltline?
    - Run parallel to Beltline
- Relief pipe
    - Runs thru irrigation lines which would need repair
    - Construction of pipe could cause issues with golf course due to hole closure during construction and restoration
    - Perhaps build retention pond near bike path instead of running water across golf course
- Engineering can provide scaled figure and Ryan and Theran can measure golf shots
- Are there areas of the golf course that could have water only during large events but not permanent standing water?

Appendix M – Cost Estimates

Conceptual Cost Estimate - West Towne Pond Expansion
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	N/A	$ 10,000
10911	MOBILIZATION	1	LUMP SUM		$ 250,000.00	$ 250,000
20101	EXCAVATION CUT	178,400	C.Y.	$25.00	$ 10	$ 1,784,000
20221	TOPSOIL	14,350	S.Y.	$ 9.50	N/A	$ 136,325
20229	MEDIUM RIPRAP - LIMESTONE	200	C.Y.	$ 137	$ 160	$ 32,000
20314	REMOVE PIPE	210	L.F.	$ 102	$ 25	$ 5,250
20321	REMOVE CONCRETE PAVEMENT	430	S.Y.	$ 5	N/A	$ 1,935
20404	CLEARING	1	LUMP SUM	$ 7,123	N/A	$ 7,123
20409	GRUBBING	1	LUMP SUM	$ 3,408	N/A	$ 3,408
20705	DETENTION BASIN SEEDING	14,350	S.Y.	$ 3.00	N/A	$ 43,050
21073	EROSION MATTING, CLASS II, TYPE C - ORGANIC	14,350	S.Y.	$ 7	$ 3.50	$ 50,225
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000	N/A	$ 25,000
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000	$ 100,000	$ 100,000
SH18	REMOVE CONCRETE CONTROL STRUCTURE	1	LUMP SUM	$ 7,000	N/A	$ 7,000
SH22	STORMWATER LIFT STATION	1	EACH	$ 250,000	N/A	$ 250,000
				Subtotal		**$ 2,705,300**
				Contingency	**25%**	**$ 676,300**
				Design	**10%**	**$ 270,500**
				Total		**$ 3,652,100**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ -**
				Total Total		**$ 3,652,100**

Conceptual Cost Estimate - Kenosha Greenway
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	N/A	$ 10,000
10911	MOBILIZATION	1	LUMP SUM	$ 168,600.00	$ 100,000.00	$ 100,000
20101	EXCAVATION CUT	13,335	C.Y.	$ 25.00	N/A	$ 333,375
20221	TOPSOIL	17,040	S.Y.	$ 9.50	N/A	$ 161,880
20403	CLEARING	17,040	SY	$ 37.50	$ 20.00	$ 340,800
20408	GRUBBING	17,040	SY	$ 3.12	N/A	$ 53,165
20705	DETENTION BASIN SEEDING	17,040	S.Y.	$ 3.00	N/A	$ 51,120
21073	EROSION MATTING, CLASS II, TYPE C - ORGANIC	17,040	S.Y.	$ 6.50	$ 3.50	$ 59,640
50402	15 INCH TYPE I RCP STORM SEWER PIPE	60	L.F.	$ 84.50	$ 70.00	$ 4,200
50403	18 INCH TYPE I RCP STORM SEWER PIPE	20	L.F.	$ 82.50	$ 115.00	$ 2,300
50420	24 INCH X 38 INCH TYPE I HERCP STORM SEWER PIPE	25	L.F.	$ 112.00	$ 140	$ 3,500
50411	48 INCH TYPE I RCP STORM SEWER PIPE	75	L.F.	$ 173.00	$ 200	$ 15,000
50462	15 INCH RCP AE	2	EACH	$ 1,212.50	N/A	$ 2,425
50463	18 INCH RCP AE	1	EACH	$ 1,339.50	N/A	$ 1,340
50483	24 INCH X 38 INCH HERCP AE	1	EACH	$ 1,411.50	$ 2,500	$ 2,500
50470	48 INCH RCP AE	1	EACH	$ 2,089.50	$ 2,500	$ 2,500
50602	15 INCH RCP AE GATE	2	EACH	$ 804.50	N/A	$ 1,609
50603	18 INCH RCP AE GATE	1	EACH	$ 389.50	$ 1,000	$ 1,000
50610	48 INCH RCP AE GATE	1	EACH	$ 1,440.00	N/A	$ 1,440
50623	24 INCH X 38 INCH HERCP AE GATE	1	EACH	$ 1,442.00	N/A	$ 1,442
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000.00	N/A	$ 25,000
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000.00	N/A	$ 50,000
				Subtotal		**$ 1,224,200**
				Contingency	**25%**	**$ 306,100**
				Design	**10%**	**$ 122,400**
				Total		**$ 1,652,700**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ -**
				Total Total		**$ 1,652,700**

Conceptual Cost Estimate - Masthead Greenway Ponds
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	N/A	$ 10,000
10911	MOBILIZATION	1	LUMP SUM	$ 271,000.00	$ 150,000	$ 150,000
20101	EXCAVATION CUT	26,550	C.Y.	$ 25.00	N/A	$ 663,750
20101	EXCAVATION CUT	1,060	C.Y.	$ 25.00	$ 13	$ 13,250
20205	SELECT FILL	1,060	C.Y.	$ 39.50	N/A	$ 41,870
20221	TOPSOIL	17,000	S.Y.	$ 9.50	N/A	$ 161,500
20229	MEDIUM RIPRAP - LIMESTONE	500	C.Y.	$ 137.00	$ 160	$ 80,000
20403	CLEARING	17,000	SY	$ 37.50	$ 20	$ 340,000
20408	GRUBBING	17,000	SY	$ 3.12	N/A	$ 53,040
20705	DETENTION BASIN SEEDING	17,000	S.Y.	$ 3.00	N/A	$ 51,000
21073	EROSION MATTING, CLASS II, TYPE C - ORGANIC	17,000	S.Y.	$ 6.50	$ 3.50	$ 59,500
50402	15 INCH TYPE I RCP STORM SEWER PIPE	110	L.F.	$ 84.50	$ 70.00	$ 7,700
50407	30 INCH TYPE I RCP STORM SEWER PIPE	140	L.F.	$ 109.50	$ 160	$ 22,400
50462	15 INCH RCP AE	1	EACH	$ 1,212.50	N/A	$ 1,213
50467	30 INCH RCP AE	2	EACH	$ 1,977.00	N/A	$ 3,954
50602	15 INCH RCP AE GATE	1	EACH	$ 804.50	N/A	$ 805
50607	30 INCH RCP AE GATE	2	EACH	$ 928.00	$ 1,200	$ 2,400
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000.00	N/A	$ 25,000
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000.00	N/A	$ 50,000
SH5	6' x 4' RCB CULVERT, EXCAVATION, BACKFILL & JOINT SEALING	113	LF	$ 600.00	$ 950.00	$ 107,350
SH6	6' x 4' RCB CULVERT WINGWALL & RAILINGS	4	EACH	$ 28,000.00	N/A	$ 112,000
				Subtotal		**$ 1,956,700**
				Contingency	**25%**	**$ 489,200**
				Design	**10%**	**$ 195,700**
				Total		**$ 2,641,600**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ -**
				Total Total		**$ 2,641,600**

Conceptual Cost Estimate - Gettle Avenue Box Storm Sewer
v2021_05_24

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	$ 20,000	$ 20,000
10911	MOBILIZATION	1	LUMP SUM	$ 175,000.00	$ 350,000.00	$ 350,000
40381	REMOVE AND REPLACE CONCRETE CURB & GUTTER, MACHINE PLACED - RESURFACING	40	L.F.	$ 15.00	N/A	$ 600
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000.00	N/A	$ 25,000
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000.00	$ 100,000	$ 100,000
SH17	22' x 6' RCB CULVERT, EXCAVATION, BACKFILL, JOINT SEALING & CONNECTIONS	1,470	LF	$ 4,000.00	N/A	$ 5,880,000
SH19	UTILITY CONFLICT ALLOWANCE	5	EA	$ 4,000.00	N/A	$ 20,000
SH20	MISCELLANEOUS STORM SEWER CONNECTION ALLOWANCE	22	EA	$ 2,500.00	N/A	$ 55,000
SH23	VEGETATION RESTORATION ALLOWANCE	1	EACH	$ 5,000.00	N/A	$ 5,000
SH24	26' ASPHALT ROAD WITH CARLSON CURB	1,470	LF	$ 200.00	N/A	$ 294,000
				Subtotal		**$ 6,749,600**
				Contingency	**25%**	**$ 1,687,400**
				Design	**10%**	**$ 675,000**
				Total		**$ 9,112,000**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ -**
				Total Total		**$ 9,112,000**

Conceptual Cost Estimate - Glen Oak Hills Park Greenway
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	N/A	$ 10,000
10911	MOBILIZATION	1	LUMP SUM		$ 150,000	$ 150,000
20205	SELECT FILL	6,215	C.Y.	$ 39.50	N/A	$ 245,493
20221	TOPSOIL	6,855	S.Y.	$ 9.50	N/A	$ 65,123
20229	MEDIUM RIPRAP - LIMESTONE	100	C.Y.	$ 137.00	$ 160	$ 16,000
20314	REMOVE PIPE	388	L.F.	$ 102.00	$ 25	$ 9,700
20403	CLEARING	6,800	SY	$ 37.50	$ 20	$ 136,000
20408	GRUBBING	6,800	SY	$ 3.12	N/A	$ 21,216
20705	DETENTION BASIN SEEDING	6,800	S.Y.	$ 11.00	$ 3	$ 20,400
21073	EROSION MATTING, CLASS II, TYPE C - ORGANIC	6,800	S.Y.	$ 6.50	$ 3.50	$ 23,800
50226	UTILITY TRENCH PATCH TYPE III	385	T.F.	$ 75.00	N/A	$ 28,875
50410	42 INCH TYPE I RCP STORM SEWER PIPE	480	L.F.	$ 201.50	$ 185	$ 88,800
50469	42 INCH RCP AE	1	EACH	$ 2,465.00	$ 2,300	$ 2,300
50411	48 INCH TYPE I RCP STORM SEWER PIPE	30	L.F.	$ 173.00	$ 200	$ 6,000
50470	48 INCH RCP AE	1	EACH	$ 2,089.50	$ 2,500	$ 2,500
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000.00	N/A	$ 25,000
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000.00	N/A	$ 50,000
SH5	6' x 4' RCB CULVERT, EXCAVATION, BACKFILL & JOINT SEALING	116	LF	$ 600.00	$ 800.00	$ 92,800
SH6	6' x 4' RCB CULVERT WINGWALL & RAILINGS	4	EACH	$ 28,000.00	N/A	$ 112,000
SH9	7' x 4' RCB CULVERT, EXCAVATION, BACKFILL & JOINT SEALING	84	LF	$ 900.00	$ 950.00	$ 79,800
SH10	7' x 4' RCB CULVERT WINGWALL & RAILINGS	4	EACH	$ 30,000.00	N/A	$ 120,000
SH20	MISCELLANEOUS STORM SEWER CONNECTION ALLOWANCE	8	EACH	$ 2,500.00	N/A	$ 20,000
				Subtotal		**$ 1,325,800**
				Contingency	**25%**	**$ 331,500**
				Design	**10%**	**$ 132,600**
				Total		**$ 1,789,900**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ -**
				Total Total		**$ 1,789,900**

Conceptual Cost Estimate -Owen Park Channel and Floodwall
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	$ 7,500	$ 7,500
10911	MOBILIZATION	1	LUMP SUM		$ 225,000.00	$ 225,000
20101	EXCAVATION CUT	4,465	C.Y.	$25.00	N/A	$ 111,625
20221	TOPSOIL	8,700	S.Y.	$ 9.50	N/A	$ 82,650
20403	CLEARING	8,700	SY	$ 37.50	$ 28	$ 243,600
20408	GRUBBING	8,700	SY	$ 3.12	N/A	$ 27,144
20705	DETENTION BASIN SEEDING	7,625	S.Y.	$ 3.00	N/A	$ 22,875
21073	EROSION MATTING, CLASS II, TYPE C - ORGANIC	7,625	S.Y.	$ 6.50	$ 3.50	$ 26,688
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000.00	N/A	$ 25,000
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000.00	$ 25,000	$ 25,000
SH21	CONCRETE FLOODWALL	8,295	SF	$ 281.00	$ 337	$ 2,797,074
				Subtotal		**$ 3,594,200**
				Contingency	**25%**	**$ 898,600**
				Design	**10%**	**$ 359,400**
				Total		**$ 4,852,200**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ 16,000**
				Total Total		**$ 4,868,200**

Conceptual Cost Estimate - Nautilus Drive Box Culvert Greenway Crossing
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	N/A	$ 10,000
10911	MOBILIZATION	1	LUMP SUM	$ 111,300.00	N/A	$ 111,300
20229	MEDIUM RIPRAP - LIMESTONE	50	C.Y.	$ 137.00	$ 160	$ 8,000
20314	REMOVE PIPE	36	L.F.	$ 102.00	$ 150	$ 5,400
20403	CLEARING	250	SY	$ 37.50	N/A	$ 9,375
20408	GRUBBING	250	SY	$ 3.12	N/A	$ 780
40381	REMOVE AND REPLACE CONCRETE CURB & GUTTER, MACHINE PLACED	80	L.F.	$ 15.00	N/A	$ 1,200
50226	UTILITY TRENCH PATCH TYPE III	92	T.F.	$ 120.00	N/A	$ 11,040
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000.00	$ 6,250	$ 6,250
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000.00	$ 25,000	$ 25,000
SH13	10' x 4' RCB CULVERT, EXCAVATION, BACKFILL & JOINT SEALING	320	LF	$ 1,400.00	$ 1,600.00	$ 512,000
SH14	10' x 4' RCB CULVERT WINGWALL & RAILING	4	EACH	$ 37,000.00	N/A	$ 148,000
SH23	VEGETATION RESTORATION ALLOWANCE	1	EACH	$ 5,000.00	N/A	$ 5,000
				Subtotal		**$ 853,300**
				Contingency	**25%**	**$ 213,300**
				Design	**10%**	**$ 85,300**
				Total		**$ 1,151,900**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ -**
				Total Total		**$ 1,151,900**

Conceptual Cost Estimate - Inner Drive Box Culvert Greenway Crossing
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	N/A	$ 10,000
10911	MOBILIZATION	1	LUMP SUM	$ 74,700.00	N/A	$ 74,700
20229	MEDIUM RIPRAP - LIMESTONE	50	C.Y.	$ 137.00	$ 160	$ 8,000
20313	REMOVE INLET	6	EACH	$ 629.50	N/A	$ 3,777
20314	REMOVE PIPE	180	L.F.	$ 102.00	$ 150	$ 27,000
20326	REMOVE FENCE	50	L.F.	$ 3.50	N/A	$ 175
40381	REMOVE AND REPLACE CONCRETE CURB & GUTTER, MACHINE PLAC	40	L.F.	$ 15.00	N/A	$ 600
50226	UTILITY TRENCH PATCH TYPE III	35	T.F.	$ 120.00	$ 144	$ 5,040
50763	TERRACE INLET	8	EACH	$ 7,000.00	N/A	$ 56,000
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000.00	$ 6,250	$ 6,250
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000.00	$ 25,000	$ 25,000
SH25	14' x 5' RCB CULVERT, EXCAVATION, BACKFILL & JOINT SEALING	97	LF	$ 2,000.00	$ 1,850.00	$ 179,450
SH26	14' x 5' RCB CULVERT WINGWALL & RAILING	4	EACH	$ 43,000.00	N/A	$ 172,000
SH23	VEGETATION RESTORATION ALLOWANCE	1	EACH	$ 5,000.00	N/A	$ 5,000
				Subtotal		**$ 573,000**
				Contingency	**25%**	**$ 143,300**
				Design	**10%**	**$ 57,300**
				Total		**$ 773,600**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ -**
				Total Total		**$ 773,600**

Conceptual Cost Estimate - Jetty Drive Box Culvert Greenway Crossing
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	N/A	$ 10,000
10911	MOBILIZATION	1	LUMP SUM	$ 48,200.00	$ 70,000	$ 70,000
20229	MEDIUM RIPRAP - LIMESTONE	50	C.Y.	$ 137.00	$ 160	$ 8,000
20313	REMOVE INLET	5	EACH	$ 629.50	N/A	$ 3,148
20314	REMOVE PIPE	226	L.F.	$ 102.00	$ 25.00	$ 5,650
20403	CLEARING	525	SY	$ 37.50	N/A	$ 19,688
20408	GRUBBING	525	SY	$3.12	N/A	$ 1,638
20705	DETENTION BASIN SEEDING	1	S.Y.	$ 11.00	$ 3	$ 3
21073	EROSION MATTING, CLASS II, TYPE C - ORGANIC	1	S.Y.	$ 6.50	$ 3.50	$ 4
40381	REMOVE AND REPLACE CONCRETE CURB & GUTTER, MACHINE PLACED - RESURFACING	40	L.F.	$ 15.00	N/A	$ 600
50226	UTILITY TRENCH PATCH TYPE III	25	T.F.	$ 120.00	N/A	$ 3,000
50741	TYPE "H" INLET	4	EACH	$ 2,755.00	$ 3,500	$ 14,000
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000.00	$ 6,250	$ 6,250
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000.00	$ 25,000	$ 25,000
SH3	4' x 4' RCB CULVERT, EXCAVATION, BACKFILL & JOINT SEALING	226	LF	$ 475.00	$ 550.00	$ 124,300
SH4	4' x 4' RCB CULVERT WINGWALL & RAILINGS	4	EACH	$ 25,000.00	N/A	$ 100,000
				Subtotal		**$ 391,300**
				Contingency	**25%**	**$ 97,800**
				Design	**10%**	**$ 39,100**
				Total		**$ 528,200**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ 2,400**
				Total Total		**$ 530,600**

Conceptual Cost Estimate - Masthead Drive Box Culvert Greenway Crossing
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	N/A	$ 10,000
10911	MOBILIZATION	1	LUMP SUM	$ 86,600	N/A	$ 86,600
20229	MEDIUM RIPRAP - LIMESTONE	50	C.Y.	$ 137	$ 160	$ 8,000
20313	REMOVE INLET	2	EACH	$ 630	N/A	$ 1,259
20314	REMOVE PIPE	151	L.F.	$ 102	$ 25	$ 3,775
40381	REMOVE AND REPLACE CONCRETE CURB & GUTTER, MACHINE PLAC	40	L.F.	$ 15.00	N/A	$ 600
50226	UTILITY TRENCH PATCH TYPE III	32	T.F.	$ 120	N/A	$ 3,840
50741	TYPE "H" INLET	2	EACH	$ 2,755	$ 3,500	$ 7,000
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000.00	$ 6,250	$ 6,250
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000.00	N/A	$ 50,000
SH5	6' x 4' RCB CULVERT, EXCAVATION, BACKFILL & JOINT SEALING	322	LF	$ 600.00	$ 800.00	$ 257,600
SH6	6' x 4' RCB CULVERT WINGWALL & RAILINGS	8	EACH	$ 28,000.00	N/A	$ 224,000
SH23	VEGETATION RESTORATION ALLOWANCE	1	EACH	$ 5,000.00	N/A	$ 5,000
				Subtotal		**$ 663,900**
				Contingency	**25%**	**$ 166,000**
				Design	**10%**	**$ 66,400**
				Total		**$ 896,300**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ -**
				Total Total		**$ 896,300**

Conceptual Cost Estimate - Yellowstone Drive Box Culvert Greenway Crossing
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	N/A	$ 10,000
10911	MOBILIZATION	1	LUMP SUM	$ 70,300	N/A	$ 70,300
20313	REMOVE INLET	3	EACH	$ 630	N/A	$ 1,889
20314	REMOVE PIPE	84	L.F.	$ 102	$ 25	$ 2,100
20321	REMOVE CONCRETE PAVEMENT	50	S.Y.	$ 5	N/A	$ 225
40381	REMOVE AND REPLACE CONCRETE CURB & GUTTER, MACHINE PLACED - RESURFACING	40	L.F.	$ 15.00	N/A	$ 600
40401	8 INCH CONCRETE PAVEMENT	50	S.Y.	$ 99	N/A	$ 4,950
50226	UTILITY TRENCH PATCH TYPE III	32	T.F.	$ 120	N/A	$ 3,840
50741	TYPE "H" INLET	50	EACH	$ 2,755	$ 3,500	$ 175,000
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000	$ 6,250	$ 6,250
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000	$ 25,000	$ 25,000
SH11	8' x 4' RCB CULVERT, EXCAVATION, BACKFILL & JOINT SEALING	80	LF	$ 1,100	$ 1,200	$ 96,000
SH12	8' x 4' RCB CULVERT WINGWALL & RAILING	4	EACH	$ 35,000	N/A	$ 140,000
SH20	MISCELLANEOUS STORM SEWER CONNECTION ALLOWANCE	1	EACH	$ 2,500	N/A	$ 2,500
				Subtotal		**$ 538,700**
				Contingency	**25%**	**$ 134,700**
				Design	**10%**	**$ 53,900**
				Total		**$ 727,300**
				Land Acquisition	**0**	**$ -**
				Wetland Mitigation		**$ -**
				Total Total		**$ 727,300**

Conceptual Cost Estimate - Quarterdeck Drive Box Culvert
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	N/A	$ 10,000
10911	MOBILIZATION	1	LUMP SUM	$ 63,000.00	$ 70,000	$ 70,000
20314	REMOVE PIPE	220	L.F.	$ 102.00	$ 25	$ 5,500
20321	REMOVE CONCRETE PAVEMENT	50	S.Y.	$ 4.50	N/A	$ 225
40381	REMOVE AND REPLACE CONCRETE CURB & GUTTER, MACHINE PLACED - RESURFACING	40	L.F.	$ 15.00	N/A	$ 600
40401	8 INCH CONCRETE PAVEMENT	50	S.Y.	$ 99.00	N/A	$ 4,950
50226	UTILITY TRENCH PATCH TYPE III	32	T.F.	$ 120.00	N/A	$ 3,840
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000.00	$ 6,250	$ 6,250
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000.00	$ 25,000	$ 25,000
SH15	12' x 5' RCB CULVERT, EXCAVATION, BACKFILL & JOINT SEALING	110	LF	$ 1,700.00	$ 1,850.00	$ 203,500
SH16	12' x 5' RCB CULVERT WINGWALL & RAILING	4	EACH	$ 40,000.00	N/A	$ 160,000
				Subtotal		**$ 489,900**
				Contingency	**25%**	**$ 122,500**
				Design	**10%**	**$ 49,000**
				Total		**$ 661,400**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ -**
				Total Total		**$ 661,400**

Conceptual Cost Estimate - Regent Street Box Culvert Greenway Crossing
v2021_04_29

Item #	Item	Quantity	Unit	"Average" Unit Cost	Revised Unit Cost	Cost
10701	TRAFFIC CONTROL	1	LUMP SUM	$ 10,000.00	$ 20,000	$ 20,000
10911	MOBILIZATION	1	LUMP SUM	$ 85,700.00	N/A	$ 85,700
20229	MEDIUM RIPRAP - LIMESTONE	50	C.Y.	$ 137.00	$ 160	$ 8,000
20314	REMOVE PIPE	250	L.F.	$ 102.00	$ 25	$ 6,250
40381	REMOVE AND REPLACE CONCRETE CURB & GUTTER, MACHINE PLACED - RESURFACING	40	L.F.	$ 15.00	N/A	$ 600
50226	UTILITY TRENCH PATCH TYPE III	44	T.F.	$ 120.00	$ 150	$ 6,600
SH1	EROSION CONTROL ALLOWANCE	1	LUMP SUM	$ 25,000.00	N/A	$ 25,000
SH2	SITE DEWATERING / STORM CONTROL ALLOWANCE	1	LUMP SUM	$ 50,000.00	$ 25,000	$ 25,000
SH7	6' x 5' RCB CULVERT, EXCAVATION, BACKFILL & JOINT SEALING	264	LF	$ 750.00	$ 950.00	$ 250,800
SH8	6' x 5' RCB CULVERT WINGWALL & RAILINGS	8	EACH	$ 28,000.00	N/A	$ 224,000
SH23	VEGETATION RESTORATION ALLOWANCE	1	EACH	$ 5,000.00	N/A	$ 5,000
				Subtotal		**$ 657,000**
				Contingency	**25%**	**$ 164,300**
				Design	**10%**	**$ 65,700**
				Total		**$ 887,000**
				Land Acquisition		**$ -**
				Wetland Mitigation		**$ -**
				Total Total		**$ 887,000**

Appendix N – Comments & Questions from the Watershed Study Report Comment Period

Questions from Spring Harbor Comment Period

6/13/21—The City received a variety of questions and comments from residents. Where questions were similar, the City summarized the main question in the "Generalized Question," responded to that, and listed the specific questions from residents that the generalized questions is addressing beneath, where applicable.

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Kenosha Greenway

1. Generalized Question: Why did the City allow volunteers to improve the greenway if there was going to be a proposed project in the greenway?

   Specific questions from residents this question is addressing:

   - *...complete disconnect between Parks, who have been encouraging (and facilitating) the residents here to reclaim the Kenosha space as park space, and Engineering who seem likely to turn the whole space into an open ditch, without much reference to anyone*
   - *There appears to be no vegetation remaining in this entire area after the work is completed. Our S. Kenosha neighborhood has spent hundreds of hours in the last couple of years clearing this entire area of invasive trees, vines, poison ivy and invasive weeds such as garlic mustard, nettles and burdock. I think what we have is a vast improvement in the Greenway and greatly enhances the recreational value of the property. We have also been promised by the city a supply of native tree seedlings to fill in areas of this greenway. Some of us are also raising milkweed and native tree seedlings for replanting the area. We take pride in our neighborhood and the greenway and strongly object to what appears to be a clear cutting of vegetation in the entire S Kenosha greenway. We have invested sweat equity in these efforts and expect the city to respect these investments.*
   - *We have worked so hard to clean up the Kenosha Greenway with city input and have a lot of pride in what we have done. If you were just going to dig it up why encourage our work?*

   Response: The City did not anticipate that widening the Kenosha greenway would be necessary to reach their flood goals until we were closer to completion of the study. We have taken the concerns of the neighborhood into account and are going to try to look further into the modeling of this area. One issue is the need to replace the Regent Street Culverts, which are starting to fail and create sink holes in the roadway. We are looking into

ways to plan for the culvert replacements that can accommodate any future greenway work but will not require the greenways to be modified at this time. Funding was budgeted for some work in some of the greenways in this area but upon review of other project priorities those projects have now been put on hold indefinitely. We apologize for any inconvenience and frustration that this has caused and appreciate the volunteer's efforts to improve the native habitat. The improvements the volunteers made will be beneficial from a habitat and flood control perspective until the greenway improvement project is budgeted and constructed—see more information about the typical process for project construction on the Watershed Studies Additional Information website.

The City will be completing additional modeling in 2022 to explore additional alternatives to the project, and quantify the impact of the project based on updated conditions.

2. Generalized Question: Can you define how much additional flood reduction would result from widening the Kenosha greenway?

   Specific questions from residents this question is addressing:
   - *overzealous to assume that excavating the waterway between South Hill and Regent St is necessary, especially since the efficacy of other efforts (improved upstream water containment, increased drainage thru Regent St culvert, added swale at Burnett St, and removal of debris from the waterway by neighborhood work team) have not been assessed*
   - *With past and current mitigation efforts, I submit that we do not have enough data to justify the proposed major construction project in the S Kenosha Greenway. Maybe after the Research Park projects are complete and we have a few rain events of sufficient magnitude to judge whether flooding is still an issue, we can then make a decision on whether the proposed project is even necessary.*
   - *The dredging project seems overzealous. Won't what we do to improve upstream water containment, create a larger Regent culvert, keep the waterway clear of downfall and debris, and the new swale near Burnett be effective in preventing serious flooding?*
   - *Regent St culvert replacement need not be tied to dredging the S Kenosha waterway but rather it is more convenient and less costly to do so.*
   - *Potential impact of culvert replacement, newly created swale at Burnett, maintenance of waterway free of debris, and planned upstream water retention efforts have not been assessed. We submit that we do not have enough data to justify the proposed major reshaping of the S Kenosha Greenway.*
   - *Additionally, it does not appear we have enough data to justify the proposed major reshaping of the S. Kenosha Greenway as the potential impact of culvert replacement, newly created swale at Burnett, maintenance of waterway free of debris, and planned upstream water retention efforts have not been assessed. The Regent St. culvert replacement also need not be tied to the dredging of the s. Kenosha Greenway, but rather it is more convenient and less costly to do so independently.*

   Response: Due to the failing culverts under Regent Street at the Kenosha greenway, the City will be creating a series of updated watershed models that help to plan and phase this corridor.

   The model will be updated to reflect current conditions, then the culvert will be sized for both long-term capacity needs once downstream flood mitigation protections are in place, and for short-term capacity needs where we will install restrictor plates to make sure we are not creating additional flooding downstream.

   The City anticipates replacing and upsizing the failing culvert under Regent Street in 2023, however the culvert will not move more water downstream until downstream capacity improvements are made.

   The additional modeling will help phase upstream and downstream improvements, as well as looking at whether a bypass flood relief pipe from Burnett Dr into the greenway north of Regent Street could mitigate or minimize future grading needs in the Kenosha greenway.

3. Generalized Question: Can we increase size of garner pond or the retention pond on Whitney way to avoid expanding the Kenosha channel?

   Specific questions from residents this question is addressing:
   - *What about increasing the retention pond on Whitney Way or removing some of the woods just east of Garner Park?*
   - *This small piece of nature in critically needed within the neighborhood. It is in solid shape with limited invasives. Garner is highly disturbed and has homeless people routinely sleeping there making it a more challenging space for kids to connect with nature. There are very limited options in this neighborhood. We would be incredibly grateful for efforts to save the mature trees and years of work to create a space that allows some native species to flourish and reminds so many people of the value of nature.*

   Response: The Garner Park pond is located directly north of a piece of land the Water Utility owns and has flagged to be a future drinking water well. Due to the potential for groundwater contamination concerns, the Water Utility will not allow for the Garner Park pond footprint to be expanded. Additionally, the pond cannot be expanded west into the park because there is a significant hill there and there isn't space to expand flood storage.

4. Generalized Question: What is the difference between Glen Oak Hills Park and the Kenosha Greenway?

   Specific questions from residents this question is addressing:
   - *Due to public concern it appears that the Glen Oak green space has been revised. I would hope the Kenosha Green space could have the same consideration.*
   - *The Parks Department advocates protecting old growth trees in Garner Park and Glen Oak Hills Greenway, while no similar recognition is noted of the importance of preserving the oak woodland on S. Kenosha. We believe this woodland should be valued as a complete entity, contiguous and all deserving of protection, despite historical divisions by streets, neighborhood boundaries or department oversight.*
   - *Historical note: Many years ago, the Parks Department managed all this property. After the decision was made to turn the S Kenosha section over to the Department of Engineering, management was cut back and buckthorn and other invasive species overgrowth occurred and native plants were crowded out. Now the community is presented with further negative consequences of inconsistent management, despite recent efforts of the Department of Engineering to help revitalize the area*
   - *The Parks Department advocates protecting old growth trees in Garner Park and Glen Oak Hills Greenway, while no similar recognition is noted of the importance of preserving the oak woodland on S. Kenosha. We believe this woodland should be valued as a complete entity, contiguous and all deserving of protection, despite historical divisions by streets, neighborhood boundaries or department oversight.*

   Response: The Glen Oak Hills Park is a part of the official City of Madison park inventory and is documented in the Park and Open Space Plan. There are recreational improvements within Glen Oak Hills Park that Parks has installed and maintained. The Kenosha greenway is mapped a greenway, and is not a part of the park inventory or in the Park and Open Space Plan. Please see Watershed Studies Additional Information and the Stormwater Drainage System webpages, for more details on the differences between Parks and Greenways.

5. Question: How does the City weigh habitat and ecological loss against a particular flood solution?

   Response: Wherever possible the City avoids tree loss. However, in developed watersheds, there is minimal additional space that the stormwater utility can utilize to either hold back, or convey stormwater. While trees are beneficial for the environment and habitat, they can impede stormwater conveyance—a large forested area slows the water down, which can add to flooding by causing increased backwater elevations. Additionally, channels with too much canopy tend to have erosion issues as the grasses and other vegetation that are necessary to stabilize the ground cannot grow effectively due to the lack of light, lending itself to bare ground. When we cannot purchase sufficient amounts of land to store more floodwater and slow/detain the water

down, another option can be to improve conveyance and speed the water up. In that situation, the common conflict with trees is that we need to deepen or widen a channel in order to move more water through quickly.

When a flood-related project is budgeted, has been through the detailed design process, and has been constructed, the City works to establish native vegetation which has deep roots that help stormwater infiltrate, as well as hold soil in place to prevent erosion. The native vegetation is also very beneficial for supporting the bottom of the food chain in our ecosystem. Insects need native vegetation to survive and when we have healthier insect populations by providing native vegetation for them to eat, live and nest, we support the bird and small mammal population as well. Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information.

6. Question: Will there be plantings on the walls of the greenway to prevent the soil on the sides from eroding to the bottom?

   Response: As with the majority of our greenway reconstruction projects, there would be native vegetation planted along the walls of the greenway to hold the soil in place. Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information.

7. Question: Will there be a barrier or fence on the side of the greenway to keep children out?

   Response: There would not be a barrier or fence to keep children out. The greenway will still be conveying the same amount of water as it currently does without a fence, it will just be better confined to the greenway area. Installing fences makes emergency access more challenging in an event that a rescue would need to occur.

8. Question: What will the greenway look like when it is not full of water?

   Response: If reconstructed per the concept shown in Figure 31 the greenway will have native grasses and flowers, as well as some native trees such as oaks along the top of the bank. It would follow the typical reconstruction restoration planning process as detailed in the Ecological Restoration in Stormwater Ponds and Greenways Storymap.

9. Question: When the greenway drains under Regent Street, what happens to the homes downstream?

   Response: The Kenosha greenway reconstruction won't have an impact on homes that flood downstream. The purpose of the greenway reconstructions is to prevent S Kenosha Dr from flooding and provide emergency access to homes in a 4% chance event, and to prevent homes along Burnett Dr from flooding in the 1% chance event.

   Expanding the culvert under Regent St, and allowing additional water to pass through the new culvert, would lead to additional downstream flooding near Gettle Ave. Due to this issue, we will not allow additional water to pass through the new culverts until there is more flood storage and conveyance downstream to manage the additional water. Additional modeling will be completed to look at alternatives as the Regent Street culverts are being designed.

10. Question: Is the function of the greenway water retention or to increase the rate of flow?

    Response: The purpose of the Kenosha greenway reconstruction is to widen the greenway to increase the rate of flow through the greenway. Right now, the greenway cannot convey the amount of water that flows through it, so it overtops its bank and flows over S Kenosha Dr and backs up Burnett Dr, which has caused significant flooding of the homes at the Burnett and Kenosha intersection for several decades.

11. Question: The study projects the removal of 13,000 cu ft of soil from the Kenosha Greenway but does not define where this soil will originate. This amount of soil is approximately 40 dump truck loads, not an insignificant amount. Figure 31 needs to define this area more clearly.

    Response: Figure 31 shows the existing and proposed contours for the conceptual project. When the project would move from a conceptual project to a budgeted project, we would collect detailed design data and refine the conceptual plans. At that point we would be able to provide a cross section to show the existing and proposed channel width.

    Please see Watershed Studies Additional Information for more information on project construction.

12. Question: RE: Figure 30: Has the new large intake/outfall structure installed this last fall on the east side of Kenosha Dr just north of Regent Street been incorporated into the model? Effective movement of water under Regent is critical in the short term given the structural issues currently affecting this section of road. I hate to see this get rushed, or any emergency actions overtake what would be best from a holistic perspective for the entire greenway. Would a larger box culvert, installed as soon as possible, reduce the need for such drastic loss of trees on Figure 31? Would a large box culvert/storage option under Regent St prevent large changes to the greenspace?

    Response: The model was built prior to creating a more robust inflow to the greenway at N Kenosha Drive just north of Regent, so that isn't included in the conceptual model, but it shouldn't impact the solution, as the water was flowing over the curb into the greenway. The City agrees that effective movement under Regent St is critical, as the culverts are not holding up well and are at risk of failing. The City plans to install the appropriate size box culvert under Regent Street in the near future, and limit the amount of water that can move through it with plates until downstream solutions are budgeted, designed, and built. The Regent Street culvert restrictor plates will be sized with the additional modeling the City is completing in 2022, as well as the phasing of upstream and downstream projects.

    Unfortunately the volume capacity needed to hold back water to prevent flooding downstream, or upstream at Burnett, is far larger than what we could fit under Regent St. There is only space to convey water under the street, not create a storage facility under the street. This is due to limited footprint of the road, and the surrounding existing utilities. For more information on the infrastructure under our streets, please visit our Hidden Infrastructure webpage, and our Flash Flooding Resilience storymap.

13. Question: RE: Figure 31: Is there a means by which less drastic loss of trees is possible? I did not see any other options evaluated for this section in the process, other than what is proposed. Is there a means by which to increase the channel size and bowl structure just south of Regent to increase retention capacity without destroying all the trees? Is there a opportunity to replace the degraded bridge due east of Trempealeau Trail with a berm/box culvert to increase retention in localized zone with less loss of trees? ? What about a change at South Hill or along the eastern edge of the park from South Hill to Regent where there is green space and less trees - build in meanders and ponds - something that would ADD VALUE to the neighborhood instead of clear cutting the park.

    Response: The purpose of the Kenosha greenway reconstruction would be widening it to increase the rate of flow through the greenway. Right now, the greenway cannot convey the amount of water that flows through it, so it overtops its bank and flows over S Kenosha Dr and backs up Burnett Dr, which causes the flooding of homes. Therefore, simply replacing the bridge due east of Trempealau Trail will not have the same flood reduction effect.

    The City will be completing additional modeling that will help figure out if and which community suggestions are viable alternative flood reduction solutions—we will have that information available in early 2023 at another public meeting once the modeling is completed.

14. Question: Impact of putting in a properly sized culvert at Regent Street, and why it cannot be used for additional storage?

    Specific questions from residents this question is addressing:

    - *In particular, the Regent St underpass is reported as undersized in the Final Draft Report. If that is going to be upsized, there are multiple opportunities to engineer a solution beneath Regent St, including oversized box culverts, storage volume, etc.*

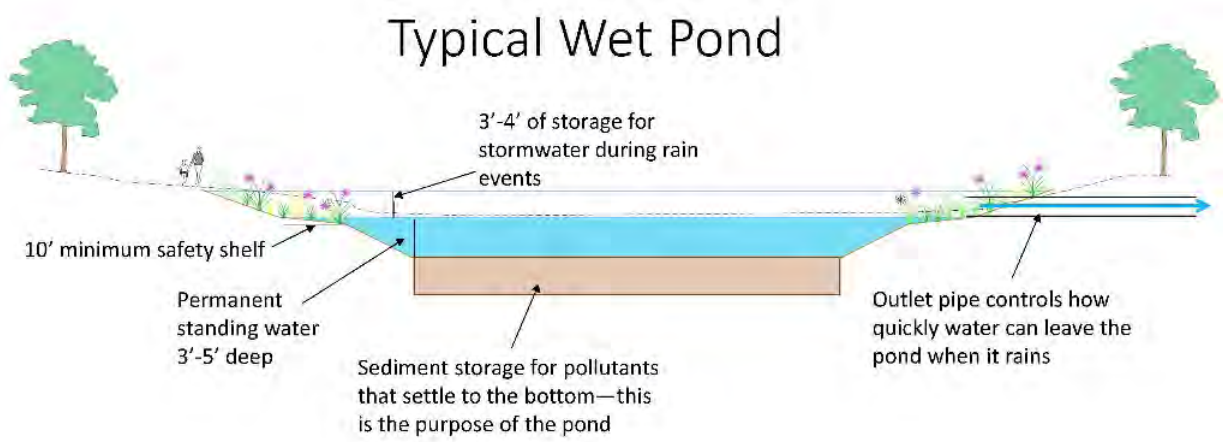
    Response: There is 500 cfs of stormwater that flows through the Kenosha Greenway during a 1% chance event. That is the equivalent of 75,000 garden hoses turned on. Or, if you can imagine pulling a string from one side of a greenway to the other, the volume of water moving past is equal to ~500 basketballs passing under that string every second.

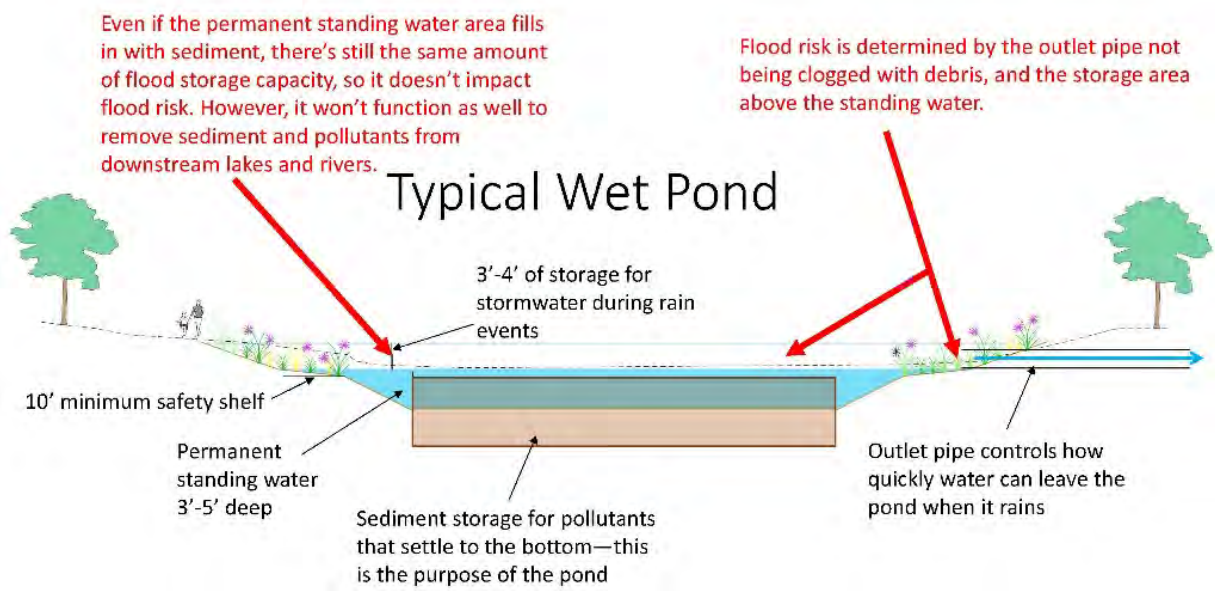
    In order to create enough storage under Regent Street to reduce stormwater flows and nearby flooding, you would need to be able to hold thousands of cubic feet of water (or, imagine basketballs) beneath the road. Unfortunately, that space doesn't exist.

    There is only space to move water under the street, not create a huge cavity for storage under the street. This is due to limited footprint of the road, and the surrounding existing utilities. For more information on the infrastructure under our streets, please visit our Hidden Infrastructure webpage, and our Flash Flooding Resilience storymap.

15. Question: Can dredging Garner Pond help to reduce flooding downstream or minimize the need for the Kenosha greenway grading?

    Response: Even though the Garner Pond is filled with sediment and needs to be dredged, that doesn't impact the pond's available flood storage. Therefore, dredging the pond will not reduce downstream flooding. If you think of a pond as a water bottle with a hole drilled in the middle, the water bottle will always hold water up to the hole, and when it you top it off (or, for a pond, when it rains), the bottle fills to the top, and slowly leaves the drilled hole in the middle brining the water level right back to just below the hole. When a pond is filled with sediment and needs to be dredged, it just means the bottom half of the water bottle has a mix of sediment and water, but the water always is below the hole, and you have the same amount of storage above it. See the pond illustrations below:





Forsythia Cunette and North/South Channel in Owen Park

1. Question: What impact will the N/S channel have on screening?

   Response: There will need to be trees removed in order to re-build the channel. When the project moves from a conceptual design to a budgeted project, we would collect design-level data that would allow us to provide a more detailed design that would clearly show which trees would need to be removed to build the channel.

2. Question: What is the N/S channel depth and width?

   Response: The conceptual solution for the N/S channel is 5 feet deep and 50 feet wide. The City anticipates that if and when this project is budgeted and in the detailed design, it will be refined to have a smaller footprint.

3. Question: Would digging the ditch deeper damage the area and spread of invasive species afterward? Would it be replanted with natives?

   Response: The City works to minimize the spread of invasive species with its construction work. Following the channel construction, it would be replanted with native species. You can learn more about the Stormwater Utility's general restoration goals by reading the Ecological Restoration in Stormwater Ponds and Greenways Storymap.

4. Generalized Question: What is the cost/benefit of N/S channel –homes flooded vs cost.

   Specific questions from residents this question is addressing:
   - *..cheaper and more protective of the land to just give money to that one house to fix whatever they need, rather than digging a new channel destroying the woods and forcing more water into the cunette, which is already overflowing.*

   Response: Individuals are free to take flood protections on their property as they see fit, including raising structures. The City does not have funds, or a grant program, for private property flood proofing as City ordinances prohibits the use of stormwater utility funds on private property improvements if the solution does not also benefit the public stormwater management system. If residents who are most at risk are willing to sell their homes to the Stormwater Utility, or flood-proof their homes, then solutions could be re-assessed based on the structures at risk of flooding at that time. The City has limited ability to purchase homes however this is an

option if the seller is willing and the City has enough money to purchase the property. This study helps property owners assess their personal levels of risk so they are able to make decisions regarding public projects or about making modifications to their property. Property owners are encouraged to determine if improvements can be made to their property to reduce flood risks.

Based on the modeling, there are 16 structures that flood due to the N/S channel overtopping and the total assessed value of these properties is ~7x greater than the cost to re-construct the channel. Additionally, there a secondary cost to the city in terms of lost tax and utility revenue for every home purchased.

5. Generalized Question: Cost/benefit of flood wall vs buying or protecting homes (clarify # of homes in 1% chance flood)?

   Specific questions from residents this question is addressing:
   - *if only one house floods at the east end of the cunette, maybe that house should be moved. Or maybe some structure could be added to that and whichever other houses flood along the cunette, rather than building a wall that goes to 11 ft. high.*

   Response: Individuals are free to take flood protections on their property as they see fit, including raising structures. The City does not have funds, or a grant program, for private property flood proofing as City ordinances prohibits the use of stormwater utility funds on private property improvements if the solution does not also benefit the public stormwater management system. If residents who are most at risk are willing to sell their homes to the Stormwater Utility, or flood-proof their homes, then solutions could be re-assessed based on the structures at risk of flooding at that time.

   Based on the modeling, there are 39 structures that flood due to the Forsythia cunette overtopping the berm, and flowing out towards Bordner Drive. The total assessed values of these properties is ~2x greater than the cost to build a flood wall.

6. Question: Instead of a floodwall, what other alternatives, such as flood mitigation on individual structures, or elevating the structures, considered? If so, why were they rejected?

   Response: The City looked at widening the existing concrete channel, however the width of the channel expansion was limited by the wooded hill on the south side of the channel, and the widening did not show sufficient flood reduction. When the concrete channel was re-built 10 years ago, the City determined that the 2 sanitary sewers crossing under the channel could not be moved without re-building sanitary sewer throughout the entire neighborhood. However, recently the City determined a possible alternative that would allow for the channel to be lowered. The City will be completing additional modeling to see the impact of lowering and widening the channel and will share the results at the fourth public meeting in 2023 once the modeling is complete.

   Individuals are free to take flood protections on their property as they see fit, including raising structures. The City does not have funds, or a grant program, for private property flood proofing as City ordinances prohibits the use of stormwater utility funds on private property improvements if the solution does not also benefit the public stormwater management system. If residents who are most at risk are willing to sell their homes to the Stormwater Utility, or flood-proof their homes, then solutions could be re-assessed based on the structures at risk of flooding at that time.

7. Generalized Question: Safety of flood wall—how is it designed to not fail due to water pressure?

   Specific questions from residents this question is addressing:

- *I'm wondering how safe a big wall is anyway if there is an earthquake or tornado, although maybe that's too remote. But, if the wall were to fail due to water pressure, the bricks or concrete would be far more damaging than water.*

Response: Flood walls are designed to withstand the forces of the anticipated water depths, including a factor of safety. This level of engineering design is completed when the project is budgeted and in the design phase.

8. Generalized Question: Why can't re-development near West Towne Pond fix flooding by Crestwood?

Specific questions from residents this question is addressing:

- *The above proposals do nothing to address the cause of the flooding, which, as I understand it, is from development west of Crestwood, including West Towne Mall. And, I have heard that re-development will be done for West Towne Mall. Can't enough water mitigation measures be done in the re-development of West Towne to avoid downstream problems? It seems to me that the extreme measures being proposed in Crestwood will not solve the basic issues and, in addition, will be very invasive and non-natural, basically destroying the woods and natural environment that make Crestwood and Owen Park desirable*

Response: The water coming from West Towne Mall all ends up in the West Towne ponds. There is significant flooding around West Towne Mall, which impacts businesses as well as arterial roads that serve as emergency service routes. The watershed study proposes a conceptual solution at West Towne Ponds that mitigates flooding around the ponds, and does not increase flooding downstream. The proposed solution maximizes all available space, so there is not additional room to try to decrease the flows leaving this area. Also, to note, there is only a 36" pipe leaving the pond, which can convey 40 CFS, and by the time the stormwater is moving past Crestwood, the additional watershed area that contributes to the flow results in 1350 CFS flowing over the Forsythia channel (34 times as much flow).
However, as areas around West Towne Mall redevelop, they will be required to meet more stringent stormwater utility rules, and this may help slightly decrease flooding throughout the watershed. Due to the unknown timeframe for redevelopment, and the fact that the City is not in control of when private land would be redeveloped, this was not included in the model.

Additionally, the largest issue at Crestwood and Gettle Ave is that there is a large upstream watershed with significant elevation change that all drains to Crestwood and then Gettle Ave, where it is very flat. The flatness of the area, and therefore the storm sewer, slows down the water, and causes it to pool deeper and spread out as it cannot leave the area as quickly. The very large peak flows that are moving through this area make it especially challenging to reduce the flooding through this area.

9. Generalized Question: Could we use a pond where the cunette is and prevent the need of a flood wall?

Specific questions from residents this question is addressing:

- *The alternate solution is to dig a Floodwater Retention Pond in the unused floodplain south of the Owen Park portion of the stormwater stream.*
- *The redesigned cement cunette that goes through Crestwood property is inadequate and dangerous; several children (4) had to be rescued from it.*

Response: Due to the very large flows of water that are moving over the cunette, creating a pond along this area would need to be very big. Please see "Why can't you put the pond in X location instead of Y" explanation below.

The flood wall allows the stormwater to get deeper before it goes into the box culvert under Bordner Drive, which pressurizes the pipe and the water can enter the pipe more quickly—it's essentially pushed into the pipe by the stacked water behind it. A pond, in contrast, would need to hold enough water to reduce the peak stormwater flows to the rate that can enter the existing box. In order to do that in the main drainage spine, there would need to be significant tree removals.

10. Generalized Question: How big would box culverts need to be to manage more water? (equivalent box size of flood wall pressuring the box)

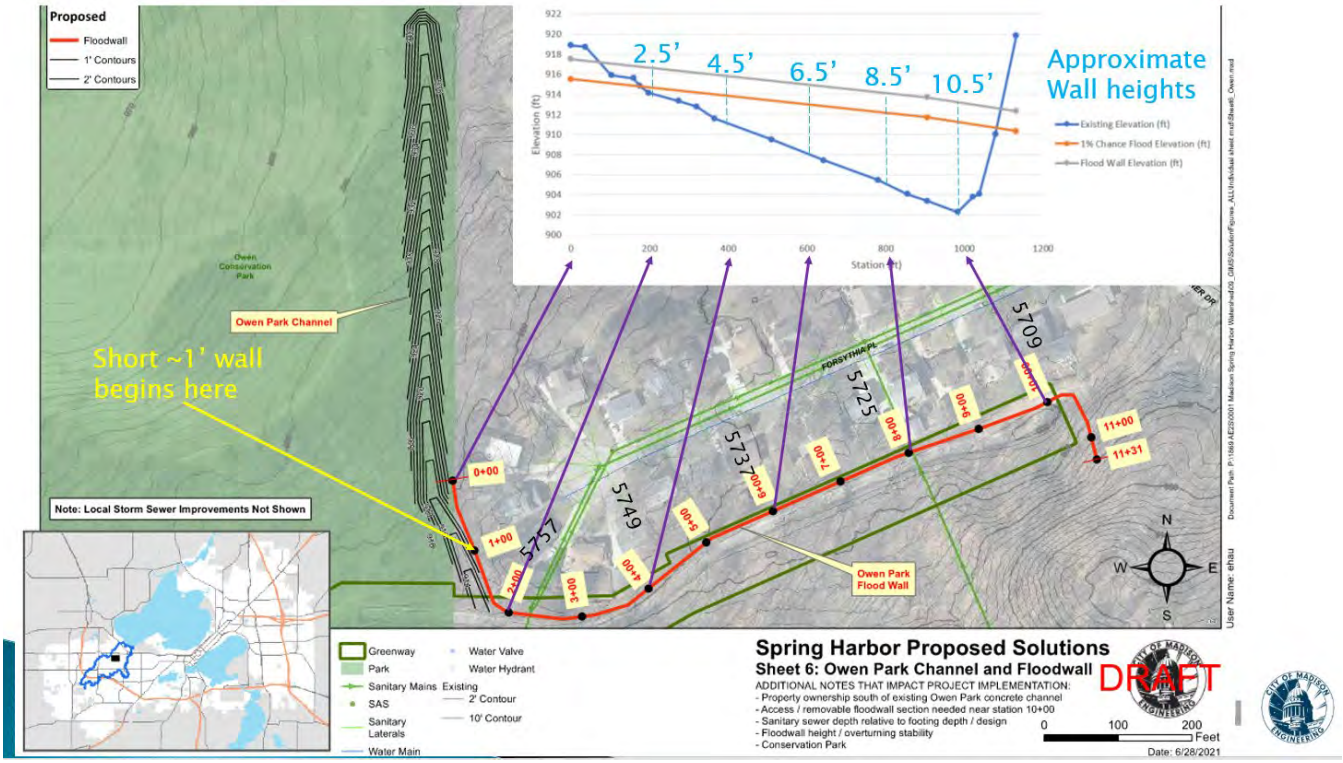
    Specific questions from residents this question is addressing:
    - *I urge you to find another solution, e.g. to expand the Box Culverts to manage more water.*
    - *As a Crestwood resident, I urge you to go with the least intrusive/labor-intensive option, which seems to be increasing the capacity of the box culverts*
    - *I find the flood-wall solution a complete overreach of the issue as an eye witness of the August 2018 rain events. What I witnessed was a failure of the Box Culvert that could not accommodate the amount of water it was supposed to divert into the Bordner Park channel causing a considerable back up of water that breached the cunnette up to my property at 5721 Forsythia. I believe that this could be prevented in future historical events by simply increasing the capacity of the Box Culvert. The cunnette as it is currently constructed did its job as expected the Box Culvert did not.*
      The city has proposed increasing the capacity of box culverts as part of a comprehensive plan throughout the Spring Harbor Watershed which would not cause physical view obstructions to residents which is completely acceptable. What I find unacceptable is an 8-9 foot wall that would completely obstruct our view of the south woods and be a permeant eyesore in the Crestwood Neighborhood. It is my hope that we can find an alternative to the flood wall proposal that would lessen the negative impact and still meet water removal objectives.

    Response: Once the flood wall was added to the model, the box culverts were able to handle 70% more flow while not flooding neighboring homes. To make the box culvert large enough to handle these flows, and not flood neighboring homes, we'd need to lower the upstream water level, and still be able to pass the larger flows. We estimate the box would need to be double its existing size, and on the downstream end near Bordner Park, the box culvert is already nearly 70 feet wide. The area of public land and easements the existing culvert crosses is already completely occupied by the existing culvert. Therefore in order to make the box culvert large enough, adjacent homeowners would need to be willing to sell their homes to the Stormwater Utility.

11. Generalized Question: I also wonder when it comes to the flood wall height where does the bottom of the flood wall begin? Is it at the top of the concrete cunette?

    Response: The conceptual solutions proposed for the flood wall to begin at the top of the berm. However, the final details of the flood wall location and specific heights would be figured out if and when the project is budgeted, during the detailed design process.

    Here is a drawing that more clearly shows the approximate wall heights along the cunette that was shared with the Crestwood Neighborhood Association. Note, these are all based on the conceptual solution and would change based on the detailed, final design once the project is budgeted.



12. Question: Page 59 of the report says, "If the greenway crossings are completed first, serious discussions on buyouts / structure raises are needed. "What does that mean exactly? I do not want to sell my house. Is that a possibility?

    Response: If the City were to increase the size of the greenway crossings upstream of the Forsythia cunette, the peak stormwater flows would arrive to the Forsythia cunette area and Gettle Ave area more quickly, and cause additional flooding. This would essentially be moving the problem downstream and as a policy the City has chosen not to proceed in that manner at this time. The City's plan and preference is to complete flood projects downstream prior to upstream so that we are not shifting the problem downstream before we improve flood resilience downstream. The City has limited ability to purchase homes however this is an option if the seller is willing and the City has enough money to purchase the property. This study helps property owners assess their personal levels of risk so they are able to make decisions regarding public projects or about making modifications to their property, including selling property to the City if they wish to do so and the City is also interested in purchase of their properties.

Glen Oak Hills Park

1. Question: Could berms be densely planted with woody species (like big trees, and evergreens, and shrubs) to reduce visibility across clear-cut berm zone? Could berms be planted with natives, not just mowed grass?

   Response: The berms would be replanted with native vegetation that will help support wildlife, and it is also beneficial for soil stability. Unfortunately we do not plant trees on top of berms because if the trees are blown over, and the root-ball is exposed, it could undermine the integrity of the berm and cause it to fail. However, trees would be replanted in areas that were impacted by construction. Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information on the Stormwater Utility's goals for revegetation after project construction.

2. Question: Could adjacent canopy tree cover near roads (where berms go closest to roadways) be protected to keep sense of a "forested park" and reduce the impact of a visual swath bisecting the park with a berm? (adjacent homeowners don't want clear-cut forest across the street... eeek!)

Response: The City would work to keep as many trees as possible, including along the edges near the roads wherever feasible. One the project is budgeted and in the design phase, Engineering, Parks and forestry would work together to create a planting plan that establishes the trees and vegetation. The plan would work to be aesthetically pleasing, promote habitat, and allow for maintenance once it's constructed. Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information on the Stormwater Utility's goals for revegetation after project construction.

3. Question: Would construction be done in a way not to spread invasive species which many of us are controlling in the park?

   Response: The City would include provisions in the contract to minimize the spread of invasives. Typically, once a project is constructed and restored with native seed and new plantings, the City hires a special restoration contractor to help the native vegetation establish in the first couple of years. Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information on the Stormwater Utility's goals for revegetation after project construction.

4. Generalized Question: Figure 29: How would keeping the improvements to the box culvert east of Glen Highway along Gettle affect the "Retention solutions" on Figures 28 and 31? Would keeping this solution on the table, increase the ability to move water out of Gettle sag and thus allow less alternations upstream (i.e. less alternations to the Greenspace on Figures 28 and 31)? The use of Hampton Ct Park should be considered as another way to reduce the Gettle sag - that area is not highly utilized.

   Specific questions from residents this question is addressing:
   - *Maybe Hampton Court Park could be reconfigured along with the western edge of 400 block of Park Way to retain water? Rather than harming the trees at the northern edge of Kenosha Park with a berm, maybe remove Park Way (road) where it intersects with Glen Hwy, and incorporate a berm on adjacent Hampton Court Park. It is unused and of low recreational or aesthetic value since it is just mowed grass between 3 roads. Maybe it could be used to store or retain water?*
   - *In particular, there is an open green space (Hampton Ct Park) immediately downstream of the Glen Oak Hills Park (between Park Way, Glen Hwy, and Hampton Ct) that could be utilized to install any number of features without degrading any of the old neighborhood trees.*

   Response: Figure 29 was updated based on more detailed survey data that became available with the Old Middleton Road project. Updating the Gettle Ave pipe slope showed the existing pipe had more capacity than was in the original model, and therefore the culvert wouldn't need to be expanded past Glen Highway. Because the downstream pipe has sufficient capacity, increasing the pipes on Gettle Ave wouldn't impact the berm size at Glen Oak Hills.

   The berms shown in Figure 28 for Glen Oak Hills are designed to keep water from overtopping the street and flooding homes along Glen Highway and Gettle Ave so modifying the solution in Figure 29 wont impact Figure 28. Hampton Court Park was looked at for storing additional water, but it isn't large enough to have an impact on volume, and in order to use part of the park as a berm, we would need to reconfigure traffic and streets in this area, and likely dead-end, Park Way and Glen Hwy which would have significant neighborhood impacts.

   Additionally, the grading shown in Figure 31 is designed to have more of the 1% chance storm flows move through the greenway, as opposed to through the greenway **and** the street. Once the storm flows overtop the street, they flood homes on Burnett Dr.

5. Question: Figure 28---Glen Oak Berms and Box Culverts: Would the proposed berms be integrated aesthetically into the park space? Is there a representative example or rendering that could be shared? How would construction vehicles access the area of the berms? The City can specify a maximum size vehicle to prevent having to remove trees and to minimize the impact to the wooded area. Volunteers have worked very hard to maintain this area and install a trail system and would be nice to see any changes be designed with walking and

park use in mind. Trails should be repaired if disrupted. These trails are used daily no matter the weather/season.

Response: The berms would be integrated into the park space. Unfortunately, we cannot plant large trees on berms as it can ruin the integrity of the berm and cause it to fail if the tree falls over and the roots are exposed. We do not have a rendering to show what this would look like in the conceptual stage, but if and when the project becomes a budgeted project, we would collect more detailed design data, refine concepts, and be able to show renderings of what the preliminary designs would look like.

We appreciate all the effort of volunteers to maintain this area and install a trail system. Any improvements made in relation to stormwater would designed along with specialized Park staff, as well as the community, to enhance existing recreational amenities wherever possible and improve native plant species. Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information on the Stormwater Utility's goals for revegetation after project construction.

Once a final design is established, final construction plans would be developed to minimize construction impact on trees.

Bordner Park

1. Question: Public presentation sounded "all-or-nothing" for this park (leave as is, or excavate to super-scary deep with cement walls.) How about a compromise? i. Bordner Park is great place for a reservoir/pond/wetland stormwater retention area. ii. Today = low in natural value (grass) and has really low usage. Not hiked on or used as park much, not natural or forested... so wouldn't damage much to use for stormwater area. iii. A pond with wetland-like planted edges could be nice looking addition to the area. iv. Maybe buy-out some chronically flooded properties near this park and convert to retention pond/wetland?

   Response: Individuals are free to take flood protections on their property as they see fit, including raising structures. The City does not have funds, or a grant program, for private property flood proofing as City ordinances prohibits the use of stormwater utility funds on private property improvements if the solution does not also benefit the public stormwater management system.

   Due to the uncertainty of whether residents would be willing to flood proof their homes, or sell their homes to the City, the solutions presented did not involve being able to rely on the assumption that residents could be convinced to do so. Therefore halfway solutions were not considered. The studies are intended to analyze what size of solutions are needed to meet the flood goals.

   If specific residents were willing to sell, or invested in flood proofing their homes, the City would be able to re-analyze solutions to find a compromised solution at that time.

   To better understand why the Glen Oak Hills is more beneficial to hold back floodwater as opposed to Bordner Park, or other areas within the main trunk line of the storm system, please see "Why can't you put the pond in X location instead of Y" explanation below.

Gettle Ave Storm Sewer

1. Question: Could you make the storm sewer as big as possible (I think Amber said 22' x 6' is the biggest?) to help drain off water better or hold water.

   Response: The purpose of upsizing the Gettle Ave storm sewer is to improve conveyance so that more water can move through quicker. The portion of storm sewer along Gettle Ave from N Rosa Rd to Glen Hwy is undersized and this "choke point" is leading towards additional flooding. The proposed pipe size solves that problem and creates near uniform capacity for the storm sewer from Bordner Park all the way to Spring Harbor. There is not a

feasible pipe size that would make the storm sewer function to hold water back—there is just too much water moving through the system, with limited road space and other utilities that need to take up the space under the road. For reference, the amount of space needed to slow down the water here is greater than digging Bordner Park 20' deeper. And, due to the downstream pipe capacity limitation (starting from under the railroad tracks all the way to Lake Mendota), adding additional capacity at Gettle wouldn't help Gettle because the additional water can't continue to move downstream.

2. Question: Can you buyout some houses on Gettle that are most prone to chronic flooding and remove them?

   Response: Individuals are free to take flood protections on their property as they see fit, including raising structures. The City does not have funds, or a grant program, for private property flood proofing as City ordinances prohibits the use of stormwater utility funds on private property improvements if the solution does not also benefit the public stormwater management system.

   If specific residents were willing to sell, or invested in flood proofing their homes, the City would re-analyze the impact on the conceptual solutions at that time.

3. Question: Can you add rain gardens there to retain water?

   Response: The scale of the issue is so large that rain gardens would not make an impact. Rain gardens help in small storms such as the 100% chance storms (thunderstorms we experience annually), but these have a fraction of the volume as the 1% chance storms that are causing the worst flooding. Please find more information on green infrastructure and our watershed studies on the Watershed Studies Additional Information website.

Nautilus Drive Detention Pond

1. Question: Could this be planted with more wetland species of trees, shrubs, and forbs? They drink water, provide needed wildlife and pollinator habitat, nature recreation, and would help make it prettier and lower the water table.

   Response: The City has planted site appropriate native grasses, forbs and trees. Following the reconstruction of the pond and greenway, the City hired an ecological restoration firm that maintained the native seed that was put down in the areas that were disturbed by the construction, and planted 48 native trees. One American elm and three bur oaks that didn't survive were replaced in fall 2021. The trees will take years to fully mature, but progress is underway.

   As of the City's Greenway Vegetation Coordinator's last walk-through in fall 2021 with the contractor they observed a lack of native forbs and heavy infestation with red clover. Native warm season grass establishment is good. The contractor will treat red clover and reed canary grass in 2022, followed by reseeding of native species not requiring winter stratification. Engineering staff will reseed native forbs requiring stratification in fall/winter 2022/2023.

   With continued aggressive weed control under contract and spring reseeding of sprayed areas, followed by inter-seeding in fall/winter, this site should be in a much better place in 2023.

Yellowstone and Quarterdeck Drive Greenways

1. Question: In addition to adding culverts here, could the park areas be regraded to add retention ponds? Since it's mostly just grass now and has low usage for recreation or viewing nature, runoff ponds would be an improvement. Using Quarterdeck Drive section to retain water might reduce need to destroy mature forest in Masthead Greenway

Response: Unfortunately, there are very low-laying houses alongside the greenway, so there is not a lot of available storage space to make a difference in peak flows. Additionally, these greenways compose the major backbone of the stormwater conveyance system, therefore there is more water moving through these greenways, and it is harder to make a notable impact in the peak flows (which are what lead to flooding). In both the Masthead and Kenosha Greenways, there is less water moving through the system, and therefore utilizing the existing space in those greenway systems to store water delays the peak flows moving through them. This allows the peak flow to move through the major backbone of the system, before the other peak flows join it, which is what causes the worst flooding at Gettle Ave.

Please see "Why can't you put the pond in X location instead of Y" explanation below.

Masthead Greenway Ponds

1. Question: If needed to slow water flow down, maybe add a couple boulder barriers at creek base without disturbing the forested areas?

   Response: The model showed that we need a certain volume of storage to significantly slow down the peak flows through the greenway. Unfortunately this cannot be accomplished with boulder barriers.

2. Generalized Question: How is climate change considered when coming up with flood plans?

   Specific questions from residents this question is addressing:
   - *It is ironic that a plan responding to climate change would recommend clearcutting trees and removing all native vegetation from an active wildlife corridor. We would hope the city is focused on protecting existing tree cover to reduce urban heat island impacts, not to indiscriminately remove trees.*
   - *Further, our understanding is that these retention basins will be nothing more than grass covered areas so they can be routinely mowed by city equipment. Deer, turkey, coyotes, foxes, and myriad birds all use the greenway which interconnects Owen to the Oakwood Village green space. This plan would be yet another loss of habitat that will negatively impact area wildlife when we know climate change will strain species.*
   - *These new dry ponds will need to be mowed by city equipment, which will end up increasing the use of fossil-fuel-powered equipment. Again, a very counter-intuitive game-plan if the city is trying to reduce our collective CO2 footprint and combat climate change.*

   Response: Much of the City's consideration of climate change when developing conceptual solutions for watershed studies is in relation to infrastructure resilience for flooding. Knowing that more intense storms will occur more frequently, the watershed studies are even more important.

   When pond and greenways are reconstructed they are revegetated with native species and managed by an ecological restoration firm for a couple of years to plan the native trees in the revegetation plan, and help establish the native seed. Native vegetation has deep roots that help stormwater infiltrate, as well as hold soil in place to prevent erosion. The native vegetation is also very beneficial for supporting the bottom of the food chain in our ecosystem. Insects need native vegetation to survive and when we have healthier insect populations by providing native vegetation for them to eat, live and nest, we support the bird and small mammal population as well. Additionally, once native vegetation is established, it doesn't need frequent mowing or maintenance.

   You can learn more about the Stormwater Utility's general restoration goals, and the impacts of revegetating with native species by reading the Ecological Restoration in Stormwater Ponds and Greenways Storymap.

   Please see Watershed Studies Additional Information for more information on how climate change was considered in watershed studies.

3. Question: Safety concerns with new pond creation—will there be fencing?

   Response: The City does not install safety fencing around stormwater infrastructure. Fences make emergency access more challenging in an event that a rescue would need to occur. The City designs stormwater infrastructure with safety features such as a safety bench around stormwater ponds with standing water, and gates on large pipes that pose safety hazards. A safety bench is a gently sloped area that is created so there are is not a sudden drop off at the water's edge. These benches are typically 15 ft wide and installed at a 10:1 slope to encourage wetland vegetation to grow. The tall, dense, wetland vegetation creates a barrier to prevent people and pets from swimming and playing in the stormwater ponds, which is not advised.

   The design details, such as the specific grading, will be figured out when the project is budgeted and in the design process.

4. Generalized Question: Will the implementation of the masthead ponds impact homeowner insurance?

   Specific questions from residents this question is addressing:
   1. *Although these are designed as dry ponds and meant to drain, the idea of 10' and 13' bodies of water backing up to homes with small children seems unnecessarily risky.*
   2. ***Safety**. Many families have small children and animals which could easily fall into a quite deep retention pond. Will there be fencing? What will the gradient be from the start of the pond to our property lines? Has the city considered what the impacts to insurance would be?*

   Response: Generally, Engineering staff have not noted an increase in insurance rates for properties next to a pond or greenway. However, if you have concerns you should contact your individual insurance provider.

5. Questions: In addition to the negative environmental and safety aspects of these retention ponds, we are naturally also very concerned about property values. As you can well imagine, the loss of this greenway will have significant negative impact to property values for residents on most of Island Dr and as well as the residents on the east side of Nautilus. It would be tragic enough to lose all of the tree cover, but to replace the green space with dry ponds that will only have grass and that would rely on the availability of city mowing would be unfortunate. Many communities require native plantings and landscaping in and around retention ponds in commercial areas for aesthetic and wildlife reasons. We're therefore very disappointed that the plan fails to make any attempt to mitigate property value loss with creative landscaping.

   Response: The full restoration plans would occur once the project was budgeted and in the design phase. The Stormwater Utility's policy is to revegetate with native seed in our ponds and greenways. You can learn more about the Stormwater Utility's general restoration goals by reading the Ecological Restoration in Stormwater Ponds and Greenways Storymap.

6. Generalized Question: If pond berms are determined to be small dams by the WI DNR, we have concerns about impacts to property values, property insurance rates, and increased flood risks:

   Specific questions from residents this question is addressing:
   - *It is also concerning that these ponds may have to be deemed small dams by WI DNR standards. We can only imagine that having such a designation in one's front yard or backyard could decrease property values further while increasing property insurance costs. We also question what the lifecycle maintenance costs are for small dams and whether this will be a priority for the city's budget long term.*
   - *On page 71 of the document discussing sequencing, the plan indicated the Masthead ponds and outlets should be completed prior to increasing the capacity of the greenway crossings. We find this concerning because it assumes there will be no issues with draining the dry ponds prior to that increased capacity. Has this been modelled to assure that you're not creating a flood risk with potential for overtopping of these retention ponds? Given that new development such as Oakwood Village's construction wasn't modelled into*

this study, under what circumstances could even a fully completed project result in overtopping of the Masthead ponds to create flooding risk that doesn't currently exist?

Response: The Stormwater Utility is responsible for managing its public land in keeping with the goals of the utility—safely conveying and treating stormwater. The Stormwater Utility does not have an obligation to maintain the land in the same way as it has been historically simply because that is neighboring homeowner's hope or expectation however there is a design and public engagement process where concerns may be voiced to help inform design decisions.

Generally, Engineering staff have not noted an increase in insurance rates for properties next to a pond or greenway. However, if you have concerns you should contact your individual insurance provider.

Part of the modeling process was to analyze the impact of larger storms through the proposed conceptual solutions. The modeling shows that with turning the Masthead greenway into ponds, in storms larger than the 1% annual chance storm (i.e. the 0.2% annual chance storm) there is not an increased flood risk to homes in the existing vs proposed conditions.

7. Generalized Question: Can a retention wall be built to prevent the flooding of the one home near Inner Drive instead of building the ponds in the Masthead Greenway?

   Specific questions from residents this question is addressing:
   - *We are wondering, after reading in the report page 48 Section 10.5.2, that one home near Inner drive flooded during the 2018 storm, if there could be retention wall mitigation for that one home similar to what you are proposing for the drainage ditch area in the Crestwood neighborhood.*

   Response: The purpose of the Masthead Greenway Ponds is to hold back water to reduce the flooding at Gettle Ave. Please see "Why can't you put the pond in X location instead of Y" explanation below.

8. Generalized Question: Why are the trees in the Masthead Greenway not given equal consideration to the trees in Owen Park?

   Specific questions from residents this question is addressing:
   - *City of Madison signs placed there call it "a Nature Sanctuary, enjoy don't destroy" and that is very much how I feel about it. Over the winter, I've been thinking a lot about the future of these woods. I see a lot of maintenance going on in Owen Park and the Crestwood Trails, clearing out invasive species and giving our native trees a chance to thrive. Our woods have been sadly neglected by the City but could be revitalized by similar efforts.*
   - *The city did an audit of the trees that exist along the proposed Masthead pond area and found hundreds of oak trees and other natives. We are wondering why this issue is not as important in the Masthead Ponds project area and why it was not addressed in the discussions with city parks.*

   Response: Owen Park is a part of the official City of Madison park inventory and is documented in the Park and Open Space Plan as a conservation park. There are recreational improvements within Owen Park that Parks has installed and maintained. The Masthead greenway is mapped a greenway, and is not a part of the park inventory or in the Park and Open Space Plan. Therefore projects that help improve the stormwater system are prioritized in these lands. Wherever possible the City avoids tree loss. However, in developed watersheds, there is minimal additional space that the stormwater utility can utilize to either hold back, or convey stormwater. When we cannot purchase sufficient amounts of land to store more floodwater and slow the water down in non-wooded areas, sometimes our only option is to create storage within existing greenways—such as in the Masthead Greenway. In that situation, the common conflict with trees is that we need to remove earth to create more water storage space, and in doing that, it can result in trees needing to be removed. To learn more about why the Masthead greenway is a proposed pond location, please see "Why can't you put the pond in X location instead of Y" explanation below.

Please see Watershed Studies Additional Information and the Stormwater Drainage System webpages, for more details on the differences between Parks and Greenways.

9. Question: We have concerns about the future maintenance of the area if this project goes forward; especially since the area will be a hole in the ground most of the time, not a pond. Are there any trees that could remain in the proposed pond area that could survive a flooding once in a while? Are there any areas that could be left at ground level to preserve the trees that already exist there?

   Response: When a project is budgeted and enters the design phase, these details would be worked out. Typically, the process involves trying to minimize quality tree loss wherever possible while still meeting the flood reduction goals. Additional, new tree plantings would consider the trees ability to handle flood depths for specific durations, and the anticipated depths and durations of flooding at different locations would inform new planting locations. Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information on the Stormwater Utility's goals and the impacts on habitat.

10. Question: We believe that the clear cutting of all trees in this area and leaving what is essentially a big hole in the ground for this project will affect the aesthetics and property values of our entire neighborhood. The study draft lists the City of Madison Flood Mitigation Goals in the section "Modeling Guidance" (no page #). This includes goal #7 that projects are set up to "provide flooding solutions that do not adversely affect the properties downstream of the flooding area." We are hoping that the same consideration will be applied to the properties to those of us who live upstream. Is there true funding for the remediation of the area?

    Response: The flood goals are specifically flood related. We make sure that our solutions do not cause additional structural flooding downstream of the flooding area.

    The Stormwater Utility is responsible for managing its public land in keeping with the goals of the utility—safely conveying and treating stormwater. The Stormwater Utility does not have an obligation to maintain the land in the same way as it has been historically simply because that is neighboring homeowner's hope or expectation. However, the City does include a public engagement process in every public works project where concerns may be voiced to help inform design decisions.

    To learn more about "Modifications to Vegetation and Screening," please visit the Stormwater Drainage System Reconstruction webpage.

11. Question: These are vibrant wooded areas currently which are home to many animals. Among these are hawks, deer, songbirds, turkeys and coyotes. This is part of what makes this neighborhood unique and wonderful. What consideration has been made for the wildlife in this area? How will it affect deer and turkey migrations within the larger area? This is one of the last remaining safe passage ways from Owen conservancy to the Research park open areas. Also, what would the downstream impacts be removing/decreasing some of these animals from the habitat on other animals and the ecosystem at large? Will other animals fill their place? This would be a significant disruption to a very well established ecosystem.

    Response: Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information on the Stormwater Utility's goals and the impacts on habitat.

12. Question: We bought our house, and happily pay our high tax rate, in large part due to the property backing up to a greenspace. We love the trees and wildlife that the greenspace brings. By clearing that all out it would greatly change the feel and desirability of the neighborhood. It also would become quite challenging for landowners on the Nautilus Drive side of things to have any sort of privacy in our backyards as we currently have. Island Drive is so much taller a fence would do nothing. This would greatly impact the homeowners and would greatly devalue our properties.

Response: The purpose of Stormwater Utility owned land is to safely and efficiently convey or store stormwater. For residents concerned about screening, we recommend planting trees and shrubs on their own property as the purpose of adjacent public property isn't for private property screening.

13. Question: What will the ponds be like when full? Will there be any mosquito or bug treatment plans in place for the large amounts of standing water? If there is an issue with smell or cleanliness, what are the city's plans to address this as it would make the area quite unpleasant?

    Response: The ponds will look similar to the ponds in Owen Park when they are full, however, unlike the Owen Park ponds, in between storms they will completely empty and you will see native vegetation on the bottom once the water recedes. Because the water moves through the system quickly, there would not be standing water that could have an odor, nor a place for mosquitos to breed.
14. Question: The drop from Island drive down to the backyards on the Nautilus Drive side of things is quite steep. What will be done to prevent the hill washing out and eroding next to and under Island Drive?

    Response: When the project is budgeted and in the design phase, the slopes of the new ponds would be designed to be stable based on flood depths, water velocities and shear stresses. Typically slopes are vegetated with native vegetation to hold soil in place, and in small areas that need more stabilization we install additional matting beneath the vegetation, or rock riprap boulders. Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information.

15. Generalized Question: Why are you putting ponds in the Masthead greenway where there is more water, and less trees, in the E/W running greenways upstream of Owen Park?

    Specific questions from residents this question is addressing:
    - *The proposal to put two ponds in that location doesn't make sense to me. We already have two ponds very close by at Nautilus Point Park, supposedly controlling the flow from that direction. The Masthead Greenway creek joins with the water coming down from the Memorial High School area and goes under Inner Drive and through the Crestwood trails. The vast majority of that water is coming from the Memorial High School source that runs between Landfall and Keelson. In fact, at times, the volume of water is so great that the flat grassy area close to Inner is flooded and the greenway path between Quarterdeck and Inner is washed out. Compared to that, the Masthead Greenway flow looks like a trickle and is not the main culprit in causing flooding. Would the ponds not be much more effective in controlling water flow towards Gettle if they were placed beyond where the two sources converge? Would you please address this question at our next meeting?*

    Response: Please see "Why can't you put the pond in X location instead of Y" explanation below.

16. Question: How much of this runoff down the Masthead area actually comes from Oakwood Village and the Research Park areas; and if it is considerable, how come the city cannot require those group to control the water runoff from their property?

    Response: Oakwood Village and Research Park contribute about a quarter of the runoff that makes it to the Masthead Greenway. The City is unable to require that private property owners spend money on flood mitigation measures that have regional impacts without the private property developing or re-developing. If Oakwood Village or a portion of Research Park would redevelop (as it did at the Element), the City's Stormwater Ordinances would dictate the peak flow reductions they'd need to reach. To learn more about New Development/Re-Development Flood Prevention, please visit the Watershed Studies Additional Information website.

17. Question: Are there any trees that could remain in the proposed pond area that could survive a flooding once in a while?

Response: When the project is budgeted and in the design phase, engineers, landscape architects and restoration experts will look at where it is possible to save existing trees while still reaching the projects flood goals. The trees will be assessed as to whether that species can handle the depth and length of the proposed flooding—typically that is okay with trees on the top of the bank. Tree re-plantings would be planned in a similar manner. Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information.

18. Question: Are there any areas that could be left at ground level to preserve the trees that already exist there?

    Response: When the project is budgeted and in the design phase, engineers, landscape architects and restoration experts will look at where it is possible to save existing trees by maintaining the existing ground level, while still reaching the projects flood goals.

Mineral Point Park

1. Question: Could part of this park be used as a reservoir? Or to slow water down in high rains? Could the adjacent public school's lands be used, too, for runoff reservoirs?

   Response: Mineral Point Park, the area just east of the school and West of S Yellowstone Drive, is a landfill. We cannot store water on a landfill as it will prevent the gas extraction system from function, and it is not allowed by WDNR code.

2. Question: Memorial High and Jefferson Middle School could regrade and make some reservoirs on some of their lesser-used land. They could highlight wetland restorations, or use ponds for other educational purposes. Win-win. It would be really exciting to regrade the area between the middle school and Mendota Spring Harbor Greenway and create ponds, wetland edge plantings, etc.

   Response: The school already does not have sufficient lands to sacrifice open space for flood storage. We looked into the possibility of underground detention as a solution in this area, and it is not cost effective. Mineral Point Park, the area just east of the school and West of S Yellowstone Drive, is a landfill. We cannot store water on a landfill as it will prevent the gas extraction system from function, and it is not allowed by WDNR code.

West Towne Mall Pond

1. Question: I wonder if Madison Public Schools would let you put some retention ponds on their land across the street?

   Response: The school already does not have sufficient lands to sacrifice open space for flood storage. We looked into the possibility of underground detention as a solution in this area, and it is not cost effective.

2. Question: Could the edges of the West Towne Mall Pond be planted with native wetland shrubs and wetland trees? Or maybe some wetland prairie edges? This would benefit pollinators, birds, and wildlife. It'd also be cheaper than mowing maintenance and look way better than just grass like now.

   Response: Yes, the City would replant the edges of the new pond with native wetland and prairie vegetation. Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information.

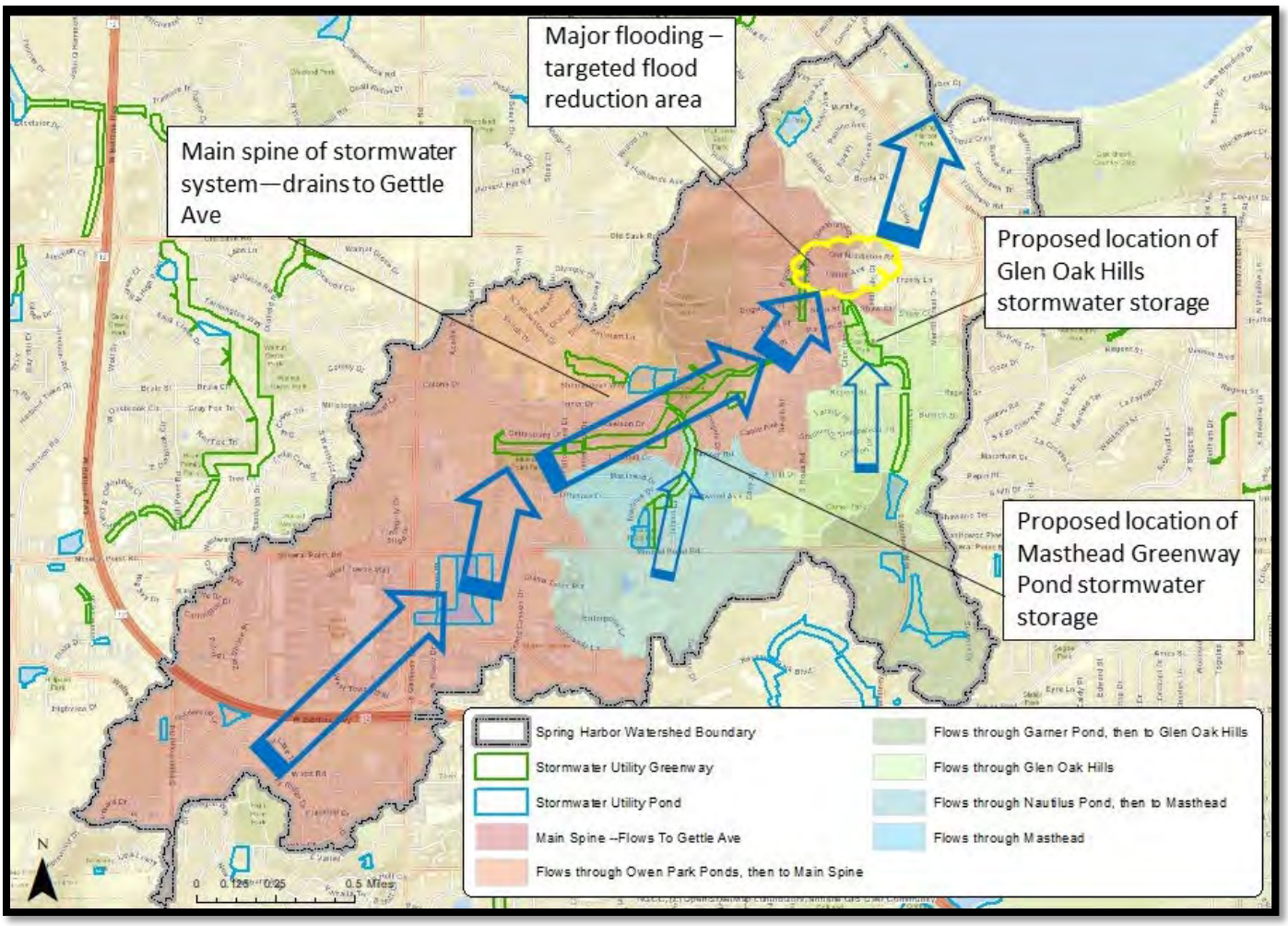
Why can’t you put the pond in X location instead of Y

A common question we’ve received is “why can’t you put the pond in X location instead of Y.” This was an especially common question from folks in the Masthead area who asked why the ponds cannot be placed in the greenways

upstream of Owen Park in the other greenways along Kneelson Dr or Gettysburg Dr, at Mineral Point Park, or around Memorial High School. While we understand why these areas are appealing (there are less trees), there are two very technical reasons why we have targeted flood storage in the Masthead Greenway and Glen Oak Hills Park/Greenway:

1. **Delaying peak flows**

This is a complicated stormwater concept. The flooding that causes the most destruction is the deepest flooding and it occurs when the largest stormwater flow, or "peak flow," moves through an area. The Gettle Ave area is most impacted by flooding, and it is the most challenging to solve. In order to reduce the "peak flow" through the Gettle Ave area, we either need to hold water back upstream, or move more water downstream faster. We found that moving water downstream faster is very expensive, and wasn't a viable solution—it would involve replacing a 17'x9' box culvert under the railroad and all the way to Spring Harbor (~$30 million), as well as completing the currently proposed pipe upsizing at Gettle Ave, and building the floodwall at Forsythia. That left the City with the option to hold water back upstream, to slow down the stormwater runoff, and reduce the peak flows.



See the image above. In this watershed, the area in red is considered the major drainage area, or "main spine." All this water flows through the greenway system flowing west to east from Mineral Point Park, to Owen Park, to Gettle Ave. In order to make an impact slowing down the flows within this "main spine" you'd need a very large pond, and based on the narrow width of the limited public land, there isn't a viable location for a large enough pond.

However, there are two branches of flow that connect into the main spine. One is in blue and flows through the Masthead Greenway. One is in green and flows through the Glen Oak Hills park/greenway. The flows through these branches are much smaller than through the main spine. Right now, the system functions such that the peak flow from the "main spine" reaches Gettle Ave at the same time as the two branches.

The intent of the proposed ponds in Masthead Greenway, and berms in Glen Oak Hills park/greenway are to hold back just enough water that the peak flows through these branches are delayed and they don't stack on top of the peak flow running through the main branch. This is easier to do in smaller branches because you need smaller ponds, and in these two branches, there are already ponds upstream which have already lessened the peak flows.

If you think about peak flows as volumes instead of flows, it's easier to think about a very simplified example—if you have a full bathtub and a full sink, and you can take 1 pitcher-full of water out of either one, it's going to have a bigger impact in your sink than in your bathtub. That's the general idea with why slowing down the water and creating ponds in the Masthead greenway works better than in the Quarterdeck greenway which is along the main spine. We'd need a much larger pond in the Quarterdeck greenway to slow down the greater flows of water.

2. **Elevations of neighboring homes**

In both Masthead greenway and around Glen Oak Hills Park/Greenway, homes are significantly higher than the centerline than the channel, and are not currently at risk for flooding. We are able to safely hold back water in these areas because there is vertical space to hold back water.

In the greenway system between Mineral Point Park and Owen Park, there are many low-lying homes that currently flood, or are very close to flooding. If we hold more water back in these systems, we will put new homes at risk of flooding.

General questions

1. General Question: Can smaller Green Infrastructure (GI) be used to address flooding issues?

   Specific questions from residents this question is addressing:
   - *Starting with efforts to promote infiltration, trap runoff, and slow drainage (with native plants and smart use of rain barrels) would be a great, short-term measure that could make an impact. I like the inclusion of permeable pavement/concrete in the report too—I don't think we had discussed much of that prior to this report. I'd like to see the city encourage local efforts now/immediately and proceed with projects like these when we see the need for those bigger hammers*

   Response: Please see the "Green Infrastructure and the Watershed Studies" section on the Watershed Studies Additional Information website.

2. General Question: Why report doesn't address water quality?

   Specific questions from residents this question is addressing:
   - *We also seem to have completely lost focus on the sediment, leaf litter, and water quality issues that were so important just a couple of years ago—where did those go?*

   Response: Please see the "Water Quality and the Watershed Studies" section on the Watershed Studies Additional Information website.

3. Question: How does this study and proposed solutions improve the natural environment of Madison?

   Response: Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information.

4. Question: How do the proposed solutions address ground water recharge by increasing infiltration?

Response: The conceptual solutions were not intended to improve groundwater recharge. It is possible that specific projects could improve groundwater recharge, and that design aspect would be looked at when projects are budgeted and in the detailed design process. For more information, please see the "Groundwater versus Stormwater," "Groundwater's Role in the Watershed Studies," and "Groundwater Recharge through Infiltration" sections of the Watershed Studies Additional Information website.

5. Question: What is Madison doing to improve natural features of these area some of which used to natural wetlands and waterways?

   Response: Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap for more information.

6. Question: Holding ponds are a common mitigation solution to flooding. As low areas flood more, what responsibilities should all areas in the watershed have to minimize flooding in lower areas?

   Response: The intent of the watershed studies it to figure out where flood solutions are most beneficial watershed wide. This means looking for upstream area to minimize flooding wherever possible. The City looked at what the impact of utilizing green infrastructure to reduce flooding watershed wide, and found that the results did not significantly reduce flooding in larger storms. You can read more about this on the "Green Infrastructure and the Watershed Studies" section on the Watershed Studies Additional Information website.

7. Question: Would there be a lower overall cost to abandon homes that are repeatedly flooded? Would the city purchase these homes?

   Response: Please see the "Purchasing Houses, Buildings or Structures" section on the Watershed Studies Additional Information website.

8. It would be good to know that city planning prevents locating homes in flood prone areas today or that property owners are aware of the risks when they buy.

   Response: Please see the "Purchasing Houses, Buildings or Structures," and "New Development/Re-Development Flood Prevention" sections on the Watershed Studies Additional Information website.

9. Generalized Question: Will the City provide Commercial property incentives to mitigate flooding?

   Specific questions from residents this question is addressing:
   - *When participating in the Zoom breakout for the Masthead ponds, we asked whether there was a potential for the city to work with private landowners and/or to directly secure private land up-stream in order to better address storm water at its source. Specifically, we wondered about potential construction projects at Oak Wood Village, CUNA Mutual and other Research Park businesses, and whether there could be incentives provided to keep more of their storm water on their site, whether through permeable paving, storage or other solutions. We would find that preferable to the possible buyouts referenced on page 59 in the Construction Sequence section in the Gettle and Forsythia areas. We would hate to see the loss of affordable and sustainably smaller homes in the city and wonder why those same funds that could potentially be used for buyouts couldn't better address the genesis of storm water issues where there's significant impermeable surfaces due to commercial buildings and parking lots.*
   - *How much of this runoff down the Masthead area actually comes from Oakwood Village and the Research Park areas; and if it is considerable, how come the city cannot require those group to control the water runoff from their property? That question about Oakwood was mentioned in the study document, but not answered.*

   Response: Most private development does not have additional land to dedicate to extra stormwater management, even if the City funded the stormwater infrastructure. Development is getting denser and there is

not enough open space to make an incremental dent over what stormwater requirements are already required by ordinance.

Please see the "Purchasing Houses, Buildings or Structures," "New Development/Re-Development Flood Prevention," and "City-Funded Solutions on Private Property" sections on the Watershed Studies Additional Information website.

10. Generalized Question: How models will stay up-to-date and solutions re-assessed? Will the public be able to comment on updated models that lead to modified solutions?

    Specific questions from residents this question is addressing:
    - *Lastly, we are a bit concerned that other watershed plans – particularly the McKenna/Greentree watershed study – may end up modifying some of the options presented in the Spring Harbor plan and hope that the city will present updated information and provide for additional comment opportunities if that is the case.*

    Response: Please see the "Watershed Study Model Updates," and "Project Construction" sections on the Watershed Studies Additional Information website.

11. Question: The timeline of this entire project is not set as of yet. We realize it depends on the priorities set by the city using the software tool. When will this program be run and made public? When will we learn the priority scores of the Masthead Pond project and the Nautilus and Offshore and Inner greenway crossings?

    Response: Please see the "Project Considerations" section on the Watershed Studies Additional Information website.

12. Question: Nowhere did I see addressed the beneficial biological aspects of natural ponds and streams addressed. How does this study and proposed solutions improve the natural environment of Madison?

    Response: The study does not address the biological aspects of natural ponds and streams. The study's intent was to figure out the scale of conceptual solutions needed to meet our flood targets. To learn more about how the Stormwater Utility works to improve the natural environment in Madison, please see the "Ecological Impacts of Solutions," "Ecological Restoration in Stormwater Ponds and Greenways" and "Green Infrastructure and the Watershed Studies" sections on the Watershed Studies Additional Information website.

Appendix O – Spring Harbor Watershed Study Amendment 1

SPRING HARBOR WATERSHED STUDY

AMENDMENT 1
MADISON, WI

02/26/2025
Minor Edits: 07/02/2025

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This amendment functions to update and supplement the Spring Harbor Watershed Study and final report. Recommendations and updated flood maps presented in this report take precedence over those presented in the original report. For the areas that this report does not cover (e.g. model development), it can be assumed that those specific details of the Watershed Study were not changed, except where noted.

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1. Executive Summary

1.1 City's Watershed Study Program

Recognizing an increase in frequency of extreme rain events within the City of Madison, the City of Madison (City) is conducting a multi-faceted approach to address stormwater flooding. As one component of that approach, City Engineering is developing comprehensive stormwater management studies for each watershed within the City. The studies are conducted in two phases.

Phase 1, Existing Conditions: Development of a hydrologic/hydraulic stormwater runoff model representing the physical and drainage properties of the watershed under existing conditions. The model is then calibrated to measured runoff events and used to identify the areas of the watershed most likely to flood under various rain conditions.

Phase 2, Proposed Conditions: Using the model developed during Phase 1, evaluate alternative methods and/or infrastructure improvements to eliminate, or reduce flooding impacts from large rain events and develop a second model of the watershed with the full recommend suite of proposed solutions that help the City meet its flood mitigation targets.

1.2 City's Flood Mitigation Targets*

City Engineering developed a set of flood mitigation targets that exceed their current minimum design standards, so as to better understand where targets are being met, where the flooding conditions could be improved, and guide the development of the recommended solutions during Phase 2 of the Watershed Studies. City Engineering 's flood mitigation targets for the Spring Harbor Watershed Study are as follows. Note that these targets may change in the future.

1. No surcharging onto the street for up to the 10-year (10% chance event) design storm
2. Centerline of street to remain passable during 25-year (4% chance event) design storm with no more than 0.2 feet of water at the centerline
3. No home or business will be flooded during the 100-year (1% chance event) design storm.
4. Enclosed depressions to be served to the 100-year (1% chance event) design storm.
5. Greenway crossings at streets to be served to the 100-year (1% chance event) design storm.
6. Safely convey stormwater during the 500-year (0.2% chance event) design storm event.
7. Provide flooding solutions that do not negatively impact downstream properties.

1.3 Original Spring Harbor Watershed Study and Public Feedback

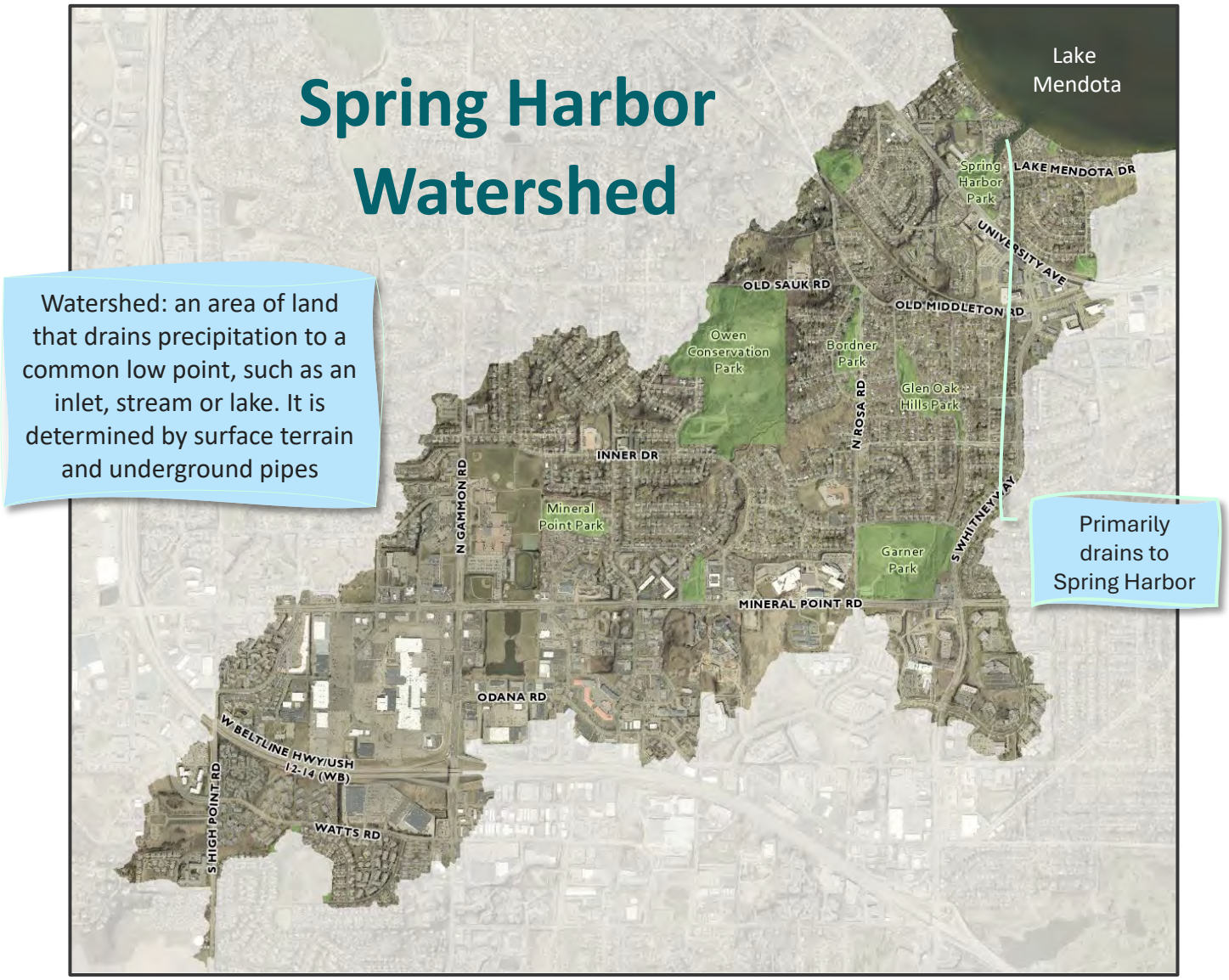
Spring Harbor was one of the first watersheds studied as a part of the City of Madison's Watershed Study Program. The study began in 2019, by AE2S an engineering firm hired by City Engineering to complete the study and was ended in June 2022. At the conclusion of the study AE2S, with the help of City Engineering, developed a recommended suite of solutions for the Spring Habor Watershed that included 3 detention area improvements, 2 channel conveyance improvements, 7 greenway crossing improvements, 1 flood wall (10.5' tall at highest point), upgrades to the Spring Harbor Box and significant upgrades to the local sewer across the watershed. These solutions would help the watershed reach the City's flood mitigation targets.

After posting the final report for public comment, the City received a significant amount of feedback centered around concerns about recommended changes to the Watershed's wooded greenways, including

* In the original Spring Harbor Watershed Study Report, the terminology *Flood Mitigation Goals* was used. This has since been updated to *Flood Mitigation Targets*, which is the terminology that will be used in this report.

the recommended Kenosha Greenway Regrading project and the Forsythia Flood Wall and Owen Park N/S Channel project. This feedback led the City to the decision to conduct additional modeling of the Spring Harbor Watershed and develop an alternate set of recommended improvements.

Figure i : Spring Harbor Watershed Overview Map



1.5 Modeling Update

The supplemental modeling for the Spring Habor Watershed was started by City Engineering in July 2022 and was completed in four major phases.

1.5.1 Living Model Update

City Engineering first started by updating the Existing Conditions and Proposed Conditions models provided by the consultants of the original watershed study. These models were updated with construction projects that had been completed since the time that the original watershed study models were built.

1.5.2 Resident Driven Scenario Modeling

After updating the models, the City began addressing residents' questions about alternative solutions for the watershed. The least favored solutions were those that would provide stormwater storage within the major wooded greenways in the watershed and excluding those solutions from the Proposed Conditions model resulted in increased flood depths downstream. As the City evaluated these modifications to the initial recommended projects, it became clear that a comprehensive reevaluation and redevelopment of the recommended solutions was necessary to balance the City's flood mitigation targets with residents' preferences.

1.5.3 All Solutions Model Development

City Engineering developed a new set of recommendations for the entire watershed, sizing local sewers first and then developing regional solutions, working from upstream to downstream. During this process many new solutions and combinations were tested. In the end a new suite of recommended solutions was developed, but in order to meet the flood mitigation targets, some unpopular storage solutions from the original watershed study still had to be included. Additionally, it was found that the lower portion of the Spring Harbor Box would need to be upsized, a project that will not be desirable for decades given the costs and anticipated remaining lifespan of the box. The City decided that this did not provide a suitable near-term plan, and additional modeling would be needed. However, City Engineering would keep this "All Solutions" suite of solutions to help document what would be needed to meet all the flood mitigation targets in the watershed.

1.5.4 Near-Term (0-25 Years) Solutions Model Development

Using feedback from residents regarding their preferences for prioritizing solutions, City Engineering worked to create a near-term plan for the watershed knowing that not all the flood mitigation targets would be able to be met watershed wide. This near-term plan would likely be implemented over the next 0-25 years and provide flood mitigation benefits to areas in the watershed without relying on or requiring the reconstruction of the Spring Harbor Box right away. Areas served by recommended projects that did not drain to the Spring Habor Box were not re-evaluated since meeting flood mitigation targets in these areas was achievable and had no effect on the rest of the watershed since these are discrete drainage areas. Solutions that provided flood mitigation to arterial roads were prioritized and regional solutions that had less resident concern were utilized in the short-term plan development. Through this process City Engineering developed a suite of recommended solutions that would be more feasible in the near-term and that would address the concerns raised by residents after the original watershed study.

1.6 Proposed Solutions and Costs

At the completion of the additional round of modeling, the City had updated the Spring Harbor Existing Conditions model and developed two new Proposed Conditions models with accompanying suites of solutions: the All Solutions and the Near-Term Solutions.

It should be noted that the flood mitigation solutions documented in this report are not meant to be full design -level efforts; they are conceptual solutions that help City Engineering 's Engineering Division understand the magnitude of solution needed in a given area to meet the established targets. As projects are evaluated further, and if they move to the point they are contemplated for programming, additional project refinement will occur. The detailed design phase collects site specific data needed for design and looks at refining the design as needed to address site constraints, permitting, and environmental issues associated with the particular project.

1.6.1 All Solutions Suite

- Upsize Upper SH (Spring Harbor) & Box Glen Hwy Box Culvert
- West Towne Retention Pond (Currently Programmed in 2025-2026)
- Masthead Greenway Pond
- Forsythia Wall (3.5' shorter at tallest point—7' max) + Owen Park Ditch (half the size of original)
- Glen Oak Hills Berms
- Greenway Crossing Upsizes: Yellowstone, Quarterdeck, Jetty, Masthead, Inner, South Hill, and Regent Box Culverts
- Beltline Off-Ramp Pond
- Garner Park Flood Wall (4' high) + Kenosha Relief Pipe
- Forsythia Cunette Modifications
- Upsized Lower SH (Spring Harbor) Box
- Local Sewer Upsize Pipes watershed-wide

1.6.2 Near-Term Solutions Suite

- Upsize Upper SH (Spring Harbor) & Box Glen Hwy Box Culvert
- West Towne Retention Pond (Currently Programmed in 2025-2026)
- Inner Dr and South Hill Greenway Crossing Upsize
- Beltline Off-Ramp Pond
- Garner Park Flood Wall (4' high) + Kenosha Relief Pipe
- Forsythia Cunette Modifications
- Local Sewer Upsize Pipes on arterials and in the West Towne Pond and Mendota drainage areas

1.6.3 Solutions Costs Summary

Table i: Solutions Cost Summary

Near-Term Solutions (0-25yrs)	All Solutions (0-50 yrs)
• Upsized Upper Spring Harbor Box - $9M • Beltline Off-Ramp Pond - $1.5M • Garner Park Flood Wall & Kenosha Relief Sewer - $2.7 M • West Towne Retention Pond - $4.5M (Currently programmed in 2025-2026) • Forsythia Cunette Modifications - $5 M • Inner Dr and South Hill Culvert - $0.7M • Local Sewer • **Total without local sewer: $23.4M**	• Upsized Upper & Lower Spring Harbor Box - $9M (upper) + $12M (lower) • Beltline Off-Ramp Pond - $1.5M • Garner Park Flood Wall & Kenosha Relief Sewer - $2.7M • West Towne Retention Pond - $4.5M (Currently programmed in 2025-2026) • Masthead Greenway Pond - $2.6M • Forsythia Wall (shorter) + Cunette Modifications - $7.1M • Glen Oak Hills Berms – $1.8M • Greenway Crossings - $4.7M • Local Sewer • **Total without local sewer: $46M**

2. Introduction

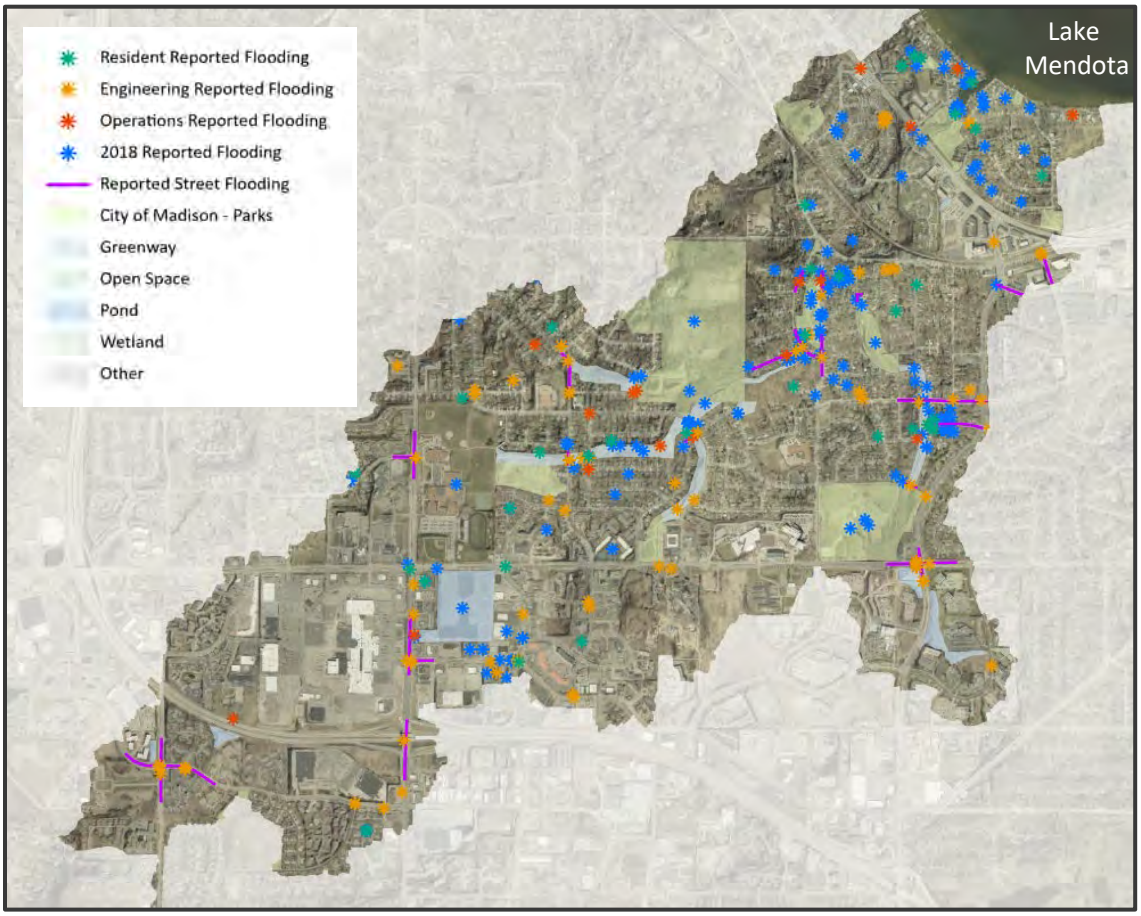
2.1 Spring Harbor Watershed Challenges

The Spring Harbor Watershed has many unique challenges that make managing stormwater and mitigating flooding within the watershed particularly difficult. Outlining these challenges below serves to provide additional background on the decision-making process in developing and recommending the conceptual flood mitigation projects.

2.1.1 The Development of the Spring Harbor Watershed

The Spring Habor Watershed in the City of Madison was developed mostly during the 1950's and 1960's. Stormwater designers, who designed the initial stormwater systems in the watershed during that time, designed to different standards. They did not plan for the larger rain events that we plan for today. Additionally, they did not account for the current trend towards more frequent intense rain events that we are experiencing today and expect to continue to experience into the future. They also did not have the modern tools that we have today that allow us to complete a comprehensive study of the entire watershed. Because of these factors, during the development of the stormwater drainage system and the surrounding areas, it was often the case that an insufficient amount of land was set aside to store or transport stormwater. This has led to frequent flooding of certain areas. Additionally, because most of the watershed is now developed for other uses there is little space available to expand the surface storage and transport of stormwater which has led engineers to rely more heavily on underground infrastructure (larger storm pipes) to mitigate the current flooding challenges.

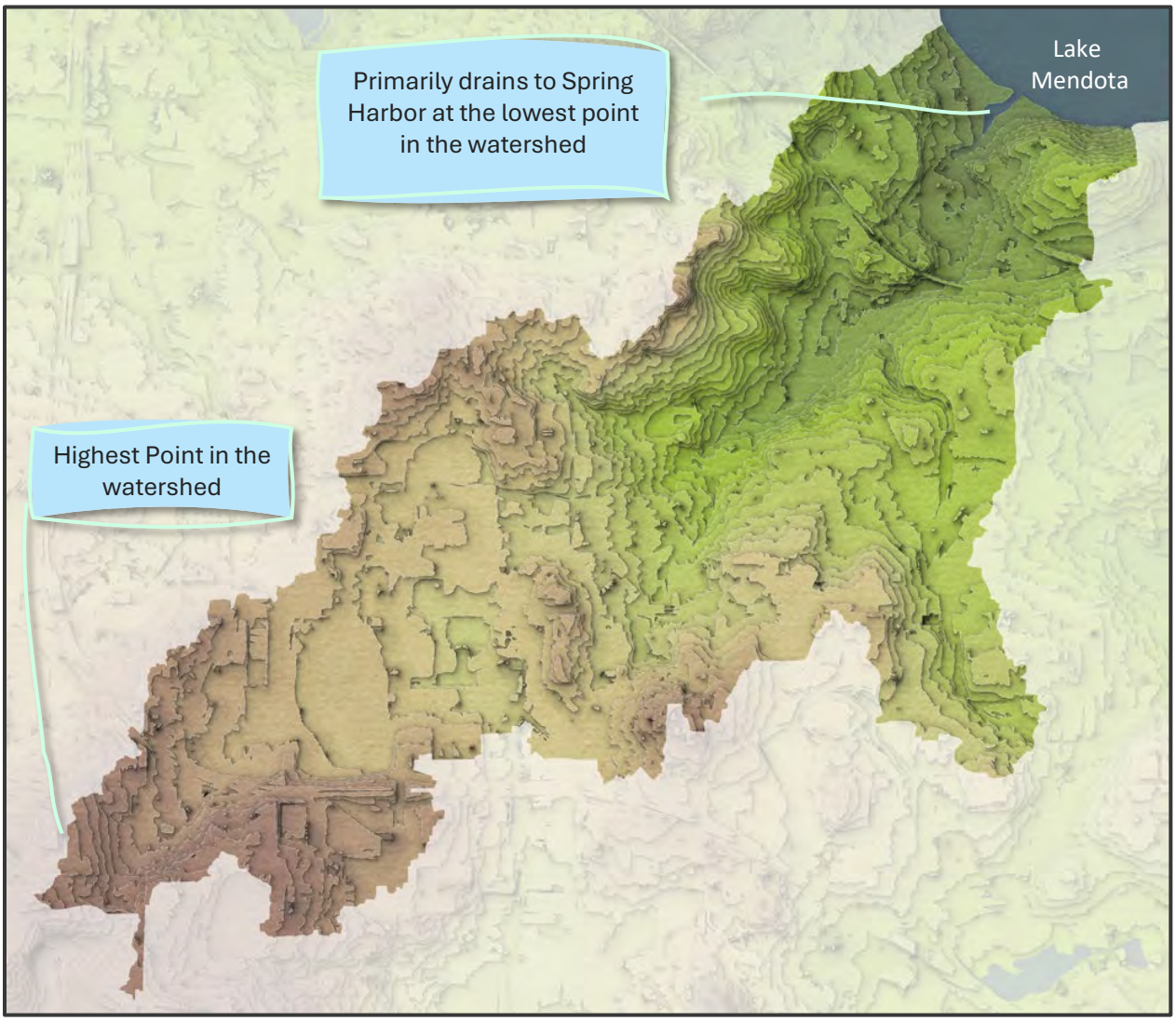
Figure ii: Flooding in the Spring Harbor Watershed Map



2.1.1 The Unique Topography of the Spring Harbor Watershed

The Spring Harbor Watershed, which spans from southwest of the Beltline down to Lake Mendota, covers approximately 2,390 acres. It ranges in elevation from about 1190 ft. at its highest point to about 850 ft. near Lake Mendota at its lowest point. The Spring Harbor Watershed boundary is drawn to encompass all areas that drain to or immediately near Spring Harbor at Lake Mendota.

Figure iii: Spring Harbor 3D Topography Map



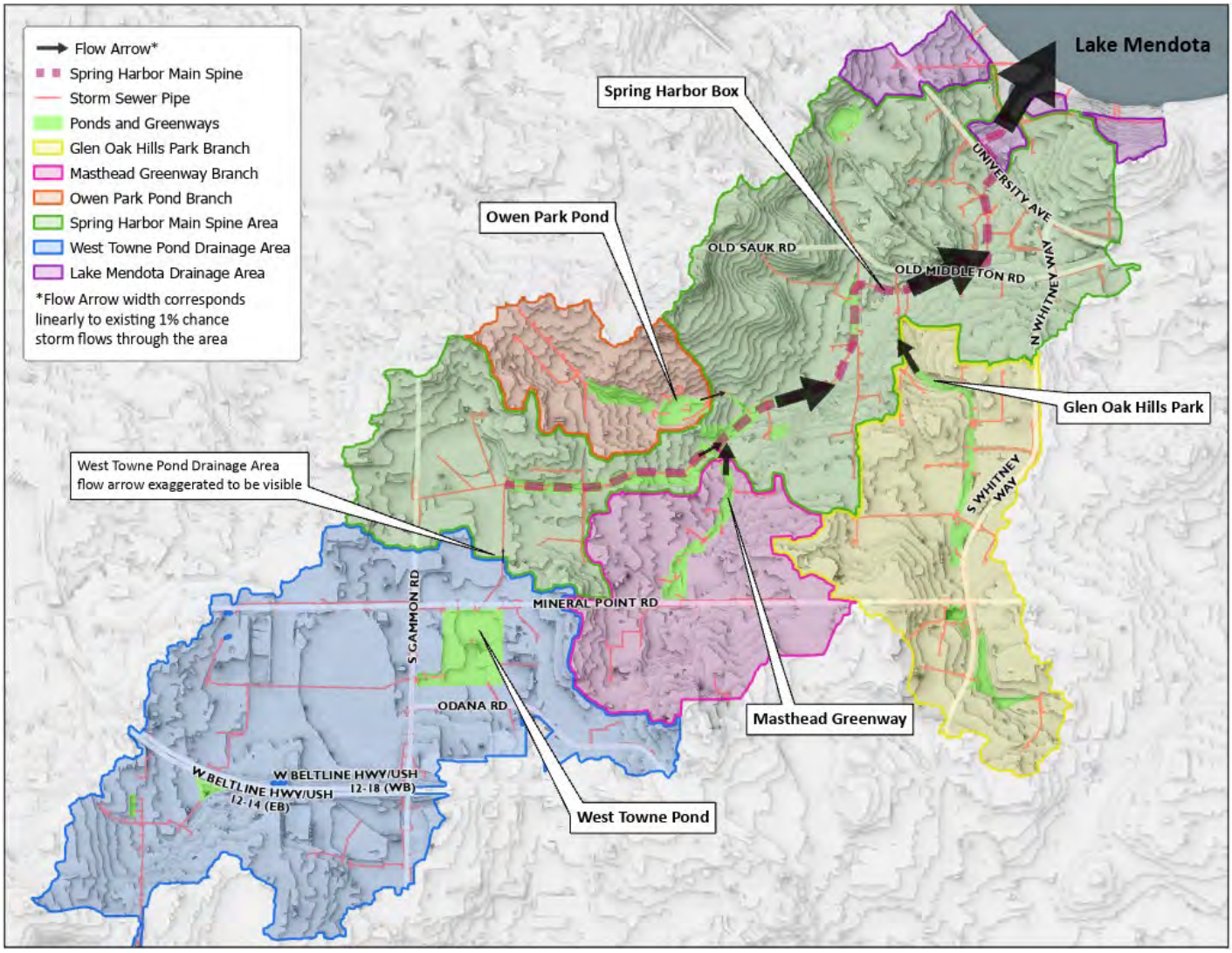
While the Spring Harbor Watershed is one single watershed, it can be subdivided further into a few different discrete drainage areas or sub-watersheds. First are the areas that drain directly to Lake Mendota near Spring Harbor, next are the areas that drain to the Spring Habor Box (a large rectangular-shaped storm pipe that carries more flow than a standard round pipe) before eventually draining to Spring Harbor at Lake Mendota, and last are the areas that drain to West Towne Pond before eventually draining to the Spring Harbor Box and then Spring Harbor at Lake Mendota.

The West Towne Pond drainage area or sub-watershed *(See the blue area in Figure iv below)* functions virtually independently from the rest of the watershed, as there are no major over land routes that stormwater can take to the Spring Harbor Box drainage area of the watershed. This is because the area is

"bathtub shaped", lower in the Middle and Higher along the edges. Additionally, the only pipe that connects the West Towne Pond drainage area to the other portions of the watershed is a 36" pipe which doesn't have additional capacity to carry more flow than it does currently. The areas that drain directly to Lake Mendota *(See the purple areas in Figure iv below)* also function virtually independently from the rest of the watershed. Flooding in these areas is dependent on the small sections of the stormwater system, storms sewers in this case, that transport stormwater directly to Lake Mendota near Spring Harbor and that don't connect to other larger portions of the stormwater system.

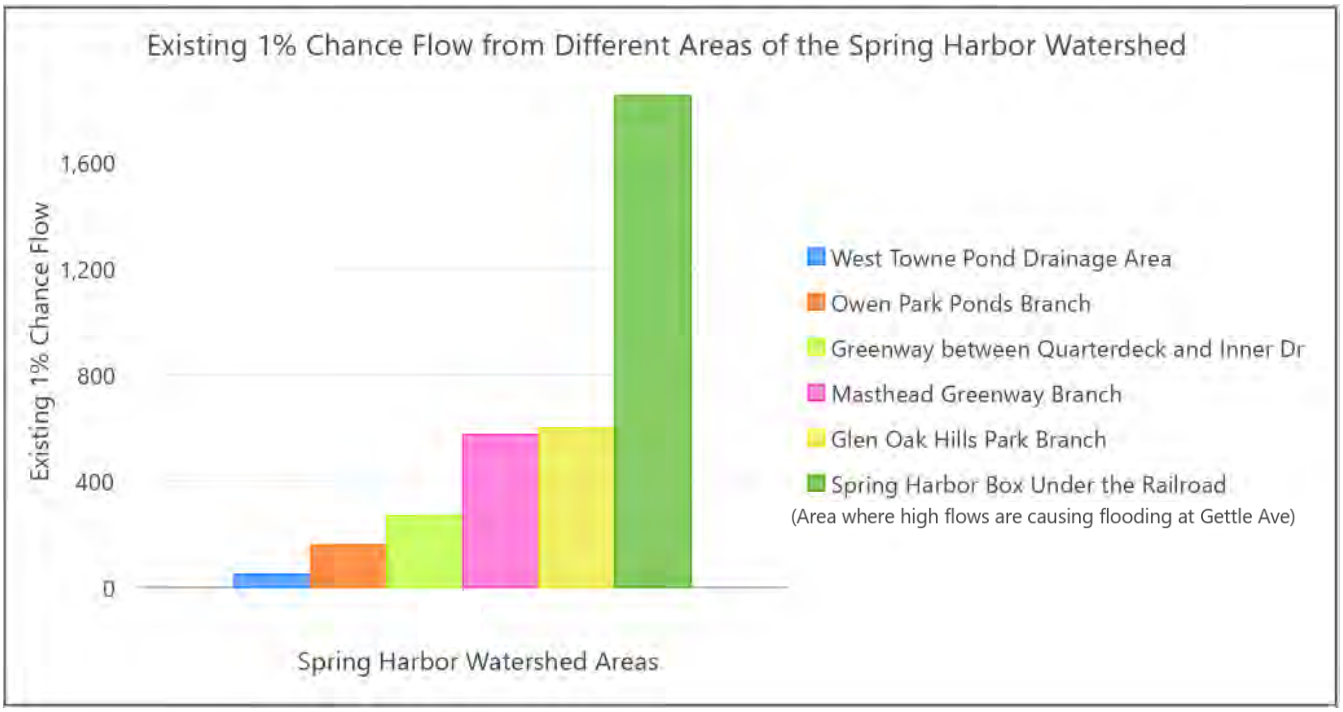
The Spring Harbor Box drainage area is the largest and most complex portion of the Spring Harbor Watershed. It is also the area with some of the biggest challenges. This portion of the watershed is made up of a main "spine" and three smaller branches. The main drainage spine *(See dotted line in Figure iv below)* flows west to east from Mineral Point Park, to Owen Park, to Gettle Ave. and finally to Spring Harbor at Lake Mendota. It also carries the largest portion of stormwater through the watershed. The watershed also has three "branches" one that flows through the Masthead Greenway *(See the pink area in Figure iv below)*, one that flows through the Owen Park Ponds *(See the orange area in Figure iv below)*, and one that flows through the Glen Oak Hills Park/Greenway *(See the yellow area in Figure iv below)*. The flows through these branches are much smaller than through the main spine but contribute to the flows and issues in the main spine.

Figure iv: Spring Harbor Drainage Areas Map



The existing 1% annual chance event flows, or the flows that we would expect during a storm that has a 1% chance of occurring during a given year, for different areas of the Spring Harbor watershed can be seen in more detail in Figure v below.

Figure v: Spring Harbor Existing 1% Chance Flows

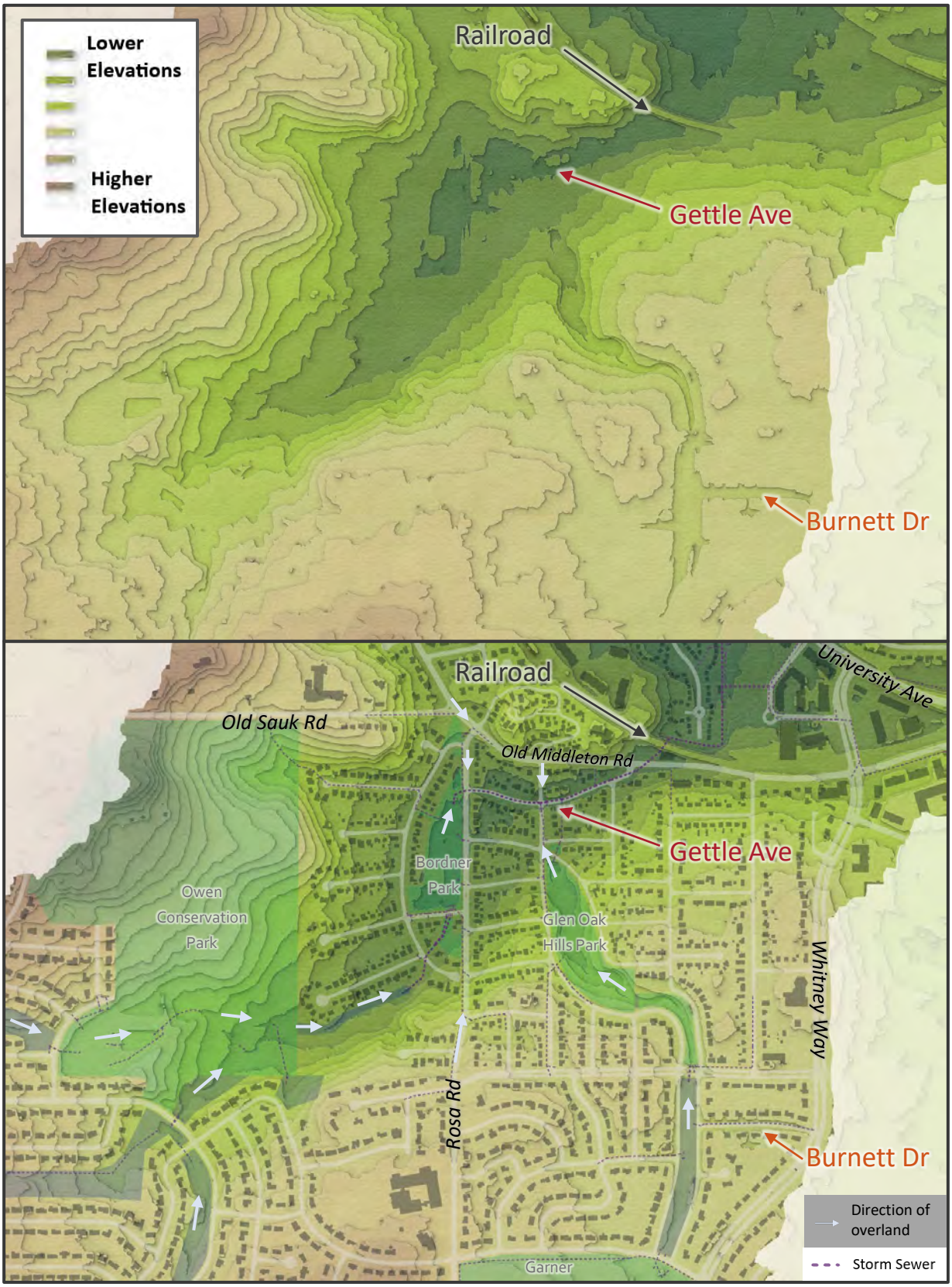


There are two areas to note in the watershed where flood mitigation is particularly difficult due to the topography. Please refer to the Figure vi on the next page to help illustrate the explanation below.

The first area is Gettle Ave., situated between Rosa Rd and Old Middleton Rd. It lies lower than the surrounding areas resulting in stormwater draining to it from many directions. It also lies on top of the first/most upstream segment of the Spring Harbor box. The box essentially functions as the only route for stormwater to leave the area and continue flowing downstream towards Spring Harbor at Lake Mendota. The surrounding higher areas especially near the railroad tracks keep the stormwater from having a secondary route to flow overland when the box becomes overwhelmed. This leads to significant flooding in the area.

The second area is Burnett Ave. located between the Kenosha Greenway and Whitney Way. Some of the homes on this road and in the surrounding areas are situated relatively low compared to the adjacent Kenosha Greenway. When the greenway becomes overwhelmed by flows draining to it the lower homes in the area quickly start to flood. One way to mitigate flooding in this area would be to increase the conveyance at the downstream end of the greenway by increasing the size of the pipe under the road at Regent St. Doing this would help stormwater leave the greenway more quickly and help mitigate some of the home flooding. However, doing this would also increase flows into the Glen Oak Hills Greenway and, as a result, to Gettle Ave. which is just downstream of the Glen Oak Hills Park and already experiences significant flooding. Unfortunately, this means the simplest solution for Burnett Dr is one City Engineering will not pursue as it does not meet the flood mitigation target that states the City must “provide flooding solutions that do not negatively impact downstream properties”.

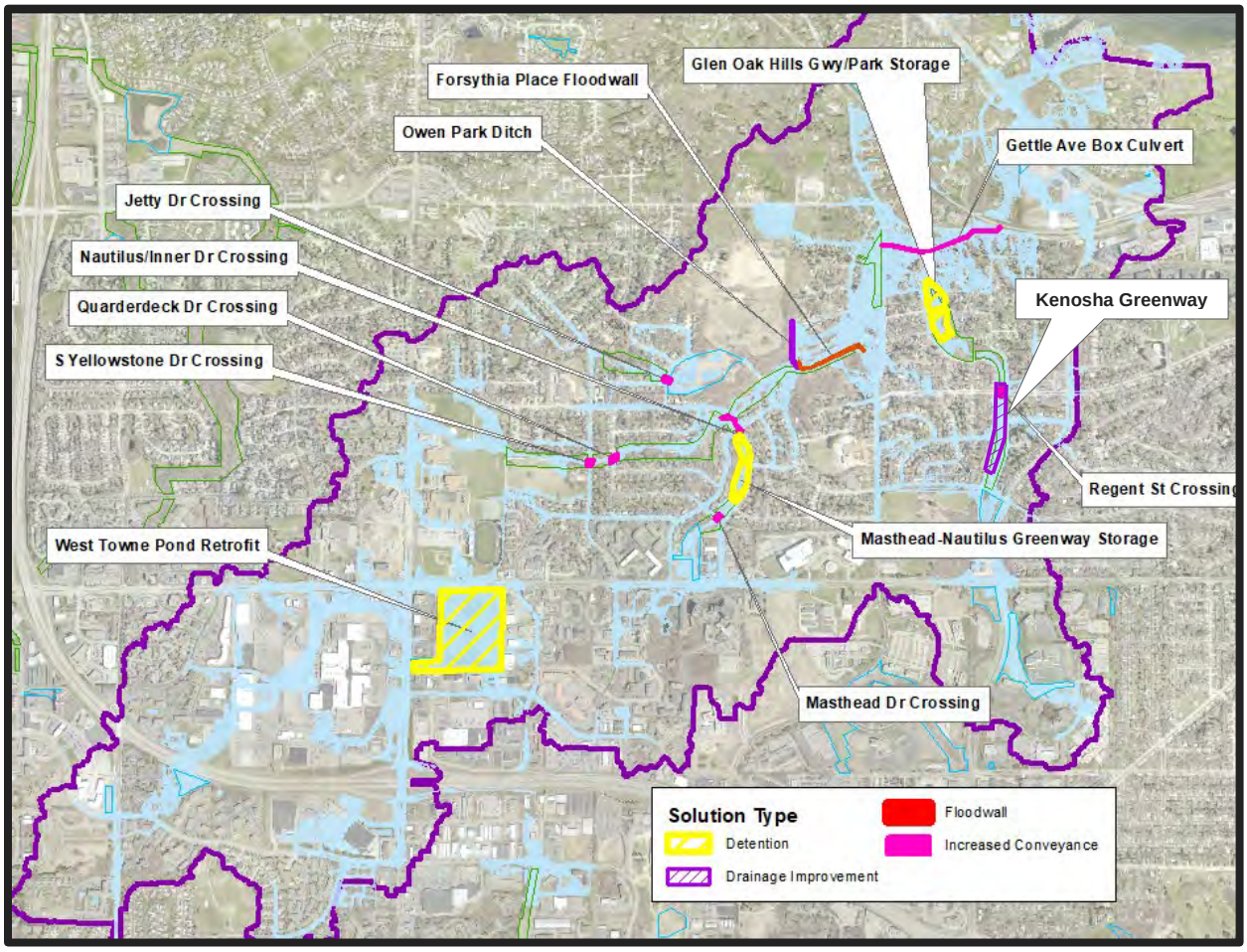
Figure vi: Spring Harbor Challenges – Gettle Ave and Burnett Dr Areas



2.2 Original Watershed Study

Spring Harbor was one of the first watersheds studied as a part of, the then new, City of Madison's Watershed Study Program. The study began in 2019, led by AE2S a consulting firm hired by City Engineering. During the study, the consultant team developed a comprehensive Hydrology and Hydraulics model of the Spring Harbor Watershed and developed a comprehensive set of flood mitigation recommended solutions within the watershed to reach the stated flood mitigation targets. Along with City Engineering, AE2S held three public information meetings (April 25, 2019, February 24, 2020, June 30, 2021) to provide updates on the study and to engage with residents. Several focus groups were also held throughout the watershed with residents to gather more information on the flooding experiences of residents and to answer questions. In the end the project team's recommendations included 3 detention area improvements, 2 channel conveyance improvements, 7 greenway crossing improvements, 1 flood wall (10.5' tall at highest point), upgrades to the Spring Harbor Box and significant upgrades to the local sewers throughout the watershed. The watershed study final report was posted for public comment in October 2021 and the contract with AE2S ended in June 2022.

Figure vii: Spring Habor Original Watershed Study Recommended Solutions



2.3 Public Feedback on Draft Final Report

During the public comment period, following the final report being posted in October 2021, City Engineering received 58 comments and over 100 individual questions. The feedback on the final report centered around concerns about recommended changes to the Watershed's wooded greenways, including the recommended Kenosha Greenway Regrading project and the Forsythia Flood Wall and Owen Park N/S Channel project. Residents were concerned about the significant tree removals required for some of the projects. They were also concerned that the overall natural feel of the area would change. Additionally, residents in the area of the Kenosha Greenway did not want the greenway vegetation and character modified as they had been voluntarily actively managing the greenway by removing invasives since 2020.

Figure viii: Original Study Public Feedback – Concern by Topic

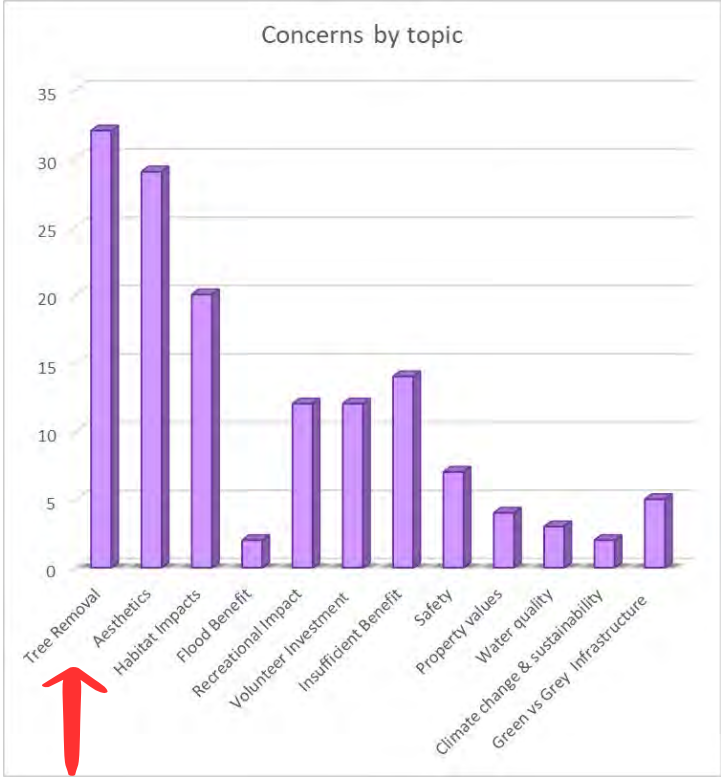
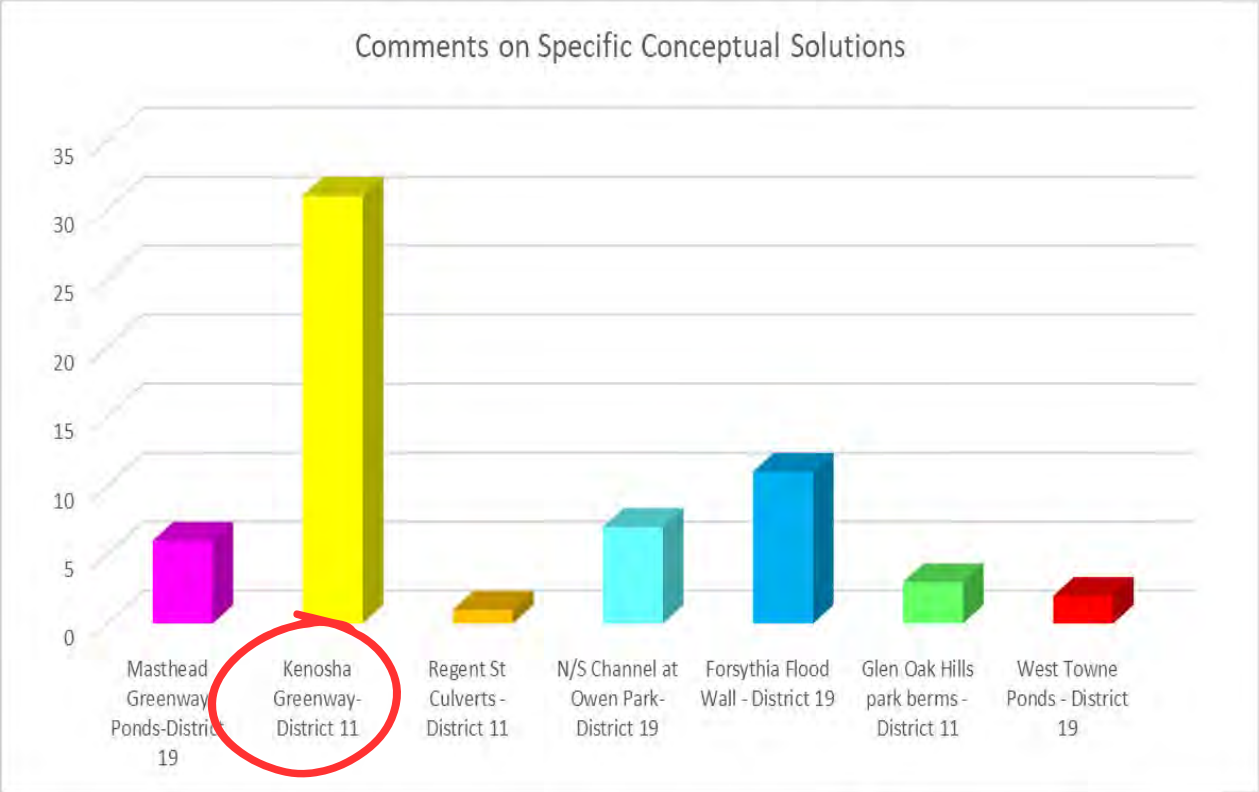


Figure ix: Original Study Public Feedback – Comments by Conceptual Solution



2.4 Need for Additional Watershed Modeling

City Engineering responded to many resident questions that were received during the comment period; however, some questions could not be answered without additional watershed computer modeling. Residents desired to know whether certain projects could be omitted or replaced by other alternatives. Residents provided many alternatives combinations that they hoped could be modeled in addition to the previous work that was done.

This led City Engineering to make the decision to conduct a round of additional watershed modeling in-house starting in July 2022. After reviewing resident feedback and completing an initial round of brainstorming, City Engineering decided it would model over 29 different scenarios and would host a 4th public information meeting to provide a project update and answer the questions that residents had after the initial study.

THE TARGETS OF THE IN-HOUSE MODELING WERE TO:

1. Determine the impact of not implementing solutions with public concerns
2. Determine the viability of alternative solutions that were recommended by the public or brainstormed internally
3. Develop near-term plan for flood mitigation projects, including a plan for the replacement of the Regent St. culvert, which was deteriorated and needed to be replaced.

Additionally, it was decided as part of this effort that City Engineering would update the Existing Conditions and Proposed Conditions models with projects within the watershed that had been completed since the development of the models starting in 2019 or that were nearing completion.

3. Living Model Updates

As part of this modeling effort, City Engineering updated the Existing Conditions and Proposed Conditions models provided by AE2S after their completion of the original watershed study. This was done to get the most accurate estimation of the flooding in the watershed at that current point in time. Several recent street reconstruction projects and private development projects, including the Element Collective project in University Research Park, were included as part of the update. General updates made to the models' datasets were also made, including the update to the most recent ground surface data that was available. Lastly, changes were made to the models' methodological parameters to standardize the model with guidance developed for the later watershed studies.

A summary of the specific updates to the models can be found in the sections below.

3.1 Existing Conditions Model Updates

1. Added Old Middleton Rd. & Craig Ave. Reconstruction Projects with new storm sewers
2. Added Gammon Rd. Reconstruction Project with new storm sewers
3. Added Mendota Dr. Reconstruction Project with new storm sewers
4. Added the designs for the Element Collective Development Project in University Research Park including new stormwater ponds and underground storage
5. Added the designs for the Zor Shrine Development Project including new storm sewer
6. Added the designs for the 5133 University Ave. Redevelopment Project new stormwater ponds
7. Added the designs for the West Place Redevelopment Project new storm sewer and underground storage
8. Added the design for Car Max Redevelopment Project new storm sewer and underground storage
9. Adjusted the manning's n in the Kenosha greenway per the recommendation of residents
10. Increased the Min/Max Infiltration rates for Owen Park subcatchments per the recommendation of residents
11. Updated 1D/2D connections in the model to optimize functionality of stormwater culverts
12. QC'ed pipes throughout the watershed and updated from plans where needed
13. QC'ed stormwater ponds throughout the watershed and added to the 2D portion of the model and updated from plans where needed
14. Split subcatchments where a finer level of detail in the models was needed to answer resident questions
15. Added pipes from older private development projects from plans where a finer level of detail in the models was needed
16. Update the model surface with City Engineering _of_Madison_DEM_2022.tif created from a Lidar flight collected in 2022

3.2 Proposed Solutions Model Updates

1. Added Old Middleton Rd. & Craig Ave. Reconstruction Projects with new storm sewers
2. Added Gammon Rd. Reconstruction Project with new storm sewers
3. Added Mendota Dr. Reconstruction Project with new storm sewers
4. Added the designs for the Element Collective Development Project in University Research Park including new stormwater ponds and underground storage
5. Added the designs for the Zor Shrine Development Project including new storm sewer
6. Added the designs for the 5133 University Ave. Redevelopment Project new stormwater ponds
7. Added the designs for the West Place Redevelopment Project new storm sewer and underground storage
8. Added the design for Car Max Redevelopment Project new storm sewer and underground storage

9. Adjusted the manning's n in the Kenosha greenway per the recommendation of residents
10. Increased the Min/Max Infiltration rates for Owen Park subcatchments per the recommendation of residents
11. Updated 1D/2D connections in the model to optimize functionality of stormwater culverts
12. QC'ed pipes throughout the watershed and updated from plans where needed
13. QC'ed stormwater ponds throughout the watershed and added to the 2D portion of the model and updated from plans where needed
14. Split subcatchments where a finer level of detail in the models was needed to answer resident questions
15. Added pipes from older private development projects from plans where a finer level of detail in the models was needed
16. Update the model surface with City Engineering _of_Madison_DEM_2022.tif created from a Lidar flight collected in 2022
17. Removed long weirs used to route water from the subcatchment runoff nodes into the storm sewers*

*To simulate inlet capacity in the original watershed models, AE2S used flat crested weirs of varying lengths to route subcatchment runoff into the storm sewers. This methodology originally seemed logical, as it was an easy way to switch between simulating areas with a specific amounts of inlet capacity for the Existing Conditions model and areas with assumed unlimited inlet capacity for the Proposed Conditions model. However, it was discovered by City Engineering during the update of the model that the very long weirs, used to simulated unlimited inlet capacity in the Proposed Conditions models, created additional model instability and reduced the amount of peak runoff getting into the storm sewers. The long weirs present in the Proposed Conditions model were removed by City Engineering to stabilize the model and provide more reliable model results. With modeled runoff flows now able to enter the storm sewers more effectively, slight increased flows were seen throughout the watershed including in the main spine of the watershed and in Spring Harbor Box (the major outlet of the watershed from Bordner Park thru the outlet at Spring Harbor). It should be noted that the increased flows from these changes is a more accurate representation of the actual stormwater system performance and by including the changes the most appropriate size for solutions would be able to be determined. The shorter weirs present in the Existing Conditions model were left in the model, as their lengths were more precise, and they were not creating instability issues.

4. Resident Driven Scenario Modeling

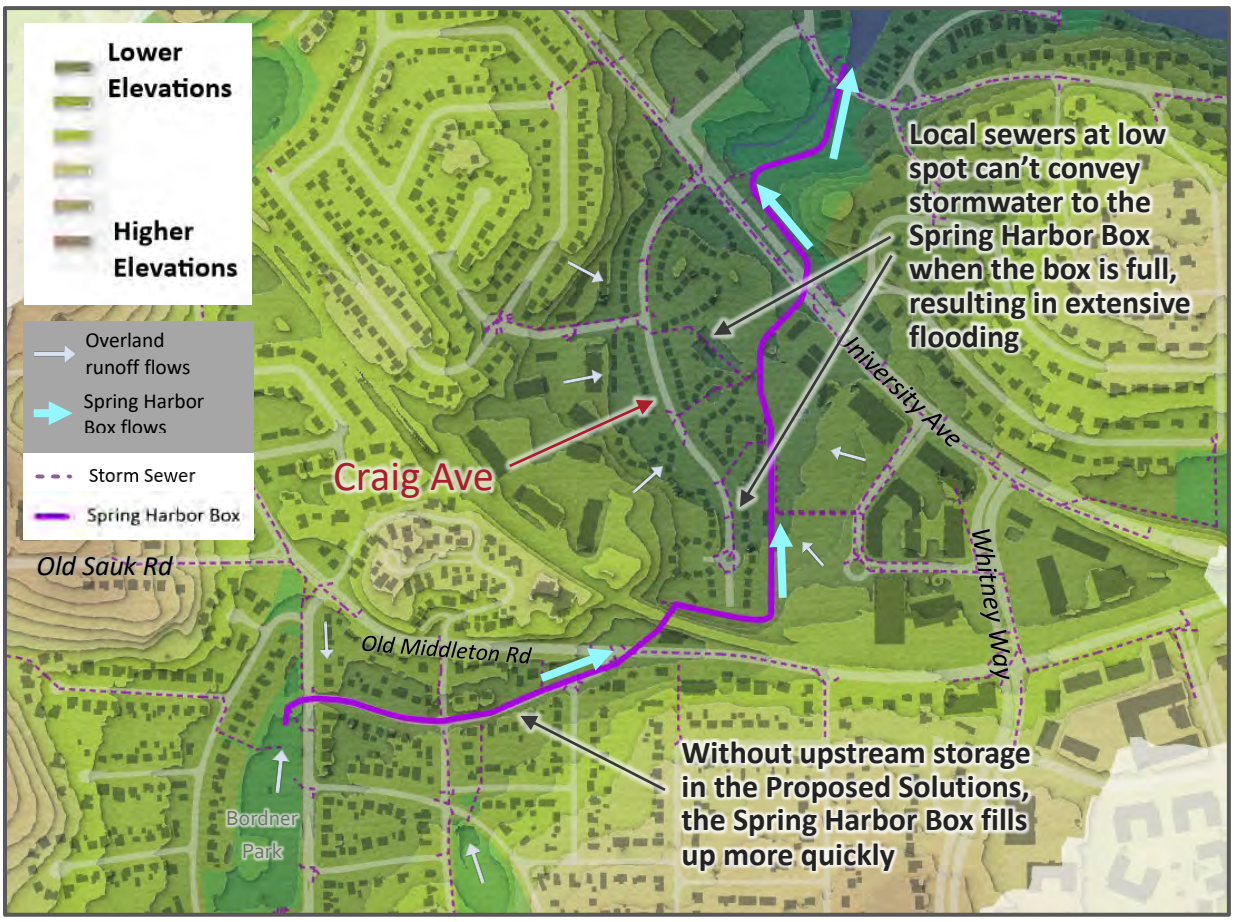
4.1 Resident Concern Driven Scenario Modeling

With the newly updated Existing Conditions and Proposed Conditions models, City Engineering started working to complete the over 29 additional modeling scenarios developed to investigate the questions and concerns raised by residents after the initial watershed study and to examine alternatives to the initial proposed solutions. It was during this time that City Engineering decided that it would be necessary to fully redevelop the suite of recommended solutions laid out during the initial watershed study, and that it would be necessary to do additional modeling to answers questions around the Craig Ave. Reconstruction and Regent St. Culvert Replacement projects that were planned to be/or needed to be constructed soon in the immediate future.

4.2 Craig Ave. Scenarios and the Decision to Redevelop the Proposed Solutions Model

While modeling these additional resident concern driven scenarios, it became clear that removing any of the stormwater storage solutions, in the upstream portion of Spring Harbor Box drainage area, resulted in negative impacts at Craig Ave. When these projects (Glen Oak Hills Berms, the Masthead Greenway Ponds, the Forsythia Flood Wall, and the Regrading of the Kenosha Greenway) were removed in the model, flows to the Spring Harbor Box increased past what had been proposed with the original recommended suite of solutions. With these increases in flows, runoff flowing overland from the surrounding neighborhood to the

Figure x: Craig Ave. Area Challenging Drainage



low spot at Craig Ave. was no longer able to enter the local storm sewer and the Spring Harbor Box, resulting in significant flooding in this area. Additional flows to the Spring Harbor Box also resulted from the improved modeling of the inlets to the system in the proposed conditions model, further exacerbated the issue. Flooding in this area was not predicted in the Existing Conditions model but was specifically predicted in the Proposed model because of the increased flows upstream.

In 2022, with the Craig Ave. reconstruction project scheduled to begin soon, City Engineering decided to run several scenarios to determine if any feasible solutions in the Craig Ave. area could be developed to mitigate the negative impacts seen in the modeling when increasing flows to the Spring Harbor Box upstream of Craig Ave. Different configurations of relief pipes from Craig Ave. to Lake Mendota were modeled. While the modeling showed that a large relief pipe could mitigate flooding at Craig Ave., the scope of the project made it similarly as infeasible as replacing the lower portion of the Spring Harbor Box that the relief pipe was meant to provide additional capacity to.

Ultimately, after discovering the many challenges created by modest alterations to the original recommended suite of solutions, City Engineering decided that it made more sense to fully redevelop the Proposed Conditions model and the recommended suite of solutions. This new Proposed Conditions model and the recommended suite of solutions would incorporate the feedback from residents and the increased flows into the local sewer from the removal of the inlet weirs. The Craig Ave. reconstruction project would move forward as designed.

4.3 Regent Street Scenario Development

After it was decided that City Engineering would redevelop the recommended suite of solutions for the Spring Habor watershed, the attention of the modeling efforts turned to the culvert under Regent St. at Kenosha Dr. which was failing and in need of replacement very soon. The redevelopment of the recommended suite of solutions would take a significant amount of time and effort, and a plan for the replacement of the Regent St. culvert needed to be developed so the culvert could be replaced during the summer of 2023.

4.3.1 Near-Term Regent Street Solutions Modeling

While the main goal at this time was to decide what size pipe would be needed to replace the current failing pipe under Regent St., it was also a goal to develop a set of recommended solutions for the Kenosha/Glen Oak Hills branch of the watershed that could function in concert with the new pipe at Regent St. During the process to develop a suite of solutions for the branch, City Engineering developed and ran a total of 40 scenarios with additional sub-scenarios. These scenarios included different combinations of upsized or additional storms sewers in the larger area, and walls/berms in Glen Oaks Hills Park/Greenway, Garner Park, and the Kenosha Greenway. The various walls and berms analyzed were included as solutions that could increase storage without the need to regrade these areas, thus minimizing impacts to trees.

4.3.2 Near-term Regent Street Recommended Solution

Through this modeling process, City Engineering was able to come to a set of conclusions. However, there were no near-term feasible solutions that had large flood improvements at Burnett without shifting flooding to Gettle Ave. Additionally, larger, possibly unpopular solutions, would be needed to prevent shifting flooding to Gettle Ave. It was decided that it would be inappropriate to recommend any of the larger projects without fully understanding the implications that they could for other parts of the larger watershed. Until the time that a full recommended suite of solutions could be developed for the watershed, City Engineering would replace the current culvert under Regent St. with slightly larger culvert pipes and build a set of terrace inlets to capture the slightly increased flows immediately downstream of Glen Oak Hills Park. This effort was shared with the public on June 28th, 2023, and constructed in late summer of 2023.

5. All Proposed Solutions Model Development

With the urgent questions addressed, City Engineering started the process of redeveloping a new suite of recommended solutions and a new Proposed Solutions Model for the Spring Harbor watershed. The goal would be to meet all City Engineering 's flood mitigation targets while minimizing projects that raised the most concerns for residents, while also ensuring the new project recommendations handled the increased flows that resulted from the removal of the inlet weirs. The development of the model and solutions would proceed starting first with the development of local sewer upgrades followed by the development of regional solution, the same process that was used to develop the original model and suite of solutions.

5.1 Local Sewers Modeling

The first stage of building the Proposed Solutions model was to upsize local storm sewers to meet the 10 and 25-year targets. This step was completed first, so increased flows from the local storm sewers would be accounted for when sizing regional solutions such as greenway crossings. First, local storm sewers were sized appropriately so runoff would not leave the storm sewers and inundate the local roads in the 10-year event. Local storm sewers were then additionally upsized so no roads would be inundated at a depth greater than .5 ft at the road centerline in the 25-year event.

5.2 Regional Solutions Scenarios Modeling

During the next stage of building the Proposed Conditions model, regional solutions were added to the model starting in the upstream sections of the watershed moving downstream. Solutions developed during the initial watershed study, that did not receive significant feedback were added into the Proposed Conditions model first. For areas where the original watershed study had recommended solutions that ended up being unpopular, City Engineering brainstormed and tested alternative conveyance and storage solutions. Initially, different combinations of solutions were tried with the desire that the timing of the peak flows leaving the branches of watershed could be shifted enough as to no longer "stack" and create excess flooding when reaching the main branch of the watershed. Ultimately the solutions that succeeded in doing this most effectively were storage solutions that slowed the stormwater reaching the main spine of the watershed. City Engineering proceeded by brainstorming and testing new alternative storage solutions not tested in the original watershed study. Some solutions were less feasible but still tested to be thorough.

In the branch of the watershed with Kenosha Greenway and Glen Oak Hills Greenway, City Engineering examined the use of flood walls at Kenosha Greenway and at the northeast corner of Garner Park as alternatives to the regrading of the Kenosha greenway and the Glen Oak Hill Berms recommended in the original watershed study. Flood walls were used in the modeling as they provide additional storage capacity to greenspaces without the need to regrade and remove a large amount of trees/vegetation and they help mitigate flooding of nearby homes. Through many iterations it was determined that a short flood wall around Garner Pond at the northeast corner of the Garner Park appeared to provide the most benefit for a relatively modest project within this area. It would help mitigate flooding downstream at Burnett Dr and would cause the least impacts to greenspace access and viewing. It would not however, create the same flood mitigation benefits as both the regrading of the Kenosha Greenway and the Glen Oak Hills Greenway.

In the branch of the watershed with the Masthead Greenway and Nautilus Pond, City Engineering brainstormed alternative storage options to the Masthead Greenway Ponds, recommended in the original watershed study, but ultimately felt that the alternatives were limited. The Nautilus Pond area had already recently been reconstructed and designed to provide significant flood mitigation benefits to the area. The remaining City owned land in this branch of the watershed was limited to what was in the Masthead greenway. The Masthead greenway had been studying during the original watershed study, and alternative storage solutions for the greenway would not be significantly different from the original recommended

solution. Because the solutions developed during the watershed studies are only meant to be conceptual solutions that help City Engineering understand the magnitude of solution needed in each area and are not meant to be full design -level efforts, evaluating alternative storage solutions in the Masthead Greenway would be most valuable when the project is budgeted and in the design phase. However, it is known that the storage is needed within this particular branch, not downstream within the main spine.

Lastly, City Engineering looked at alternative storage solutions in the main branch of the watershed. Because the highest flows through the watershed happen in this main branch of the watershed, alternative storage solutions in the area would need to be different than those in other areas. Because so much of the watershed drains to the main spine, including from the side branches, even when the rainfall intensities are low the flows through the main spine are significant. Additionally, because the most intense rainfalls are often preceded by light rainfall, solutions in the main spine needed to both allow through the significant flows often seen during the earlier parts of a storm and have stormwater storage available for only the most intense parts of a storm. One example of this would be a main channel with adjacent dry basins that only start to fill up when the main channel fills and overflows. If only a standard pond was built, rather than a pond and channel, the pond would end up filling during the earlier parts of a storm with no storage capacity remaining for the most intense parts of a storm that cause the worst flooding. The biggest drawback of these types of solutions is that they often have larger footprints and require significant disruptions to the surrounding landscape.

For the main spine, City Engineering considered 3 locations for these alternative storage solutions: the Mendota-Spring Harbor Greenway between Quarterdeck Dr and Inner Dr, the Owen Conservation Park Area, and the Bordner Park Area. The Mendota-Spring Harbor Greenway between Quarterdeck Dr and Inner Dr was too narrow for the type of storage solution needed (described above). Additionally, some homes surrounding the current greenway are situated low relative to the greenway and could be at greater flooding risk if additional stormwater was stored in this area. The Bordner Park area was also considered for alternative solutions, but City Engineering felt that storage options in the park were thoroughly evaluated during the original watershed study. Lastly, alternative storage solutions in the area of the Owen Conservation Park were considered as alternatives to the Forsythia wall recommended in the original study. Generally, these solutions were less desirable, as they would have impacts to the Owen Conservation Park area but, to be thorough, were evaluated as potential projects. The solutions examined included a large flood berm with a large box culvert immediately upstream of a modified version of the Forsythia Cunette (Figure xxxvii), and a series of dry ponds running adjacent to a modified version of the Forsythia Cunette (Figure xxxvi). While these solutions did mitigate flooding enough to meet the City's flood mitigation targets in the area, with other watershed storage solutions, the footprints of the projects and the resulting disruptions to the surrounding natural areas were not preferable to the disruptions from a Forsythia Cunette Wall. These two solutions are not recommended but the details of the solutions have been included in this report.

5.4 Final All Proposed Solutions Suite, the Drawbacks, and Need for Additional Near-Term Proposed Solutions

Through this process of testing alternative solutions, City Engineering concluded that, to meet the flood mitigation targets watershed-wide, many of the solutions that were unpopular in the original watershed suite of solutions would still be needed. Additionally, even with all these solutions in place, the replacement of the Lower portion of the Spring Habor Box would still be needed to mitigate negative impacts to Craig Ave. from increasing flows to the box upstream. The lower Spring Harbor Box is currently in good condition and will not need to be replaced for several decades, and construction was estimated to cost $12 million (2024 dollars). Unfortunately, this set of solutions did not address the concerns of residents and would not be constructable for several decades. Because of this City Engineering decided to keep the All Solutions model and suite of solutions as future hypothetical recommendations to be documented in the updated study and potentially

more closely evaluated after the near-term solutions are implemented. These solutions would show the level of projects that would be needed to reach all the City's flood mitigation targets and would function as possible options for when the time came that the Lower Spring Harbor Box could be reconstructed, decades in the future. Also, as conditions change in the watershed or opportunities presented themselves for larger projects City Engineering would understand the potential benefits of such projects without needing additional study. From this decision, City Engineering also decided to make a second near-term solutions model and suite of solutions that would not include the Lower SH Box upsize or any regional solutions that City Engineering felt would not be feasible or popular in the near term.

5.3 All Solutions Recommended Solutions Suite

Solutions included in the All Solutions model and suite of solutions from the original watershed study:

- Upsize Upper SH (Spring Harbor) & Box Glen Hwy Box Culvert
- West Towne Retention Pond (Currently Programmed in 2025-2026)
- Masthead Greenway Pond
- Forsythia Wall (3.5' shorter at tallest point—7' max) + Owen Park Ditch (half the size of original)
- Glen Oak Hills Berms
- Greenway Crossing Upsizes: Yellowstone, Quarterdeck, Jetty, Masthead, Inner, South Hill, and Regent Box Culverts
- Local Sewer Upsize Pipes watershed-wide

New regional solutions included in the All Solutions model and suite of solutions:

- Beltline Off-Ramp Pond
- Garner Park Flood Wall (4' high) + Kenosha Relief Pipe
- Forsythia Cunette Modifications
- Upsized Lower SH (Spring Harbor) Box

Original Watershed Study solutions that are Excluded from the All Solutions model and suite of solutions:

- Kenosha Greenway

All Solutions Suite map can be found on Figure xxi: All Solutions - Recommended Solutions (0-50 yrs)

6. Near-Term (0-25 Years) Proposed Solutions Model Development

With the All Solutions model and suite of solutions complete, City Engineering started the process of developing a modified set of solutions for the near-term. The goals of this new model and suite of solutions, were to meet as many of the City's flood mitigation targets as possible while not including the Lower SH Box upsize or any regional solutions that City Engineering felt would not be feasible or supported by residents in the near term.

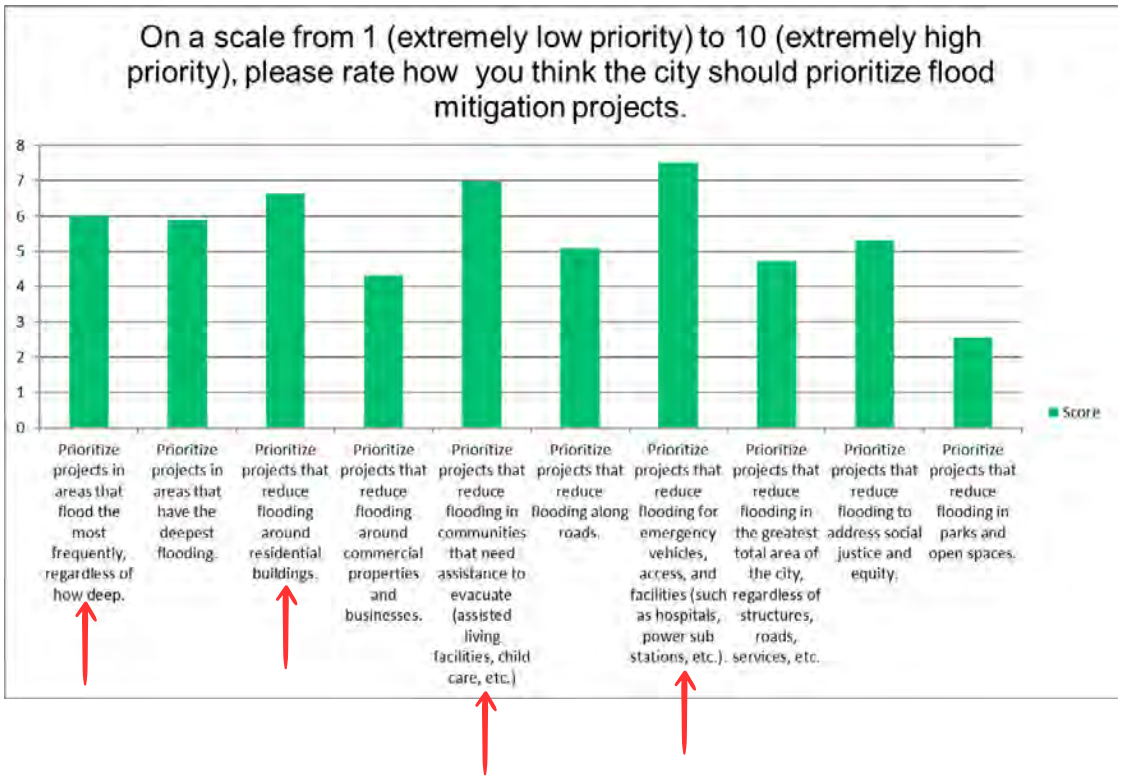
Knowing that the watershed study flood mitigation targets would not be met watershed-wide, City Engineering used resident feedback (from a citywide resident survey conducted starting in May 2021- https://www.cityofmadison.com/news/2021-05-11/survey-open-city-engineering-works-to-prioritize-flood-projects) as a guide for what areas would be prioritized in the Near-Term Solutions. These priorities included:

- Providing access for **Emergency Vehicles**
- Reducing risk of flooding for **residential homes**
- Reducing risk of flooding for residential homes that **flood most frequently or deepest**
- Reducing risk of flooding for **communities that need evacuation assistance**

The process developed to prioritize these needs is detailed in the following sections.

Figure xi: Feedback from Resident Survey

https://www.cityofmadison.com/news/2021-05-11/survey-open-city-engineering-works-to-prioritize-flood-projects



6.1 Splitting up the Watershed

To start the process of creating a near-term model and suite of solutions, City Engineering first started by reevaluating the challenges of developing the All Solutions model and suite of solutions. During this part of the modeling process, the Spring Habor Box was found to be the main limitation. When the Spring Harbor Box is replaced, there is a limit of how large it can reasonably be built while still fitting underneath the road. This means there is additionally a limit to how much stormwater can be sent to the box, within a certain period, before it becomes overwhelmed, and flooding occurs. Areas that drained to the Spring Harbor Box would need to be limited by the capacity of the Spring Harbor Box. Additionally, areas of the watershed that did not drain to the Spring Habor Box, the Mendota Drainage Area, or that did not have a meaningful impact on it, the West Towne Pond Drainage Area, (see Figure iv for reference) didn't have to be subject to the same restrictions. These two areas could keep the solutions that were recommended in the All Solutions suite of solutions. The areas draining to the Spring Harbor Box would need to continue to be evaluated.

6.2 Downsizing Flood Mitigation Targets Analysis

Next in the process of developing solutions for the portion of the watershed draining to the Spring Harbor Box, City Engineering wanted to evaluate if it would be possible to lower the City's flood mitigation targets evenly across the area. This would be a simple way to limit the flows reaching the Spring Harbor Box. Multiple scenarios were run adjusting the local storm sewers and regional solutions to meet the City's flood mitigation targets instead for smaller storms, e.g. meeting the "no surcharging onto the street" target for the 5-year storm instead of for the 10-year storm. However, the resulting flows to the Spring Habor Box were still too large and causing flooding, so reducing the City's flood mitigation targets for this portion of the watershed was not a viable solution.

6.3 10-Year and 25-Year Targets for Arterial Roads

After determining it was not feasible for City Engineering to reduce flood mitigation targets evenly across the Spring Habor box drainage area, City Engineering brainstormed other possible ways to adjust the targets. Due to the importance of the watershed's arterial roads, for transporting emergency vehicles during large storm events and for the BRT routes, these roads were prioritized first. This also aligned with what residents felt was most important to prioritize based on the feedback from the resident survey noted previously on Figure xi: Feedback from Resident Survey. The arterial roads prioritized included Whitney Way, University Ave., Mineral Point, and Gammon Rd and the local sewers would be upsized so that the 10-Year and 25-Year flood mitigations targets were met for those roads. It should be noted that for University Ave., the 10-Year goal could not be fully met due to overland flows from the Indian Hill Neighborhood. However, this goal could be met for University Ave. with the inclusion of improved roads with curb and gutter for the unimproved portions of this neighborhood Indian Hill Neighborhood.

6.4 Feasible Regional Solutions

Compared to upsizing the local sewers watershed-wide, by upsizing the local sewers only on arterial road to meet the 10-Year and 25-Year targets, there were limited increases in flow to the main spine of the Spring Harbor box drainage area. However, because the main spine of the Spring Harbor box already had limited capacity with the existing flows, it did cause additional flooding in the Gettle Ave. area. To mitigate these impacts, City Engineering added in the regional solutions from the All Solutions model that were expected to cause the least amount of concern to residents while providing flood mitigation benefits to the most flood prone areas, including Gettle Ave. These solutions included:

- Forsythia Cunette Deepened & Lowered
- Garner Park Flood Wall & Kenosha Storm Sewer Upsize

- Glen Hwy Box Culvert
- Upper Spring Harbor Box Upsize

6.5 Solutions to Mitigate Negative Impacts

After adding the region solutions, City Engineering felt that the suite of solutions developed adequately provided access to arterial roads and provided flood mitigation benefits to some of the highest flood risk areas while seeming feasible in the near-term. City Engineering did a final analysis to determine if there were any areas of the Spring Harbor drainage areas that were being impacted negatively by one of the other solutions that had been incorporated at that point. City Engineering determined that two areas in the watershed (a small area on Craig Ave. and a small area near the intersection of South Hill Dr and Inner Dr) had a slight increase in flood depth in the 1% chance event. City Engineering determined that to mitigate these negative impacts two solutions could be added that would ensure the near-term solutions weren't moving the flooding to other places within the watershed. To mitigate flooding in these two areas the following solutions were included:

- Inner Dr and South Hill Greenway Crossing Upsize
- Craig Ave. Sewer Upsize

Note: City Engineering also investigated upsizing the Quarterdeck greenway crossing which floods frequently and is predicted to overtop in the 2-year storm in the Existing Conditions model. However, it was found that when adding this solution into the near-term model resulted in negative impacts downstream that we were not able to mitigate without additional large regional solutions.

6.6 Near-Term Recommended Solutions Suite

Solutions included in the Near-Term Solutions model and suite of solutions from the original watershed study:

- Upsize Upper SH (Spring Harbor) & Box Glen Hwy Box Culvert
- West Towne Retention Pond (Currently Programmed in 2025-2026)
- Inner Dr and Sout Hill Greenway Crossing Upsize
- Local Sewer Upsize Pipes on arterials

New regional solutions included in the Near-Term Solutions model and suite of solutions:

- Beltline Off-Ramp Pond
- Garner Park Flood Wall (4' high) + Kenosha Relief Pipe
- Forsythia Cunette Modifications

Original Watershed Study solutions that are Excluded from the Near-Term Solutions model and suite of solutions:

- Kenosha Greenway
- Masthead Greenway Pond
- Forsythia Wall
- Glen Oak Hills Berms
- Owen Park Ditch
- Upsize Lower Spring Harbor Box

Near-Term Solutions Suite map can be found on Figure xxii: Near-Term Recommend Solutions (0-25 yrs)

7. Flood Mitigation Solutions Frequently asked Resident Questions

Why can't we more effectively utilize the greenspaces in the upstream areas of the watershed to infiltrate water and prevent flooding downstream?

The Spring Harbor Watershed is approximately 2,390 acres. 120 acres of those are managed by the Stormwater Utility, with 58 acres specifically being owned by the Stormwater Utility. During a 24-hr 1% annual chance storm (6.6 inches of rain in 24 hours) the Spring Harbor Watershed will receive 1,314 ac-ft* of rainfall (which is equivalent to the volume held by 647 Olympic swimming pools), 847 ac-ft of which our modeling shows will become runoff (which is equivalent to the volume 417 Olympic swimming pools). This 847 ac-ft of stormwater is what is then left for the Stormwater Utility to manage or what will otherwise flow unmanaged overland to areas that are lower in elevation. Based on our modeling, the watershed is already infiltrating 35% of the runoff during a 1% annual chance storm, in order for the Stormwater Utility-owned land to infiltrate the remaining runoff it would need to infiltrate an additional 14.6 ft (847 acres-ft ÷ 58 acres) of stormwater over the entire 58 acres of Stormwater Utility-owned land. This is an unattainable goal.

Why can't re-development near West Towne Pond fix downstream flooding?

The water coming from West Towne Mall all ends up in the West Towne ponds. There is significant flooding around West Towne Mall, which impacts businesses as well as arterial roads that serve as emergency service routes. The watershed study proposes a conceptual solution at West Towne Ponds that mitigates flooding around the ponds and does not increase flooding downstream. The proposed solution maximizes all available space, so there is not additional room to try to decrease the flows leaving this area. Also, to note, there is only a 36" pipe leaving the pond, which can convey 40 cubic feet per second, and by the time the stormwater is moving past Crestwood, the additional watershed area that contributes to the flow results in 1200 cubic feet per second flowing over the Forsythia channel (30 times as much flow). In other words, West Towne and everything upstream is only contributing to 3% of the flows by the time you reach Crestwood and the downstream areas near Gettle that flood. However, as areas around West Towne Mall redevelop, they will be required to meet more stringent stormwater utility rules, and this may help slightly decrease flooding throughout the watershed. Due to the unknown timeframe for redevelopment, and the fact that the City is not in control of when private land would be redeveloped, this was not included in the model. To learn more about the City's redevelopment standards see:

https://www.cityofmadison.com/development-services-center/land-development/private-property/stormwater-management

What other alternatives, such as flood mitigation on individual structures, or elevating the structures, considered? If so, why were they rejected?

Individuals are free to take flood protections on their property as they see fit, including raising structures. The City does not have a grant program and is not able to provide this type of assistance because, to utilize public funds on private property, the SWU needs to justify that the use of those funds benefits the public in general not just the property where they are being spent. If residents who are most at risk are willing to sell their homes to the Stormwater Utility, or flood-proof their homes, then solutions could be re-assessed based on the structures at risk of flooding at that time.

* An ac-ft or acre-foot is a unit of volume equivalent to the amount of water needed to cover an acre of land to a depth of 1 foot.

Could area upstream of Forsythia be used for flood storage to decrease conveyance of water in the cunette?

The Masthead Greenway Ponds is a recommended solutions that would increase storage and decrease flows to Forsythia. The Yellowstone and Quarterdeck Drive Greenways were evaluated but unfortunately the greenways are too narrow, and there are very low-laying houses alongside the greenway, so there is not a lot of available storage space to make a difference in peak flows. Additionally, these greenways compose the major spine of the stormwater conveyance system, therefore there is more water moving through these greenways, and it is harder to make a notable impact in the peak flows (which are what lead to flooding). In both the Masthead and Kenosha Greenways, there is less water moving through the system, and therefore utilizing the existing space in those greenway systems to store water delays the peak flows moving through them. This allows the peak flow to move through the major backbone of the system, before the other peak flows join it, which is what causes the worst flooding at Gettle Ave.

Could we use a pond where the Forsythia Cunette is and prevent the need of a flood wall?

As part of this recent modeling, the City did evaluate the creation of a pond and other storage solutions at this location. To achieve the same level of flood mitigation, a pond along this area would need to be very big. Due to the topography of the area, options for storage are very limited.

The flood wall allows the stormwater to get deeper before it goes into the box culvert under Bordner Drive, which pressurizes the pipe and allows more water to enter—it's essentially pushed into the pipe by the stacked water above it. A pond(s), in contrast, would need to hold enough water to reduce the peak stormwater flows to the rate that can enter the existing box. In order to do that in the main drainage spine, there would need to be significant tree removals south of the existing cunette and due to the steep topography, there would need to be a large retaining wall built on the southern side of the pond(s). For details, see Figure xxxvi: Not Recommended Solutions - Forsythia Pond.

Will there be more sediment at the harbor?

There are many varying factors that determine the amount of sediment that deposits at the outfall of Spring Harbor.

Small storm events – most of the sediment and sand that accumulates on roadways and parking lots is transported to local water bodies in small and frequent storm events. The proposed flood solution projects would not materially affect how storms of this size (generally 100% chance storm event and smaller) flow through our system. Therefore, the City would expect no significant change in either the amount of sediment transported or rate at which it is transported.

Large storm events – large storm events can dislodge sediment that makes up the banks or has accumulated in the greenways (stormwater channels) themselves, especially in heavily wooded greenways. This is a result of erosive forces generated during very high rates of flow. These can be large washouts (Pheasant Branch Creek in 2018), or smaller more isolated washouts (10 cubic yards/one dump truck load) experienced in isolated places along the greenway. In an urban area, the washouts of greenways are due to the greenway experiencing flows/velocities/shear stresses that the greenway was not designed to accommodate. In the case of the greenways feeding Spring Harbor the proposed flood solutions take this into consideration and provide design solutions to improve existing greenways and ensure that they are designed to accommodate these larger storm events.

Safety of flood wall—how is it designed to not fail due to water pressure?

Flood walls are designed by structural engineers to withstand the forces of the anticipated water depths, including a factor of safety. This level of engineering design is completed when the project is budgeted and in the design phase.

How fixed is the recommended timeline? Could any projects be pushed back further or moved up?

Projects that increase the amount of stormwater storage, such as the Masthead/Glen Oak Hills greenway projects, could possibly be moved up in the implementation order if there is an opportunity to do the work and the public support is there.

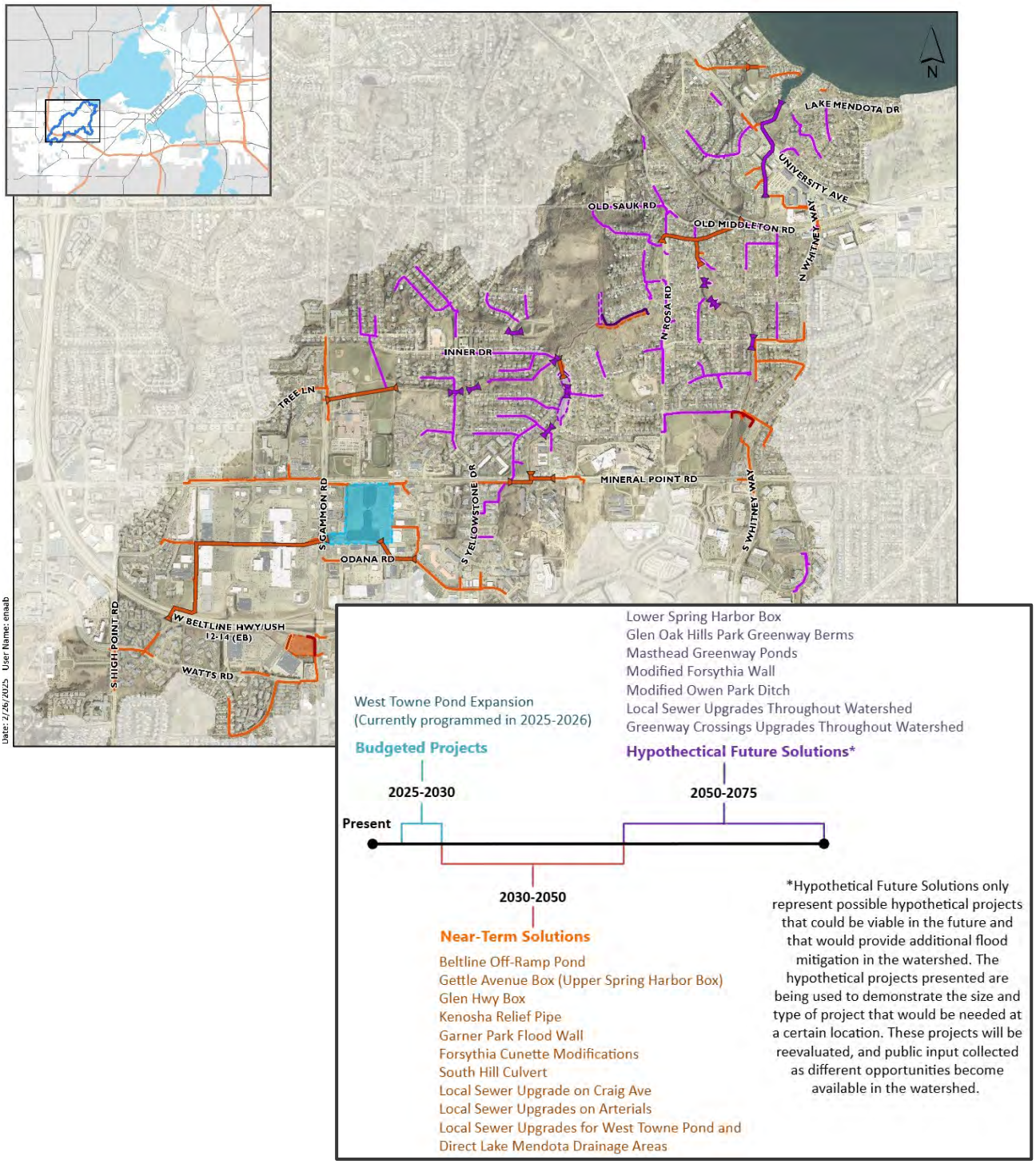
Projects that increase storm conveyance, such as larger pipe and culverts, can only be completed when the necessary storage or increased conveyance is completed downstream. The City will not mitigate flooding at one location if it makes flooding worse at a different location.

8. Solutions Timeline and Implementation Order

8.1 Recommended Solutions Timeline

The below graphic and timeline are an estimation of when projects within the watershed will be constructed based on the recommendations in this report.

Figure xii: Recommended Solutions Timeline Map and Timeline



8.2 Solutions Implementation Order

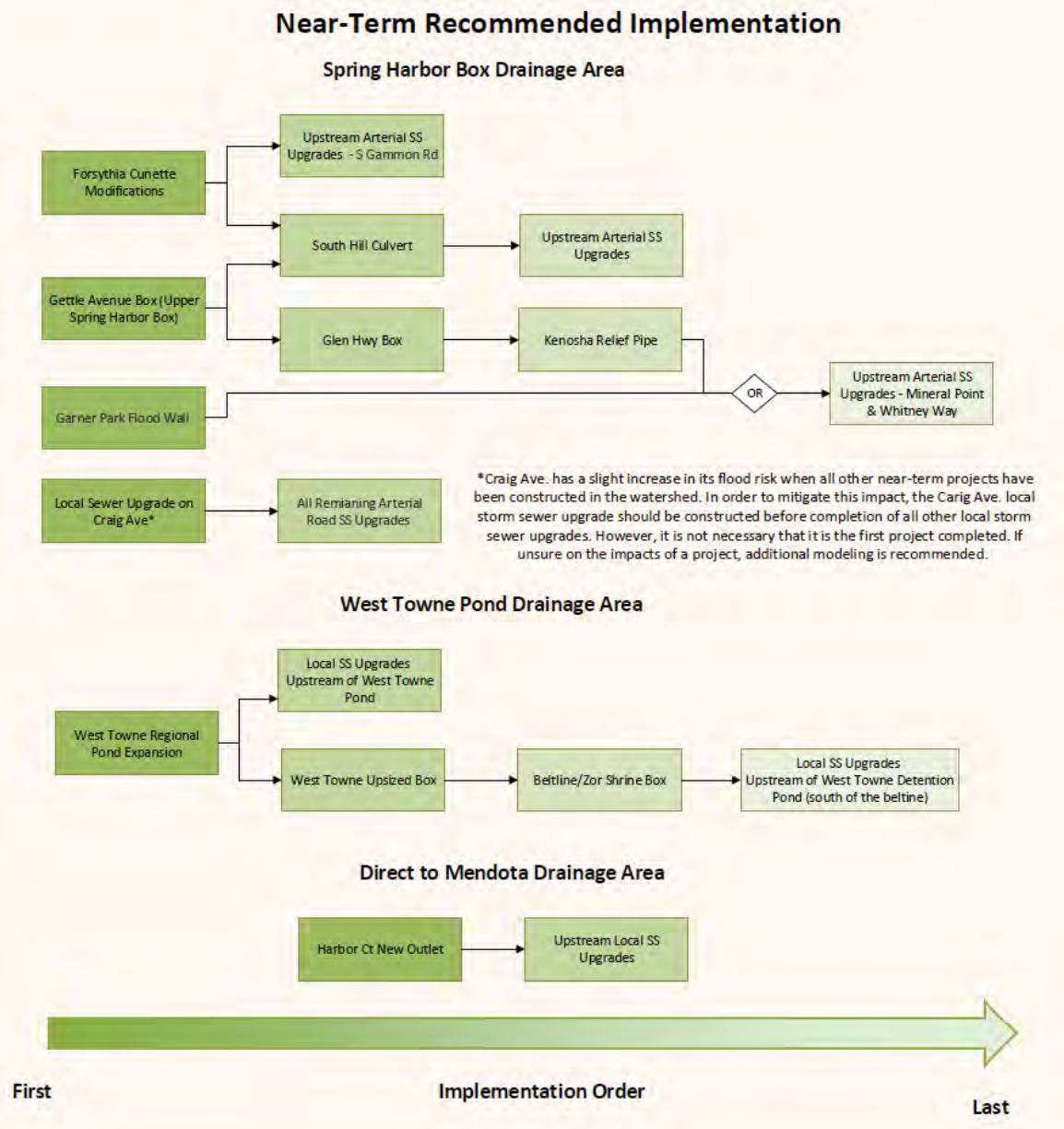
The below sections display the recommended implantation orders of projects that were considered during this portion of the watershed study.

NOTES ON THE IMPLEMENTATION ORDER:

1. City Engineering will not implement a flood mitigation project if it results in an increase in flooding downstream or in a different area of the watershed. Implementation sequences were developed to follow this policy.
2. As new opportunities become available to implement solutions in the watershed, additional modeling will be done to explore options that were not foreseen at the time of this modeling.

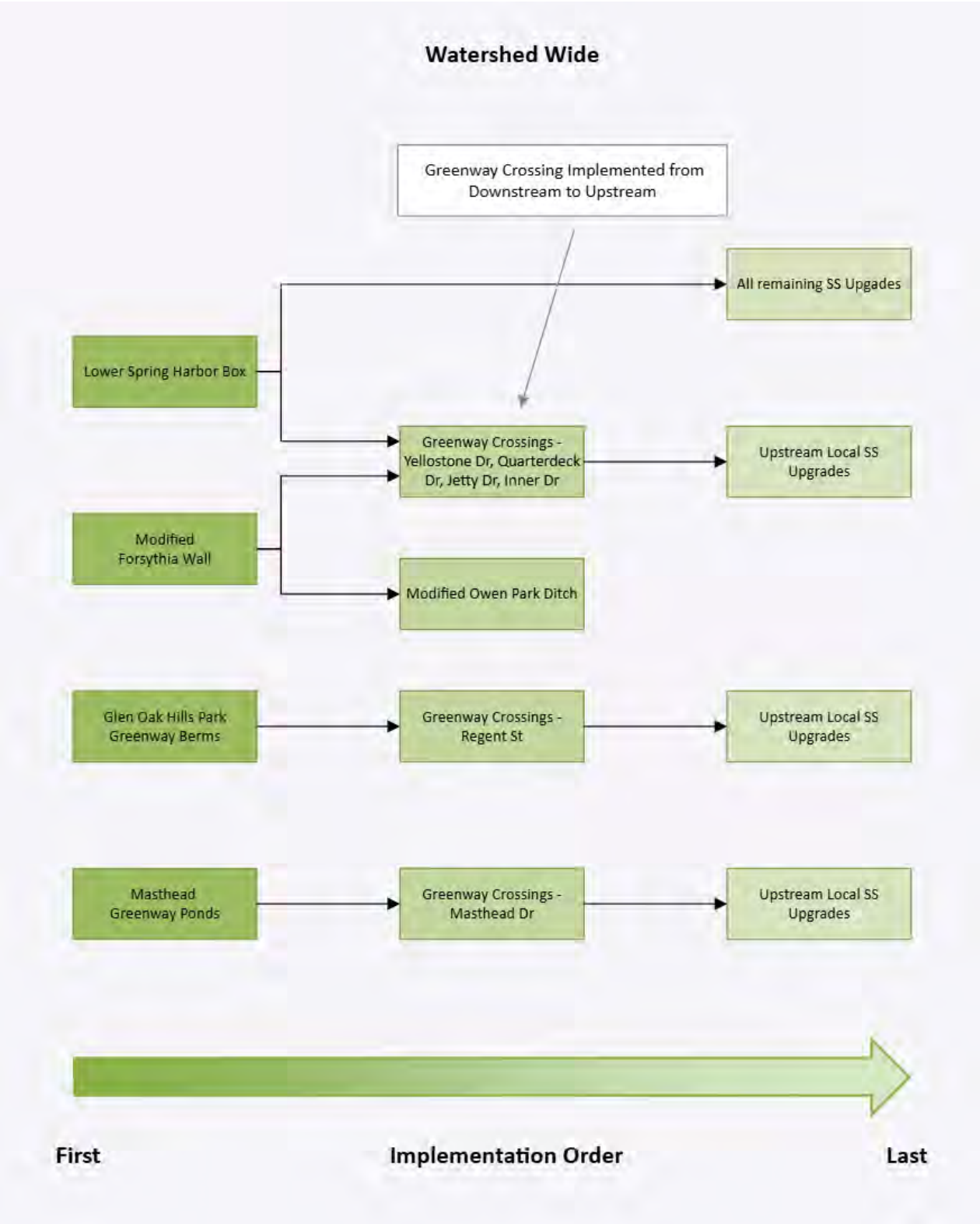
8.2.1 Near-Term Solutions Implementation Order

Figure xiii: Near-Term Recommended Solutions Implementation Order Flowchart



8.2.2 Future Hypothetical solutions Implementation Order

Figure xiv: Future Hypothetical Recommended Solutions Implementation Order Flowchart



9. Recommended Project Permits

Below is a table of the permits that we anticipate will be required to construct the solutions presented in this report.

Table ii: Recommended Project Permits

Project	Anticipated Permits Needed
West Towne Retention Pond (Currently Programmed in 2025-2026)	• City of Madison Erosion Control • Wisconsin DNR Construction Site Disturbance (WRAPP) • Wisconsin DNR/USACE Permit for Wetland Disturbance • Artificial Wetland Permit
Glen Oak Hills Berms	• City of Madison Erosion Control • Wisconsin DNR Construction Site Disturbance (WRAPP) • If the drainage is considered navigable by the WDNR, a Wisconsin DNR Chapter 30 permit would be needed for a culvert along with water quality certification from the USACE (Section 401/404). • If the WDNR takes jurisdiction over the embankment as a small dam, a dam construction permit through NR 333 would be needed.
Forsythia Wall	• City of Madison Erosion Control • Wisconsin DNR/USACE Permit for Wetland Disturbance • Wisconsin DNR/ USACE Permit for Streambank Stabilization
Forsythia Cunette	• City of Madison Erosion Control • Wisconsin DNR Construction Site Disturbance (WRAPP) – May depend on if a • Wisconsin DNR/USACE Permit for Wetland Disturbance • Wisconsin DNR/ USACE Permit for Streambank Stabilization • Level of permitting effort dependent on potential WDNR navigability determination
Masthead Greenway Pond	• City of Madison Erosion Control • Wisconsin DNR Construction Site Disturbance (WRAPP) • If the drainage is considered navigable by the WDNR, a Wisconsin DNR Chapter 30 permit would be needed for a culvert along with water

	quality certification from the USACE (Section 401/404). • If the WDNR takes jurisdiction over the embankment as a small dam, a dam construction permit through NR 333 would be needed.
Upsize Upper Spring Harbor & Box Glen Hwy Box Culvert	• Wisconsin DNR Permit for Culvert • City of Madison Erosion Control • Determination by WDOT on Bridge or Culvert Identification/Number
Beltline Off-Ramp pond	• City of Madison Erosion Control • Wisconsin DNR Construction Site Disturbance (WRAPP) • DOT ROW Permit – (will depend on final design and coordination in land acquisition)
Garner Park flood wall (4' high)	• City of Madison Erosion Control • If the WDNR takes jurisdiction over the wall as a small dam, a dam construction permit through NR 333 would be needed.
Upsized Lower SH (Spring Harbor) Box	• City of Madison Erosion Control • Wisconsin DNR Construction Site Disturbance (WRAPP)
Greenway Crossings	• City of Madison Erosion Control • Wisconsin DNR Construction Site Disturbance (WRAPP) • If the drainage is considered navigable by the WDNR, a Wisconsin DNR Chapter 30 permit would be needed for a culvert along with water quality certification from the USACE (Section 401/404Water Quality Information)

10. Recommended Project Cost Estimates

City staff provided unit costs based on 2024 dollars, which were adjusted based on project specifics and input from City Engineering. Cost estimates should be considered a Class 4 estimate based on guidance from the Association for the Advancement of Cost Engineering (AACE International), which corresponds to a feasibility study level of design (1% to 15%). A Class 4 estimate is generally considered to have an accuracy range of –15% to -30% (i.e., overestimate the true cost estimate) an +20% to +50% (i.e., underestimate the true cost estimate). A contingency of +25% was assigned to all opinions of probable costs to reflect the feasibility level of design.

Table iii: Recommended Project Cost Estimates

Near-Term Solutions (0-25yrs)

- Upsized Upper Spring Harbor Box - $9M
- New regional solutions
    - Beltline Off-Ramp Pond - $1.5M
    - Garner Park Flood Wall & Kenosha Relief Sewer - $2.7 M
- Regional solutions
    - West Towne Retention Pond - $4.5M (Currently programmed in 2025-2026)
    - Forsythia Cunette Modifications - $5 M
- South Hill Culvert - $0.7M
- Local Sewer
- **Total without local sewer: $23.4M**

All Solutions (0-50 yrs)

- Upsized Upper & Lower Spring Harbor Box - $9M (upper) + $12M (lower)
- New regional solutions
    - Beltline Off-Ramp Pond - $1.5M
    - Garner Park Flood Wall & Kenosha Relief Sewer - $2.7M
- Regional solutions
    - West Towne Retention Pond - $4.5M (Currently programmed in 2025-2026)
    - Masthead Greenway Pond - $2.6M
    - Forsythia Wall (shorter) + Cunette Modifications - $7.1M
    - Glen Oak Hills Berms – $1.8M
- Greenway Crossings - $4.7M
- Local Sewer
- **Total without local sewer: $46M**

11. Original Study & Additional Modeling Engagement

For the original watershed study and this additional round of modeling, it was City Engineering's goal to provide engagement opportunities for other City of Madison departments, the Spring Harbor Watershed alders, and residents.

The following list includes some of the meetings that were held to provide engagement opportunities during the **original watershed study**:

- Public Information Meeting #1 – April 25th, 2019
    - Almost 100 attendees
- 8 Focus Groups – Summer/Fall 2019
    - 132 attendees
- Public Information Meeting #2 – February 24th, 2020
    - Almost 60 attendees
    - Breakout rooms following PIM
- Public Information Meeting #3 – June 30th, 2021
    - Approximately 40 attendees
    - Breakout rooms following PIM
- Public Comment Period on Study Draft Final Report – January 28th, 2022, through March 4th, 2022

The following list includes some of the meetings that were held to provide engagement opportunities during this **additional round of modeling** by the City:

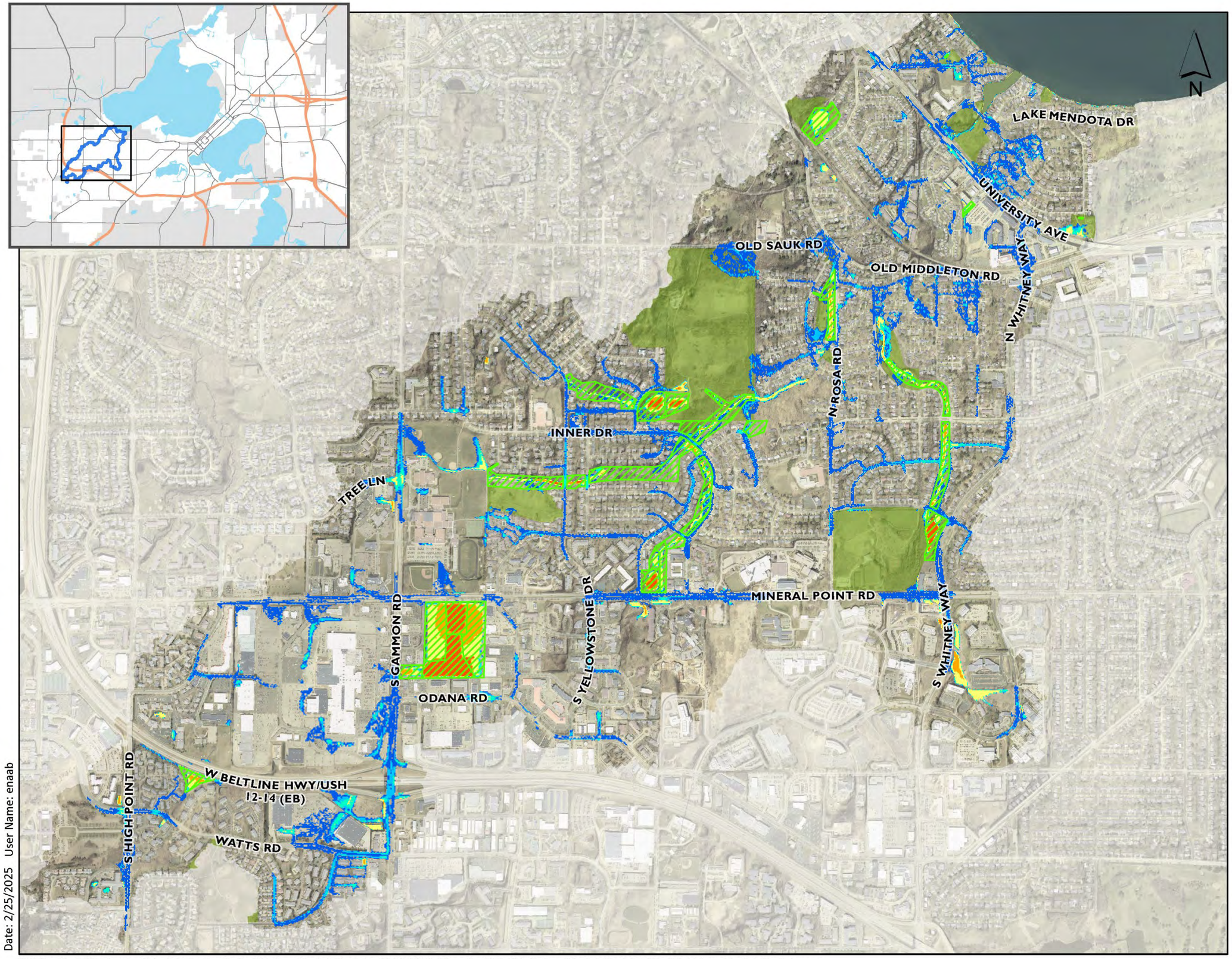
- PWI* – April 30th, 2024 **PWI is the City Internal Public Works Improvement Team Meeting, a group comprised of department heads and mayor's staff.*
- Meeting with Parks staff
- Meeting with Water Utility staff
- Meeting with Alders of impacted districts – June 6th, 2024
- Public Information Meeting #4 – August 27th, 2024
    - Approximately 80 registrants
    - Breakout rooms following PIM
- Board of Park Commissioners** – November 6th, 2024 *** The Board of Park Commissioners (BPC) is the policy-making and recommending body for the Parks Division and consists of seven members: five appointed residents and two Alders.*
- Public Comment Period on the Watershed Study Amendment 1 – February 28th, 2025, through March 30th, 2025
- Board of Public Works Planned Date – July 16th, 2025

12. Next Steps

It is the recommendation of City Engineering that the Near-Term suite of solutions is accepted as the new official suite of solutions for the Spring Harbor Watershed and that they are incorporated into City Engineering 's construction prioritization matrix with the solutions from the other City of Madison Watershed Studies.

Additionally, it is recommended that City keep a record of the All Solutions suite of solutions to be considered in the future as additional options become available in the watershed or as resident opinions shift, and to help future engineers understand the types and sizes of solutions needed to meet the flood mitigation targets in the watershed.

13. Figures



Updated Existing Conditions - 50% Annual Chance Storm Flooding

Amendment: 1
Figure: xv

Spring Harbor Watershed Study
City of Madison

Ponds and Greenways

Parks

50% Annual Chance Inundation

Maximum Water Depth (Feet)

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 3
- 3 - 6
- 6 - 20

0 275550 1,100 Feet

CITY OF MADISON ENGINEERING

Date: 2/25/2025 User Name: enaab

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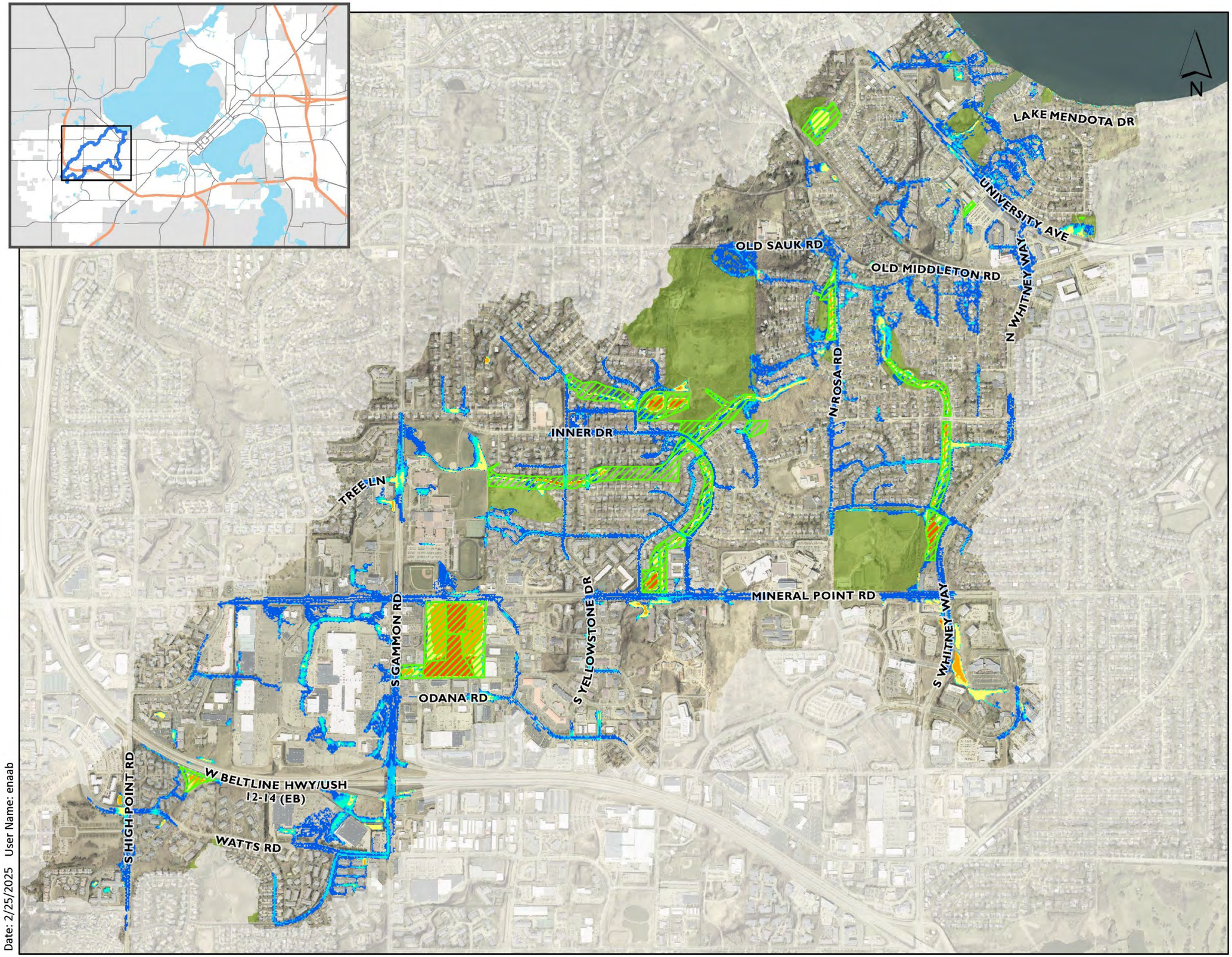
Updated Existing Conditions - 10% Annual Chance Storm Flooding

Amendment: 1
Figure: xvi

Spring Harbor Watershed Study
City of Madison



Ponds and Greenways

Parks

10% Annual Chance Inundation

Maximum Water Depth (Feet)

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 3
- 3 - 6
- 6 - 20

0 275550 1,100 Feet

CITY OF MADISON ENGINEERING

Date: 2/25/2025 User Name: enaab

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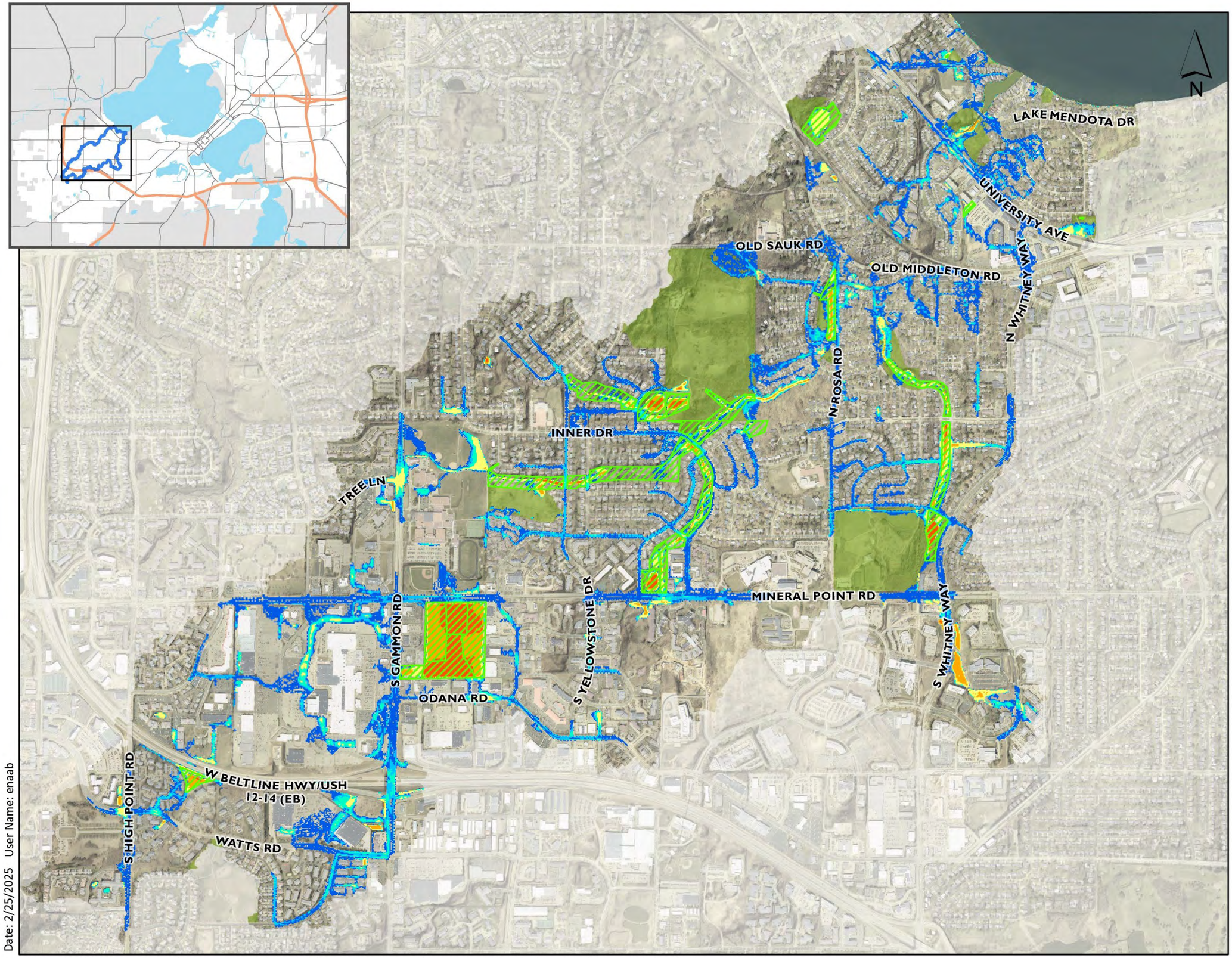

Updated Existing Conditions - 4% Annual Chance Storm Flooding

Amendment: 1
Figure: xvii

Spring Harbor Watershed Study
City of Madison

Ponds and Greenways

Parks

4% Annual Chance Inundation

Maximum Water Depth
(Feet)

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 3
- 3 - 6
- 6 - 20

0 275550 1,100 Feet

CITY OF MADISON ENGINEERING

Date: 2/25/2025 User Name: enaab

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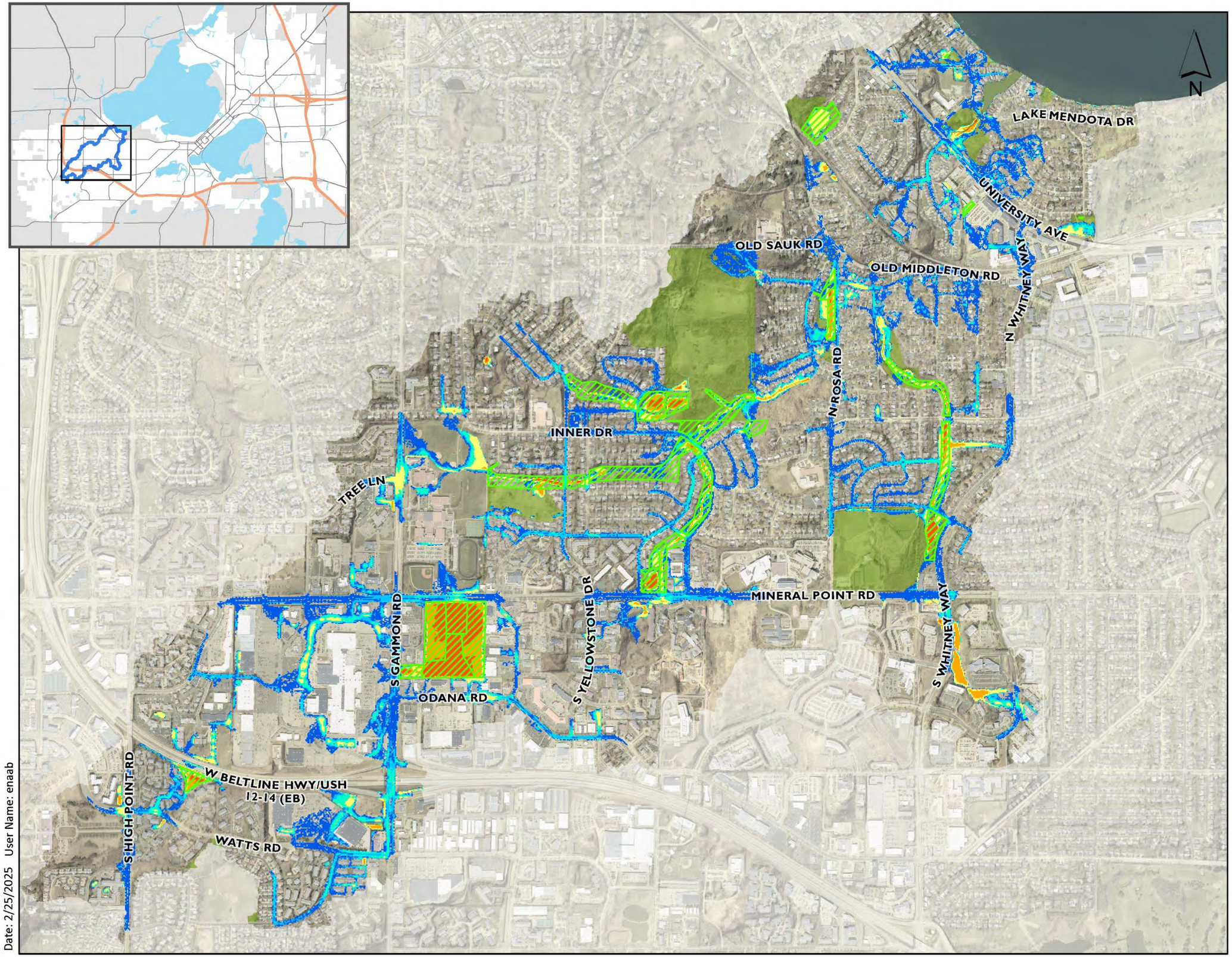
Updated Existing Conditions - 2% Annual Chance Storm Flooding

Amendment: 1
Figure: xviii

Spring Harbor Watershed Study
City of Madison



Ponds and Greenways

Parks

2% Annual Chance Inundation

Maximum Water Depth (Feet)

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 3
- 3 - 6
- 6 - 20

0 275550 1,100 Feet

CITY OF MADISON ENGINEERING

Date: 2/25/2025 User Name: enaab

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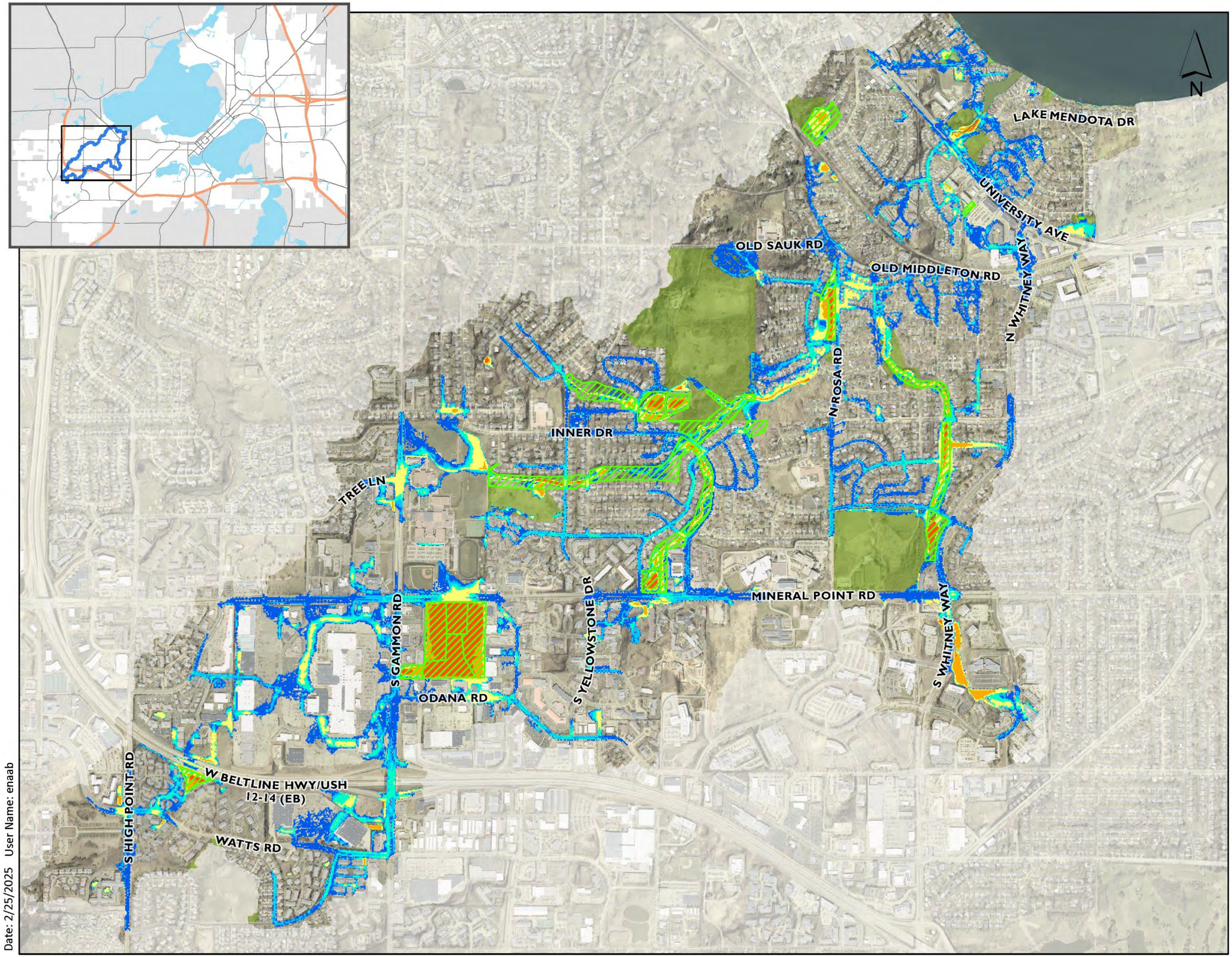
Updated Existing Conditions - 1% Annual Chance Storm Flooding

Amendment: 1
Figure: xix

Spring Harbor Watershed Study
City of Madison



Ponds and Greenways

Parks

%1 Annual Chance Inundation

Maximum Water Depth (Feet)

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 3
- 3 - 6
- 6 - 20

0 275550 1,100 Feet

CITY OF MADISON ENGINEERING

Date: 2/25/2025 User Name: enaab

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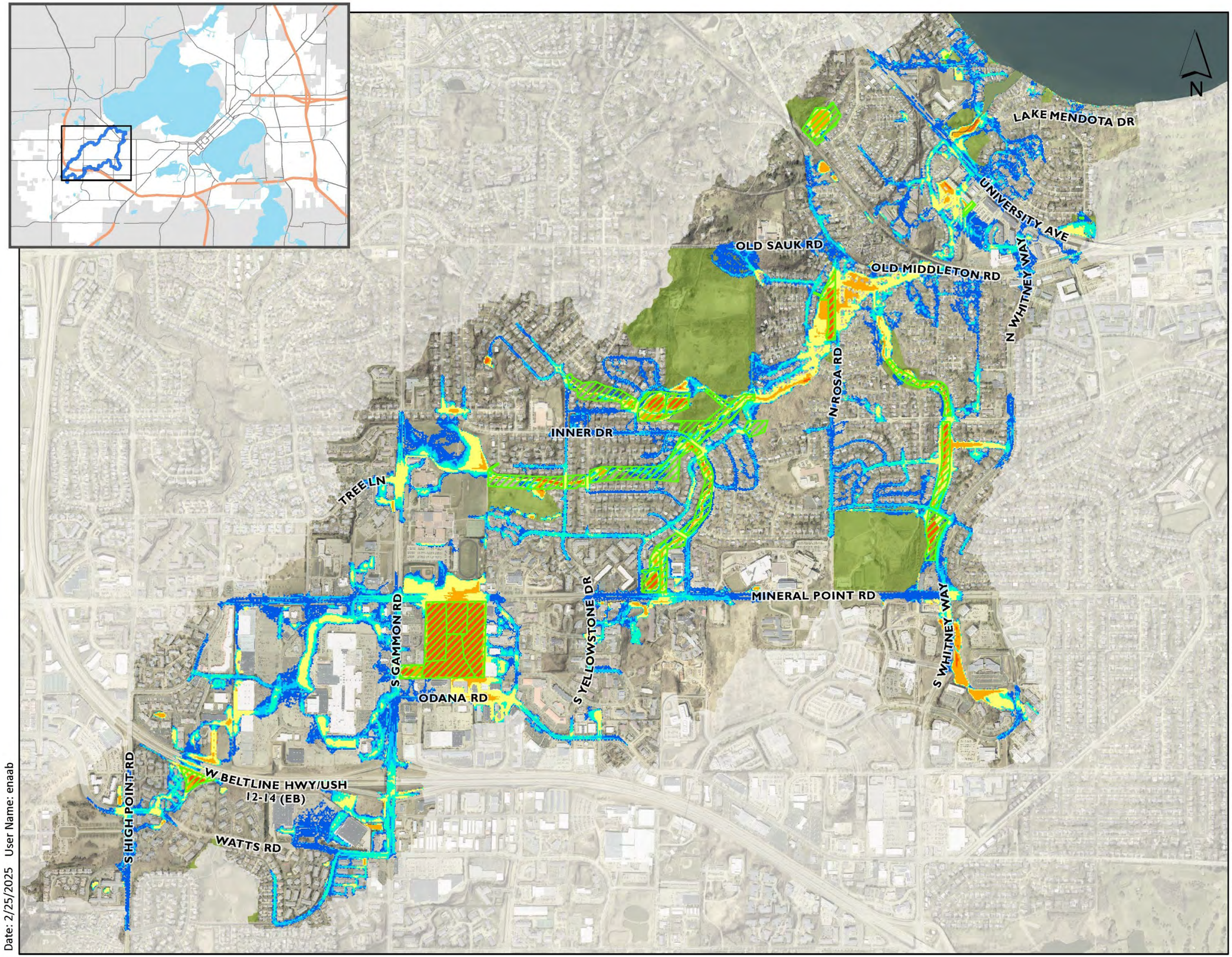
Updated Existing Conditions - 0.2% Annual Chance Storm Flooding

Amendment: 1
Figure: xx

Spring Harbor Watershed Study
City of Madison



Ponds and Greenways

Parks

0.2% Annual Chance Inundation

Maximum Water Depth (Feet)

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 3
- 3 - 6
- 6 - 20

0 275550 1,100 Feet

CITY OF MADISON ENGINEERING

Date: 2/25/2025 User Name: enaab

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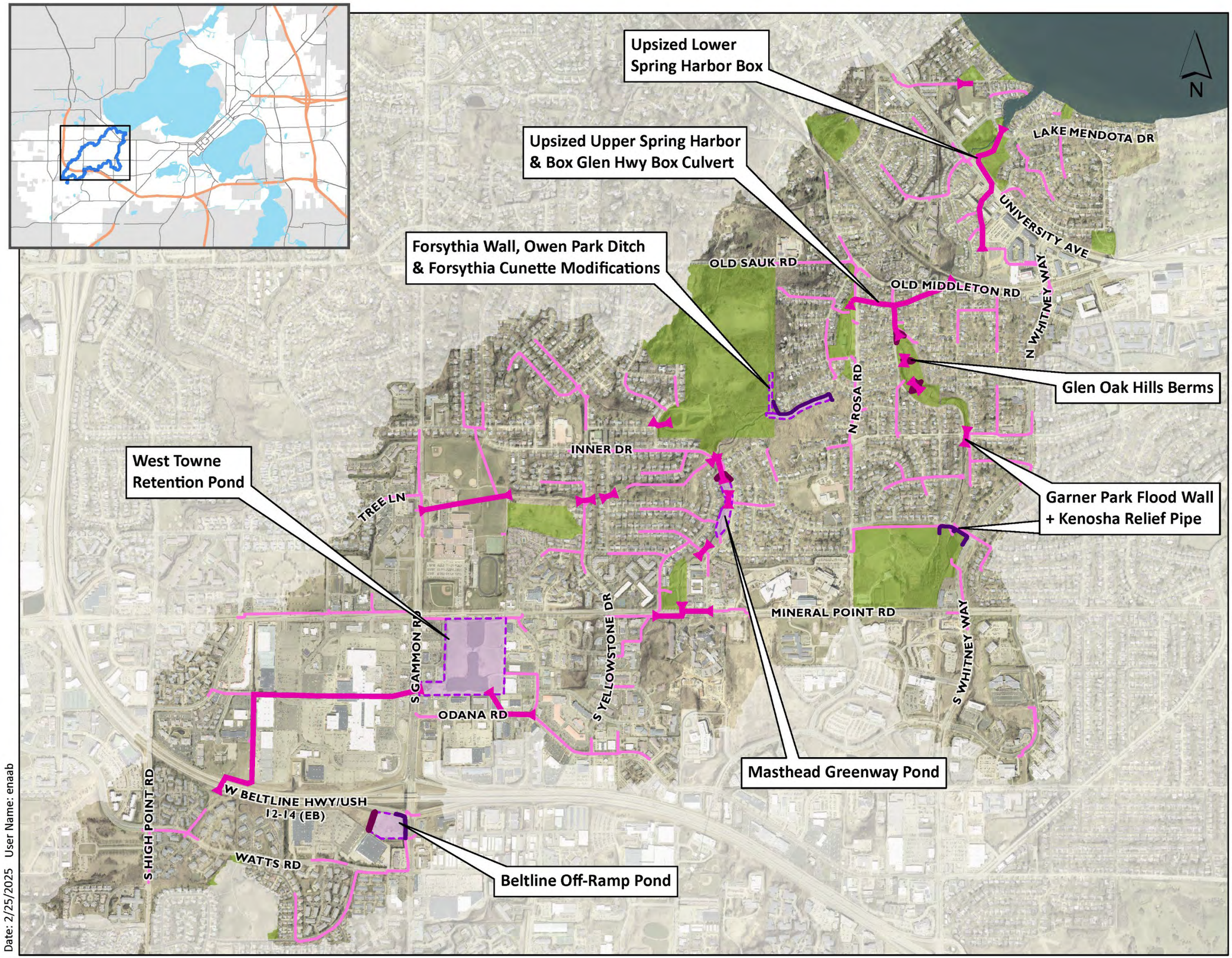
All Recommended Solutions (0-50 yrs)

Amendment: 1
Figure: xxi

Spring Harbor Watershed Study
City of Madison



Proposed Solutions

- Proposed Box
- Proposed Pipes
- Berm
- Floodwall
- Channel; Pond; Other

Other Data

- Parks

0 275550 1,100 Feet

CITY OF MADISON ENGINEERING

Date: 2/25/2025 User Name: enaab

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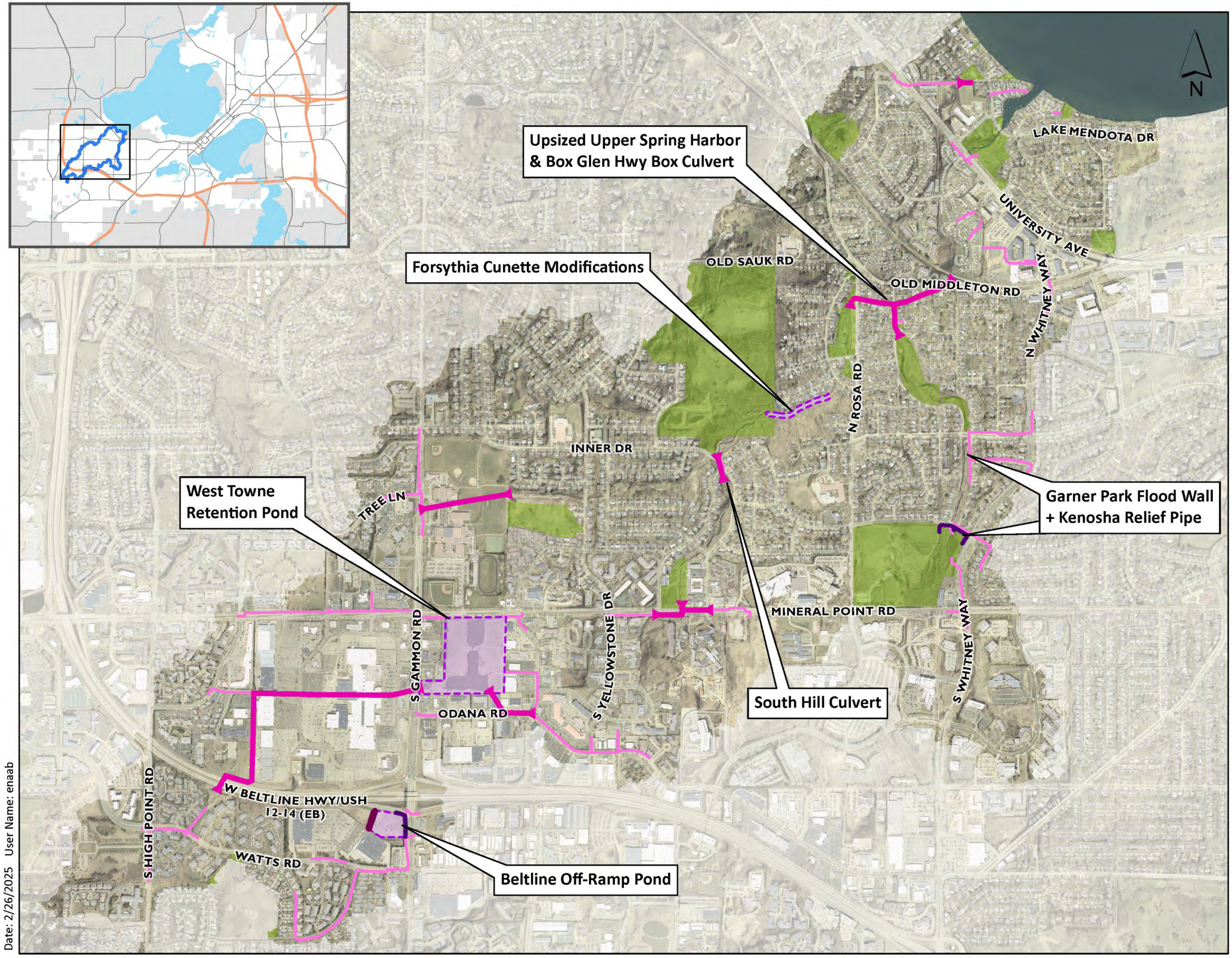
Near-Term Recommended Solutions (0-25 yrs)

Amendment: 1
Figure: xxii

Spring Harbor Watershed Study
City of Madison



Proposed Solutions

- Proposed Box
- Proposed Pipes
- Berm
- Floodwall
- Channel; Pond; Other

Other Data

- Parks

0 275550 1,100 Feet

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Date: 2/26/2025 User Name: enaab

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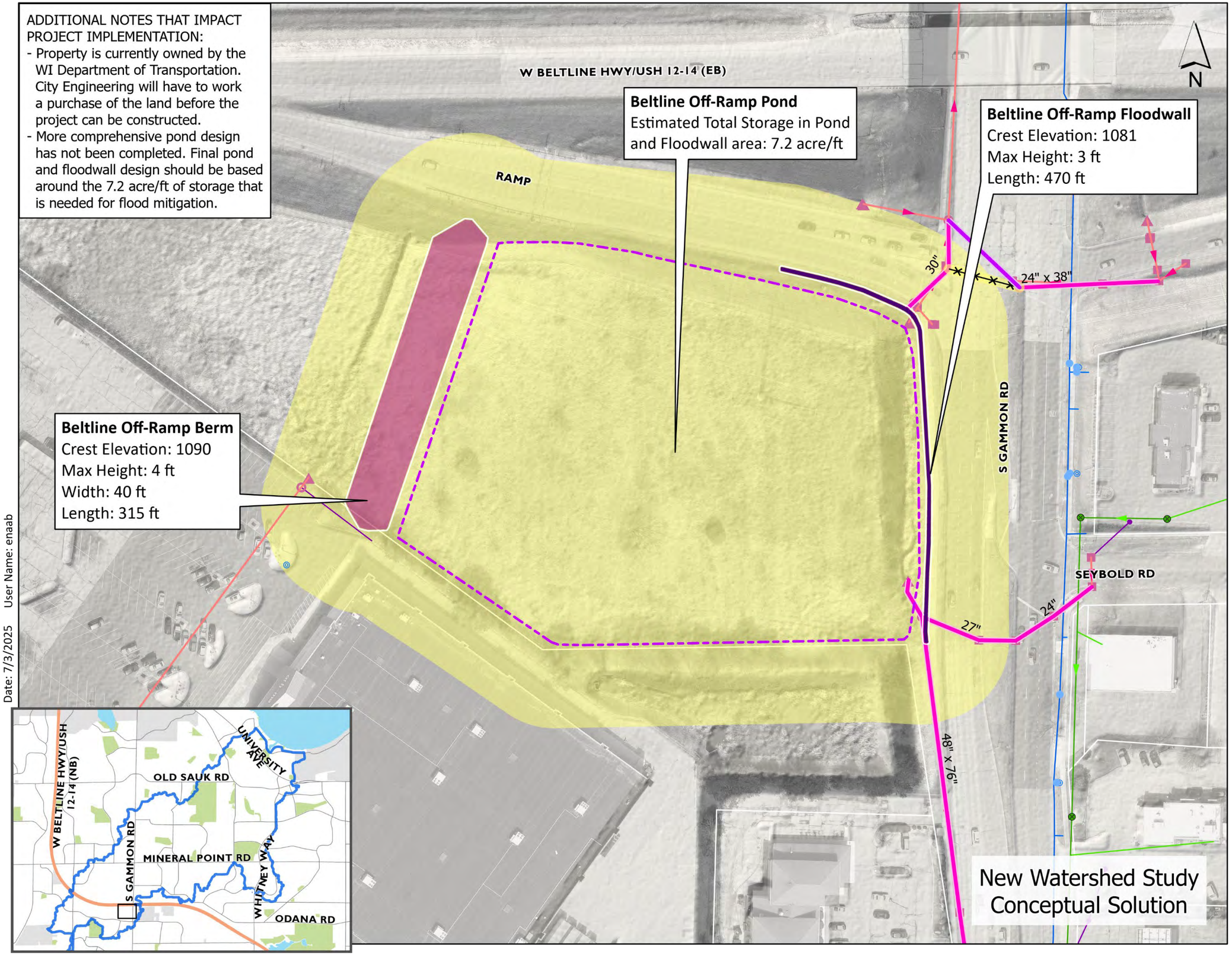
Near-Term Solution- Beltline Off-Ramp Pond & Berm

Amendment: 1
Figure: xxiii

Spring Harbor Watershed Study
City of Madison

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
- Property is currently owned by the WI Department of Transportation. City Engineering will have to work a purchase of the land before the project can be constructed.
- More comprehensive pond design has not been completed. Final pond and floodwall design should be based around the 7.2 acre/ft of storage that is needed for flood mitigation.



Date: 7/3/2025 User Name: enaab

Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
- Ponds and Greenways
- Parks
- Railroads
- Park Paths

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 15 30 60 Feet

CITY OF MADISON ENGINEERING

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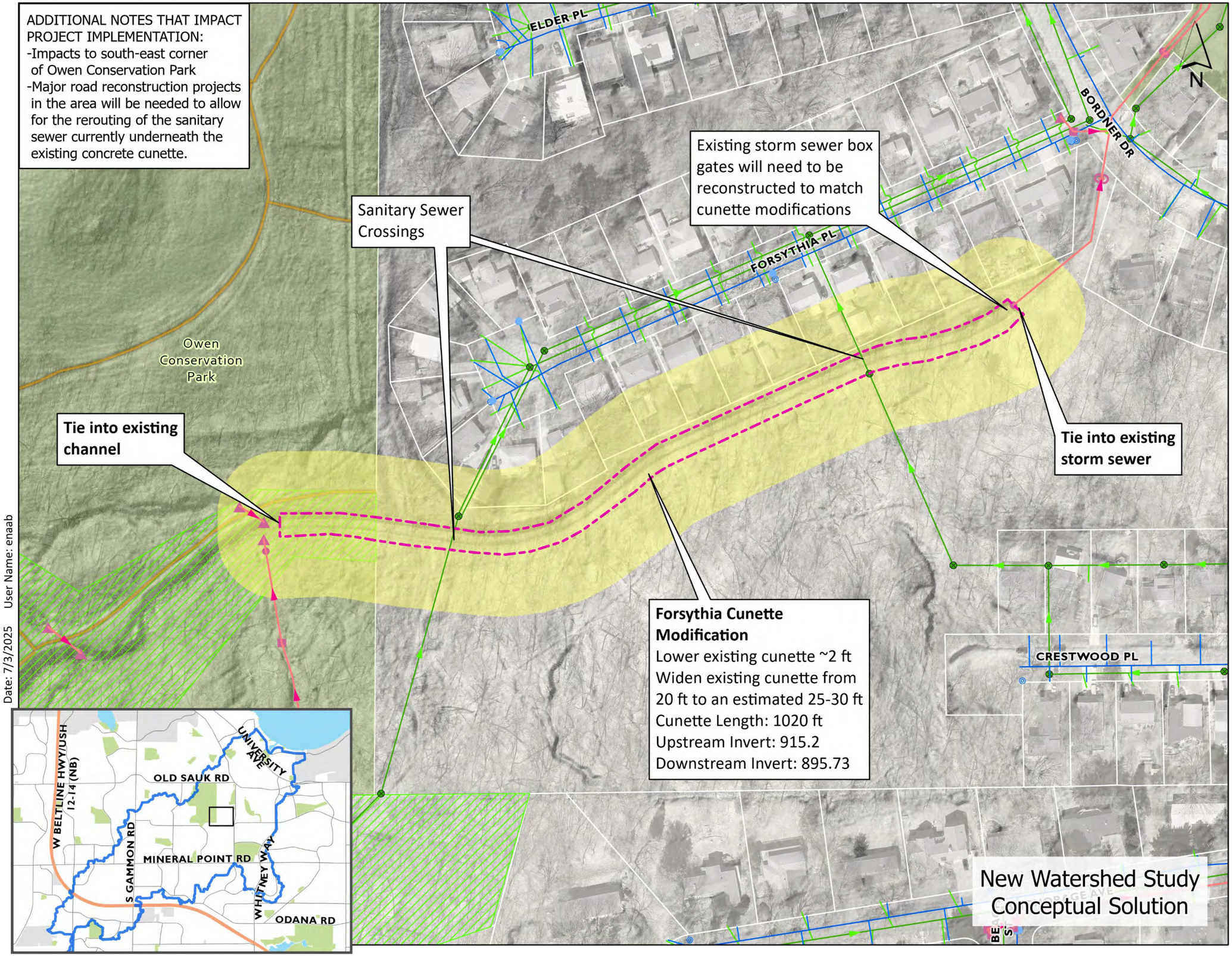
Near-Term Solution - Forsythia Cunette Modifications

Amendment: 1
Figure: xxiv

Spring Harbor Watershed Study
City of Madison



Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
- Ponds and Greenways
- Parks
- Railroads
- Park Paths

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 25 50 100 Feet

CITY OF MADISON ENGINEERING

User Name: enaab
Date: 7/3/2025

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Near-Term Solution - Garner Park Flood Wall & Kenosha Relief Pipe

Amendment: 1
Figure: xxv

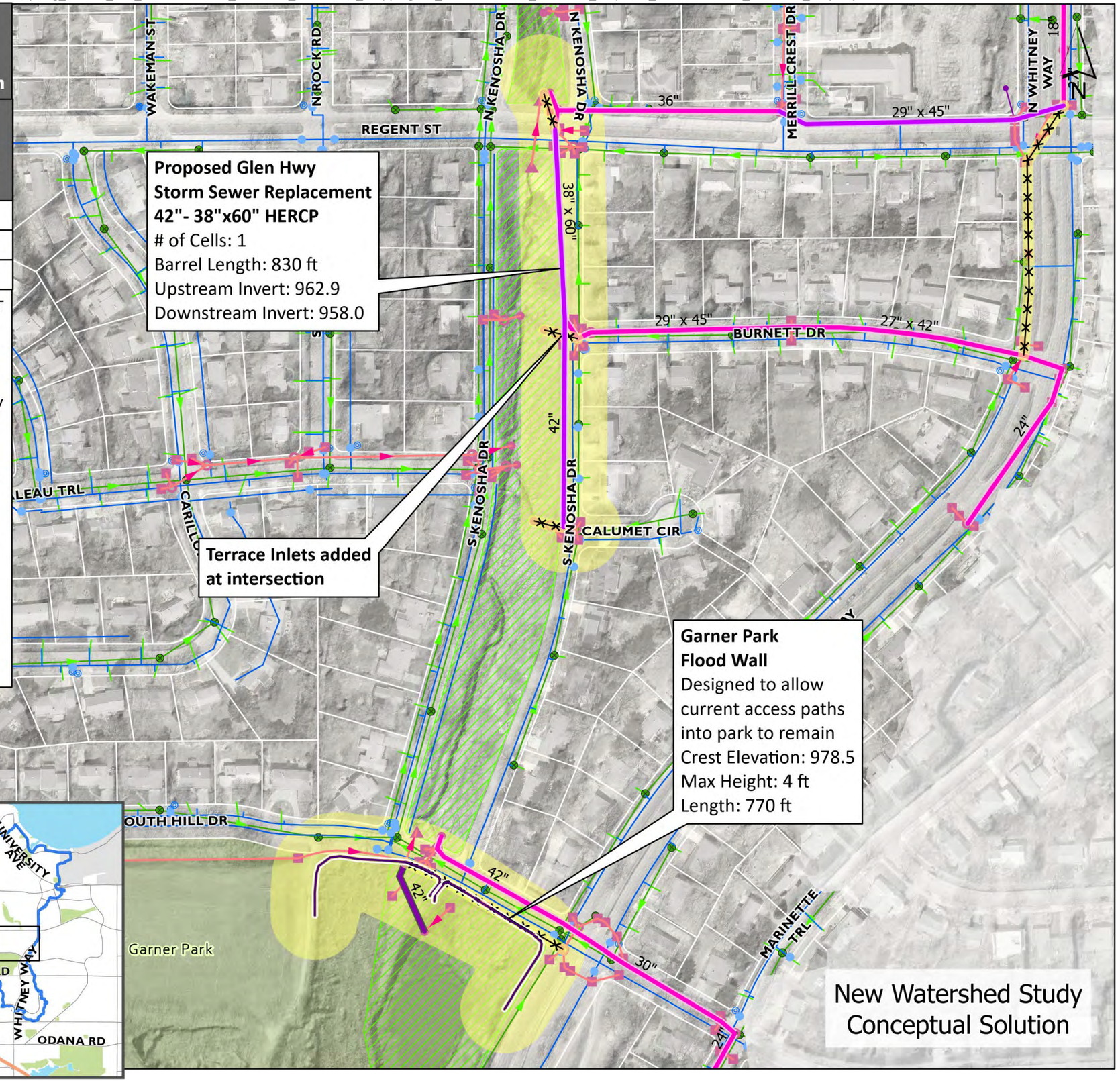
Spring Harbor Watershed Study
City of Madison

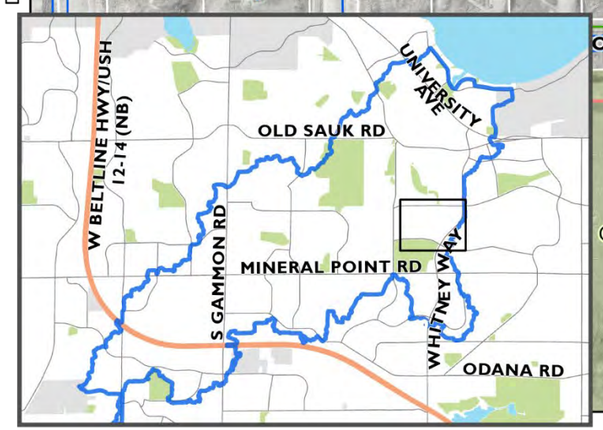
Additional time that stormwater will be held the Garner Pond Area during a certain percent chance storm

Annual Percent Chance Event	Additional Flooded Duration in Pond Area
1%	3.5 hours
10%	1.5 hours
50%	30 mins

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
- -Impacts to north-east corner of Garner Park and to Garner Pond
- -Wellhead protection zone
- -Coordination with the Water Utility and future Water Utility well site needed to construct project
- -We do not anticipate impacts to trees from the additional time the area will experience flooding, see table above

NEW CONCEPTUAL SOLUTION IS AN ALTERNATIVE TO GRADING THE KENOSHA GREENWAY
- -Addresses community desire to preserve the wooded Kenosha greenway that volunteers have been actively managing by removing invasives since 2020





Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
- Ponds and Greenways
- Parks
- Railroads
- Park Paths

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 40 80 160 Feet

CITY OF MADISON ENGINEERING

User Name: enaab
Date: 7/3/2025

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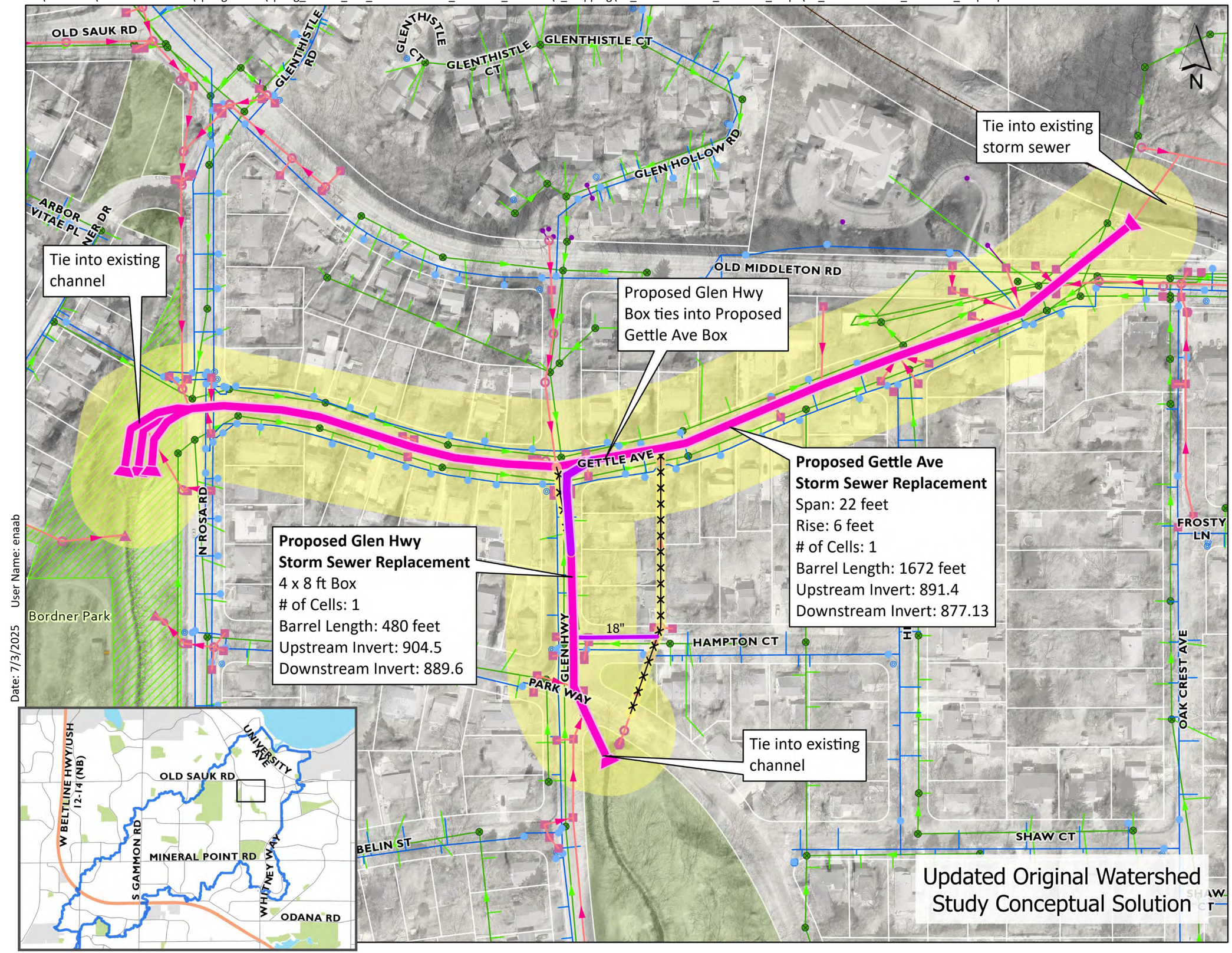
Near-Term Solution - Upsized Upper Spring Harbor Box & Glen Hwy Box

Amendment: 1
Figure: xxvi

Spring Harbor Watershed Study
City of Madison



Date: 7/3/2025 User Name: enaab

Recommended Solutions

- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data

- Ponds and Greenways
- Parks
- Railroads

Storm Sewer

- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities

- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 25 50 100 Feet

CITY OF MADISON ENGINEERING

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Near-Term Solution - West Towne Retention Pond

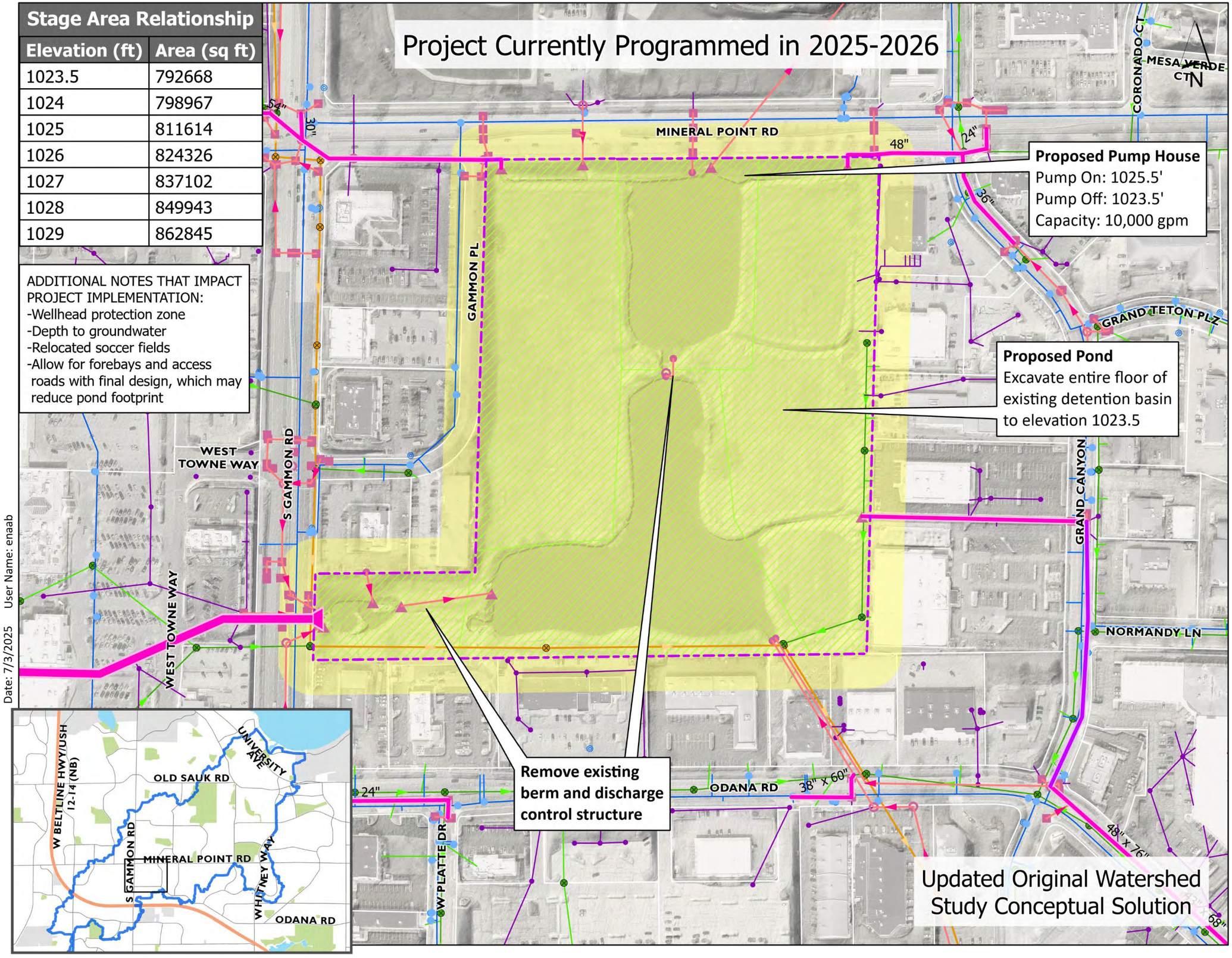
Amendment: 1
Figure: xxvii

Spring Harbor Watershed Study
City of Madison

Stage Area Relationship

Elevation (ft)	Area (sq ft)
1023.5	792668
1024	798967
1025	811614
1026	824326
1027	837102
1028	849943
1029	862845

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
-Wellhead protection zone
-Depth to groundwater
-Relocated soccer fields
-Allow for forebays and access roads with final design, which may reduce pond footprint



Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
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- Parks
- Railroads

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 40 80 160 Feet

CITY OF MADISON ENGINEERING

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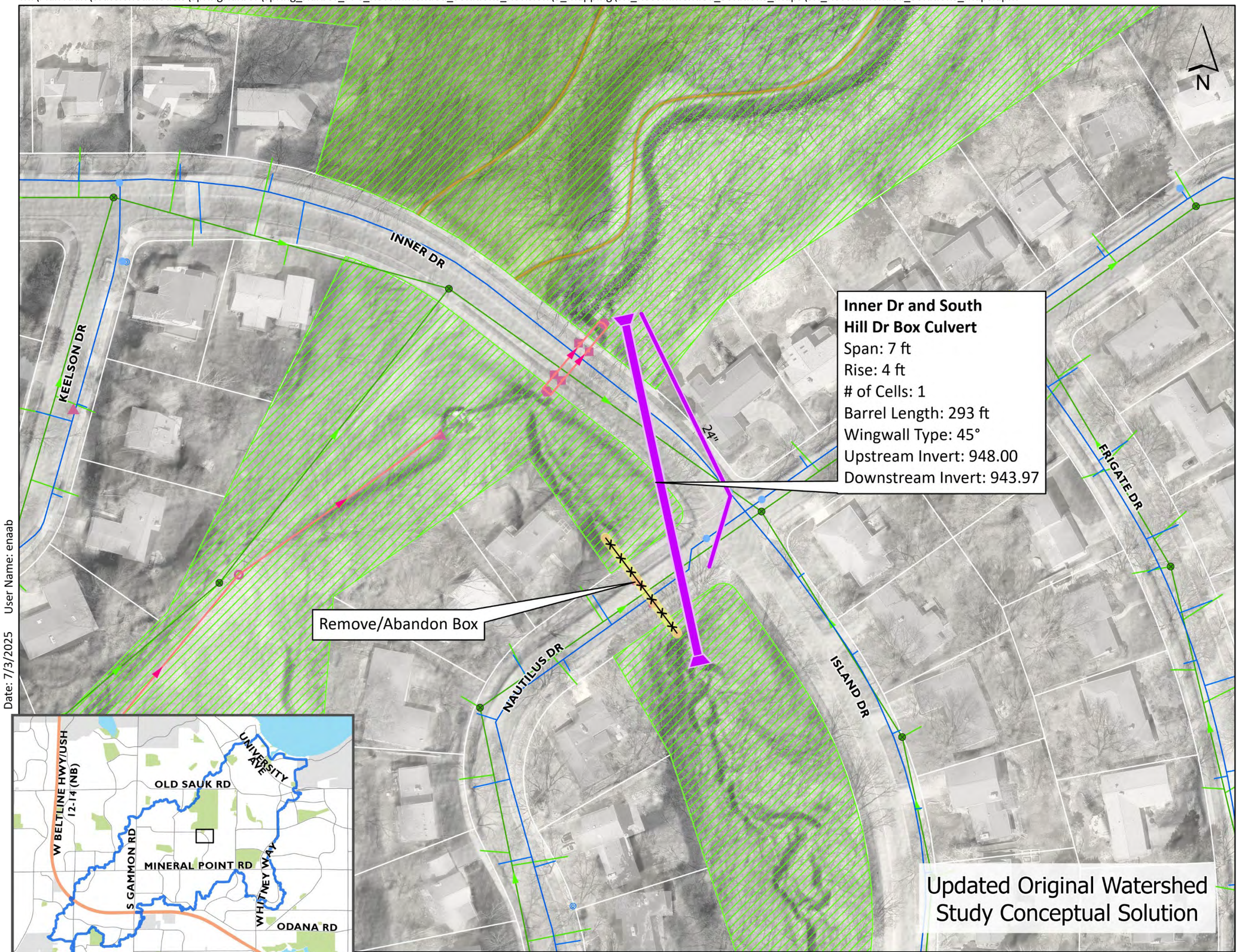
Near-Term Solution- Inner Dr and South Hill Dr Box Culvert

Amendment: 1
Figure: xxviii

Spring Harbor Watershed Study
City of Madison



User Name: enaab

Date: 7/3/2025

Recommended Solutions

- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data

- Ponds and Greenways
- Parks
- Railroads
- Park Paths

Storm Sewer

- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities

- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 15 30 60 Feet

CITY OF MADISON ENGINEERING

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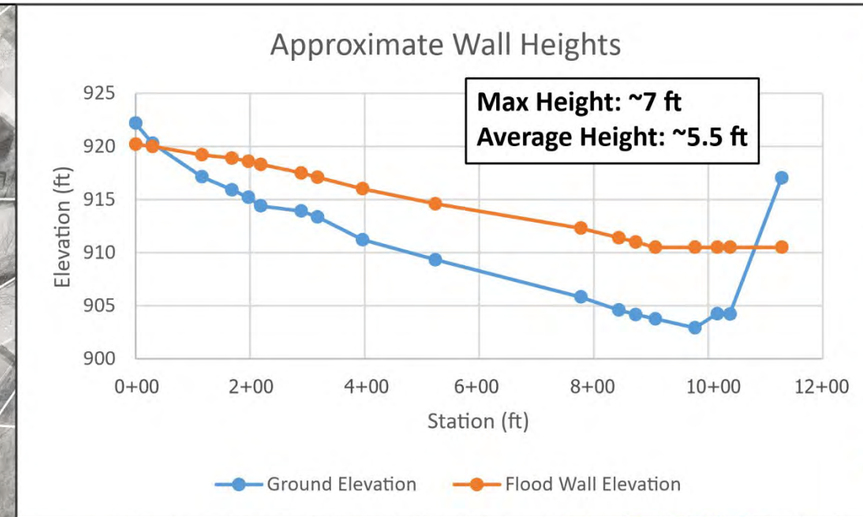
Future Hypothetical Solution - Forsythia Wall & Owen Park Ditch

Amendment: 1
Figure: xxix

Spring Harbor Watershed Study
City of Madison

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
- Access / removable floodwall section needed near gate / connection with existing box
- Sanitary depth relative to footing depth / design
- Floodwall height / overturning stability
- Impacts to north-east corner of southeast corner of Owen Park
- Coordination needed on impacts to existing walking paths within Owen Conservation Park and on Crestwood Neighborhood land
- Design to consider drainage on north side of wall, which may include piping downspouts through wall with backflow preventers or a drainage pipe to Bordner Park via Bordner Drive
- Construction of Modified Forsythia Cunette required for solution to meet flood mitigation targets



Owen Conservation Park

Proposed Owen Park Ditch

FORSYTHIA PL

BORDNER DR

42"

34" X 53"

N

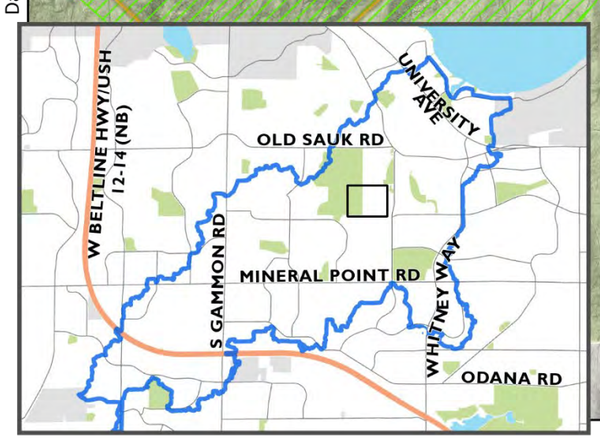
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00
11+00
11+30

Proposed Forsythia Flood Wall
Wall height updated to be about 3 ft lower than the floodwall proposed in the original watershed study.
New Max Height: ~7ft
Length: ~1,130 ft

CRESTWOOD PL

Near-Term Proposed Solution
Forsythia Cunette Modification

Updated Original Watershed Study Conceptual Solution



Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
- Ponds and Greenways
- Parks
- Railroads
- Park Paths

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 20 40 80 Feet

CITY OF MADISON ENGINEERING

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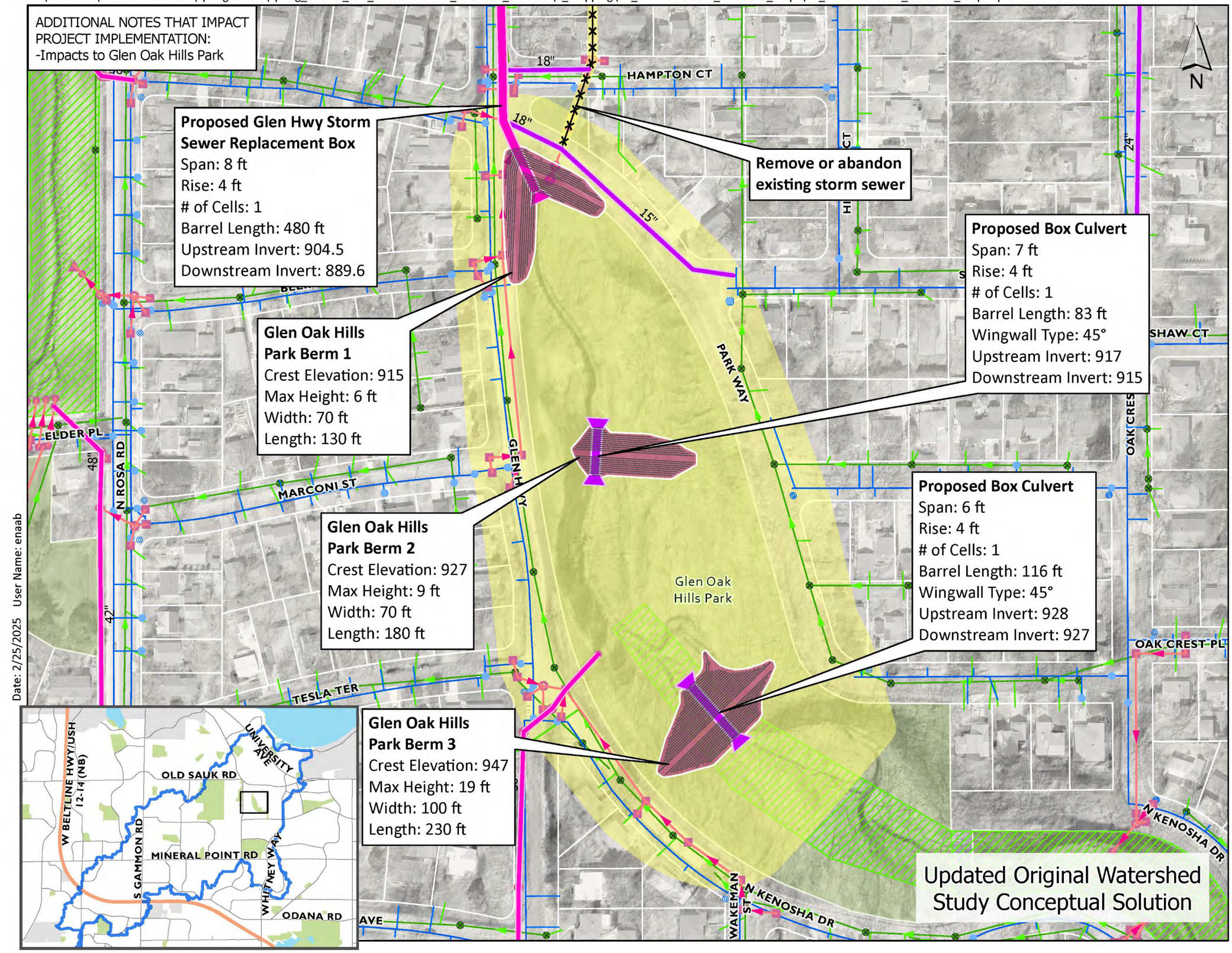
Future Hypothetical Solution - Glen Oak Hills Berms

Amendment: 1
Figure: xxx

Spring Harbor Watershed Study
City of Madison



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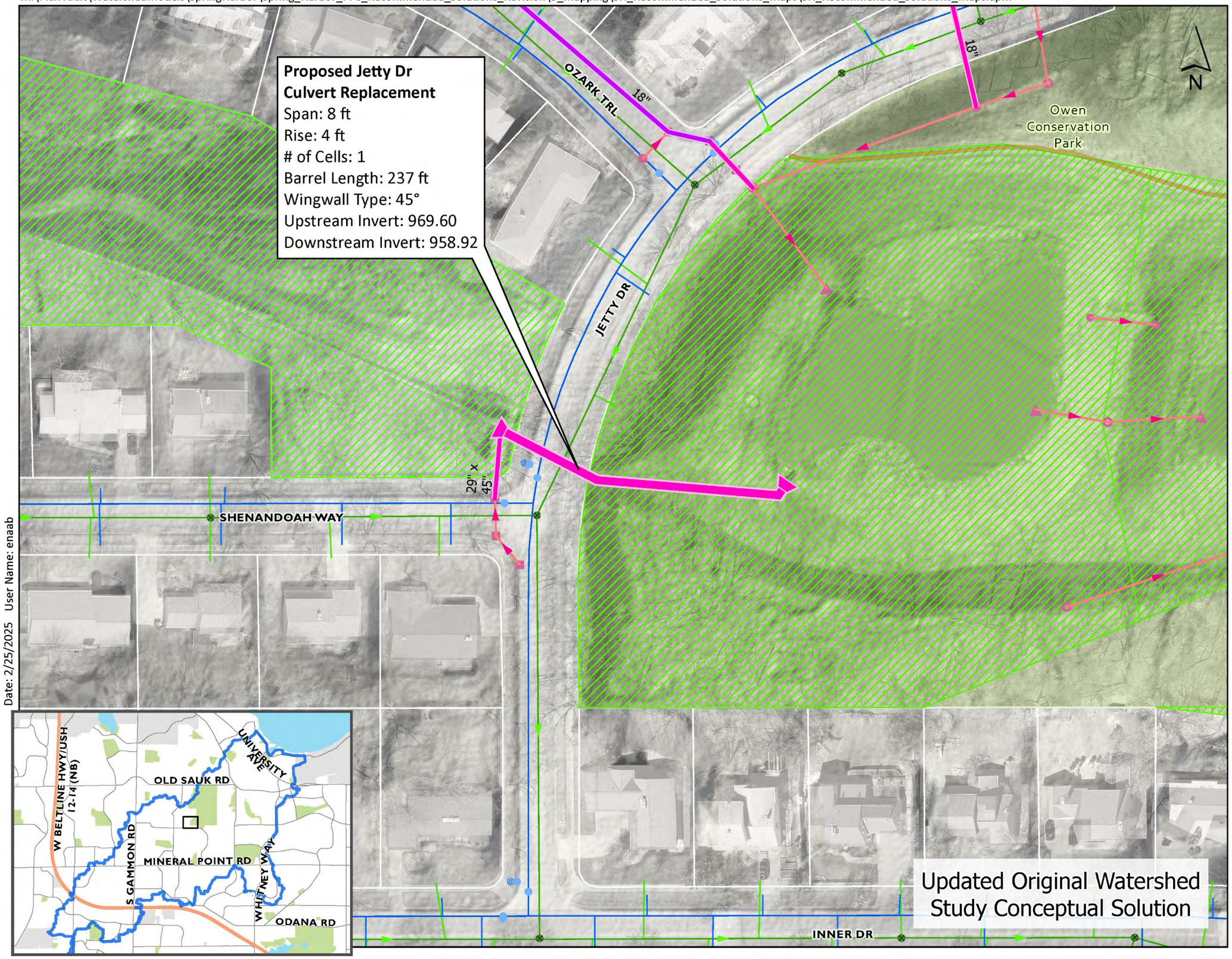

Future Hypothetical Solution - Jetty Box Culvert

Amendment: 1
Figure: xxxi

Spring Harbor Watershed Study
City of Madison

Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
- Ponds and Greenways
- Parks
- Railroads
- Park Paths

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 15 30 60 Feet

CITY OF MADISON ENGINEERING

Date: 2/25/2025 User Name: enaab

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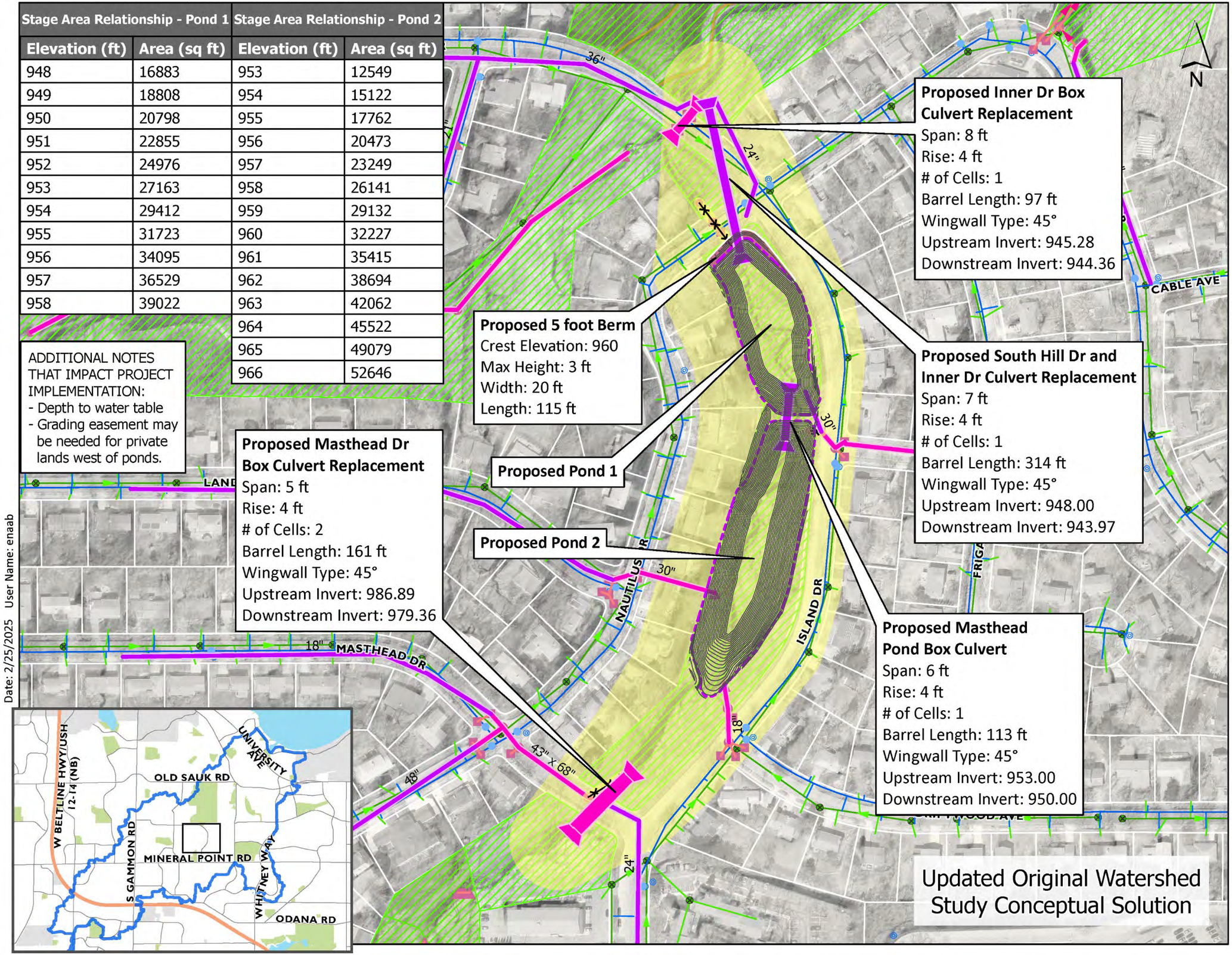
Future Hypothetical Solution - Masthead Greenway Pond

Amendment: 1
Figure: xxxii

Spring Harbor Watershed Study
City of Madison

Stage Area Relationship - Pond 1		Stage Area Relationship - Pond 2	
Elevation (ft)	Area (sq ft)	Elevation (ft)	Area (sq ft)
948	16883	953	12549
949	18808	954	15122
950	20798	955	17762
951	22855	956	20473
952	24976	957	23249
953	27163	958	26141
954	29412	959	29132
955	31723	960	32227
956	34095	961	35415
957	36529	962	38694
958	39022	963	42062
		964	45522
		965	49079
		966	52646

ADDITIONAL NOTES THAT IMPACT PROJECT IMPLEMENTATION:
- Depth to water table
- Grading easement may be needed for private lands west of ponds.



Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
- Ponds and Greenways
- Parks
- Railroads
- Park Paths

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 37.575 150 Feet

CITY OF MADISON ENGINEERING

Date: 2/25/2025 User Name: enaab

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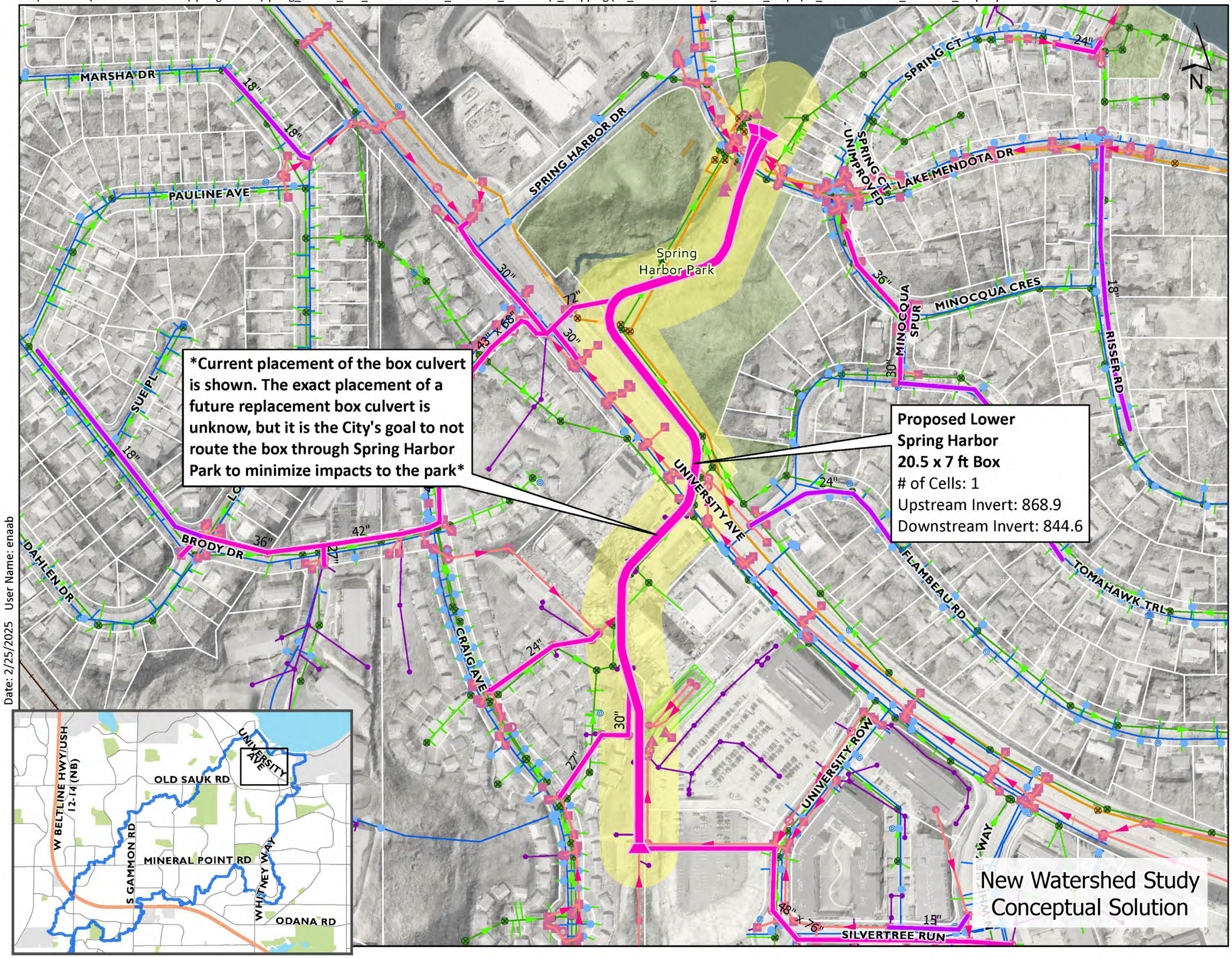
Future Hypothetical Solution - Upsized Lower Spring Harbor Box

Amendment: 1
Figure: xxxiii

Spring Harbor Watershed Study
City of Madison



Date: 2/25/2025 User Name: enaab

Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
- Ponds and Greenways
- Parks
- Railroads
- Park Paths

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 45 90 180 Feet

CITY OF MADISON ENGINEERING

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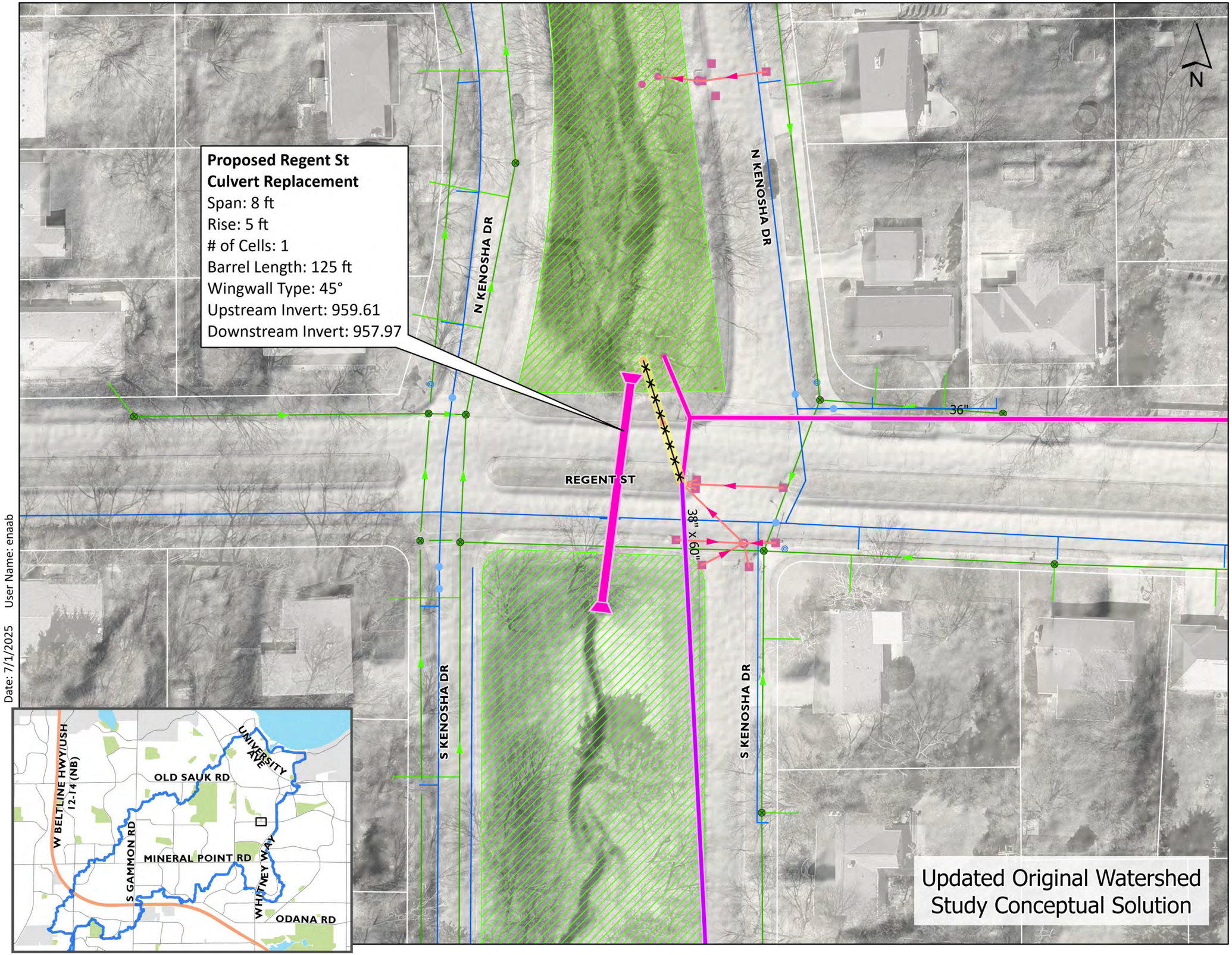
Future Hypothetical Solution - Regent Box Culvert

Amendment: 1
Figure: xxxiv

Spring Harbor Watershed Study
City of Madison



Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
- Ponds and Greenways
- Parks
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- Park Paths

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 10 20 40 Feet

CITY OF MADISON ENGINEERING

Date: 7/1/2025 User Name: enaab

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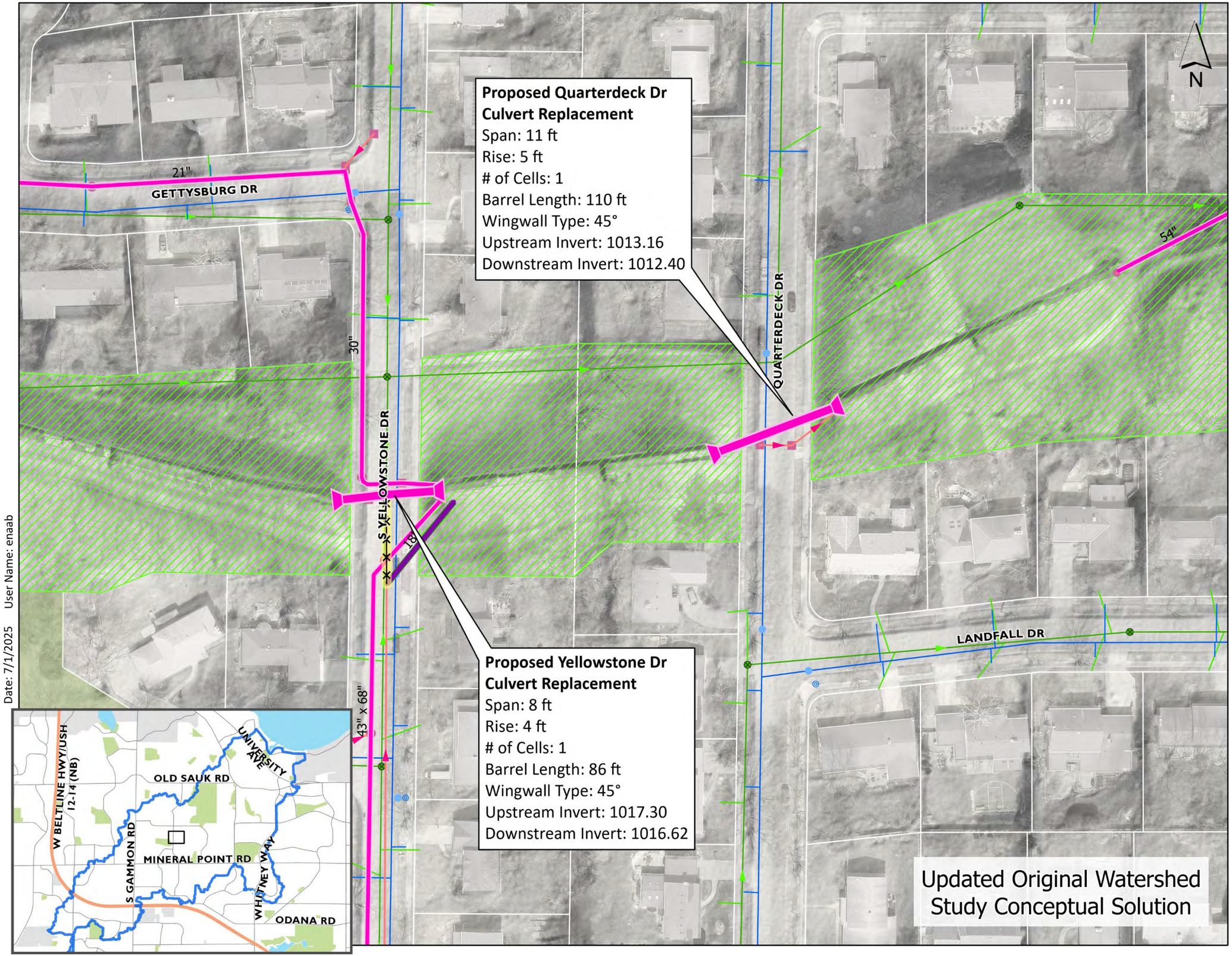
Future Hypothetical Solution - Yellowstone and Quarterdeck Box Culverts

Amendment: 1
Figure: xxxv

Spring Harbor Watershed Study
City of Madison



Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
- Ponds and Greenways
- Parks
- Railroads
- Park Paths

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 15 30 60 Feet

CITY OF MADISON ENGINEERING

Date: 7/1/2025 User Name: enaab

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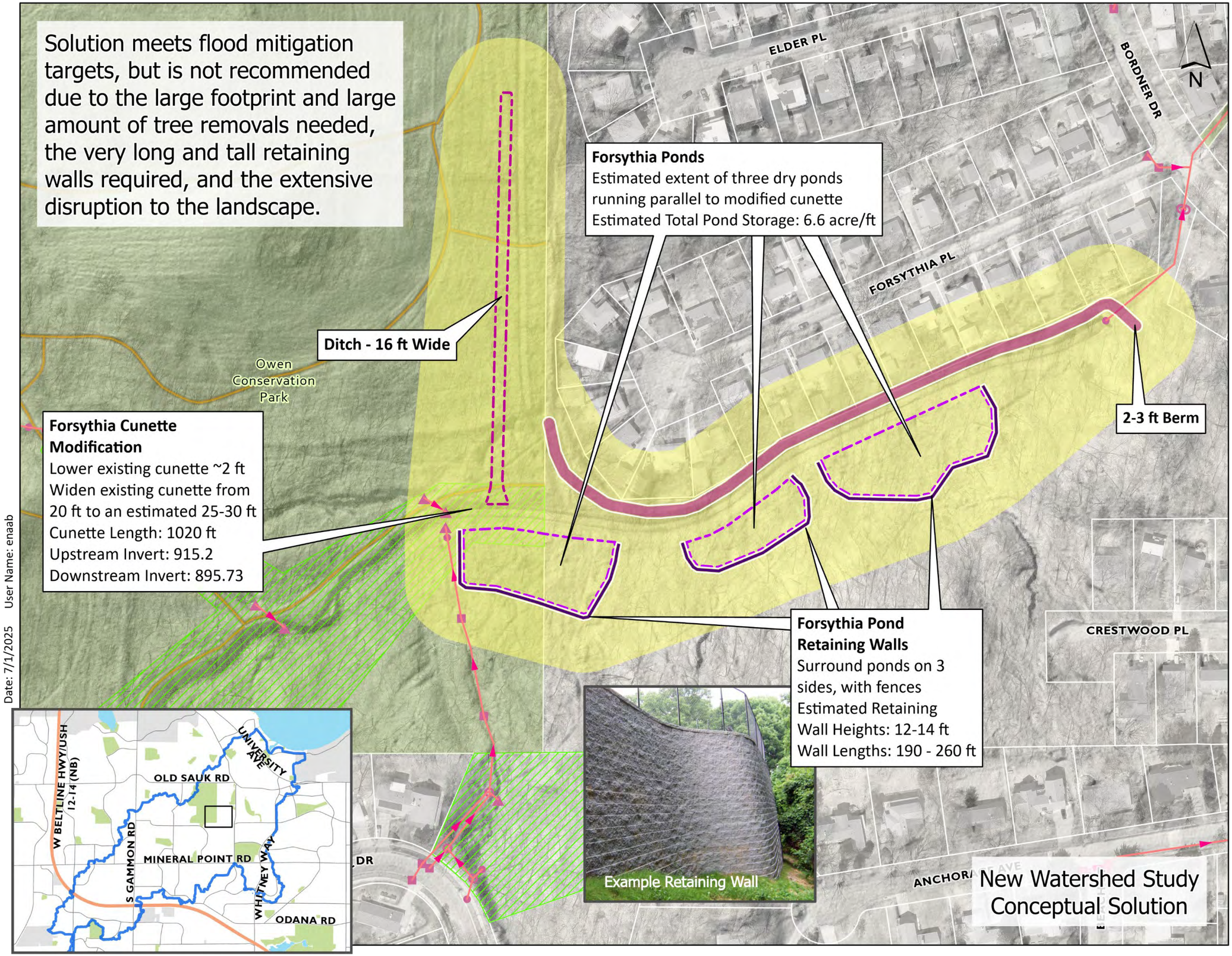

Not Recommended - Forsythia Pond

Amendment: 1
Figure: xxxvi

Spring Harbor Watershed Study
City of Madison

Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
- Ponds and Greenways
- Parks
- Railroads
- Park Paths

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 25 50 100 Feet

CITY OF MADISON ENGINEERING

User Name: enaab

Date: 7/1/2025

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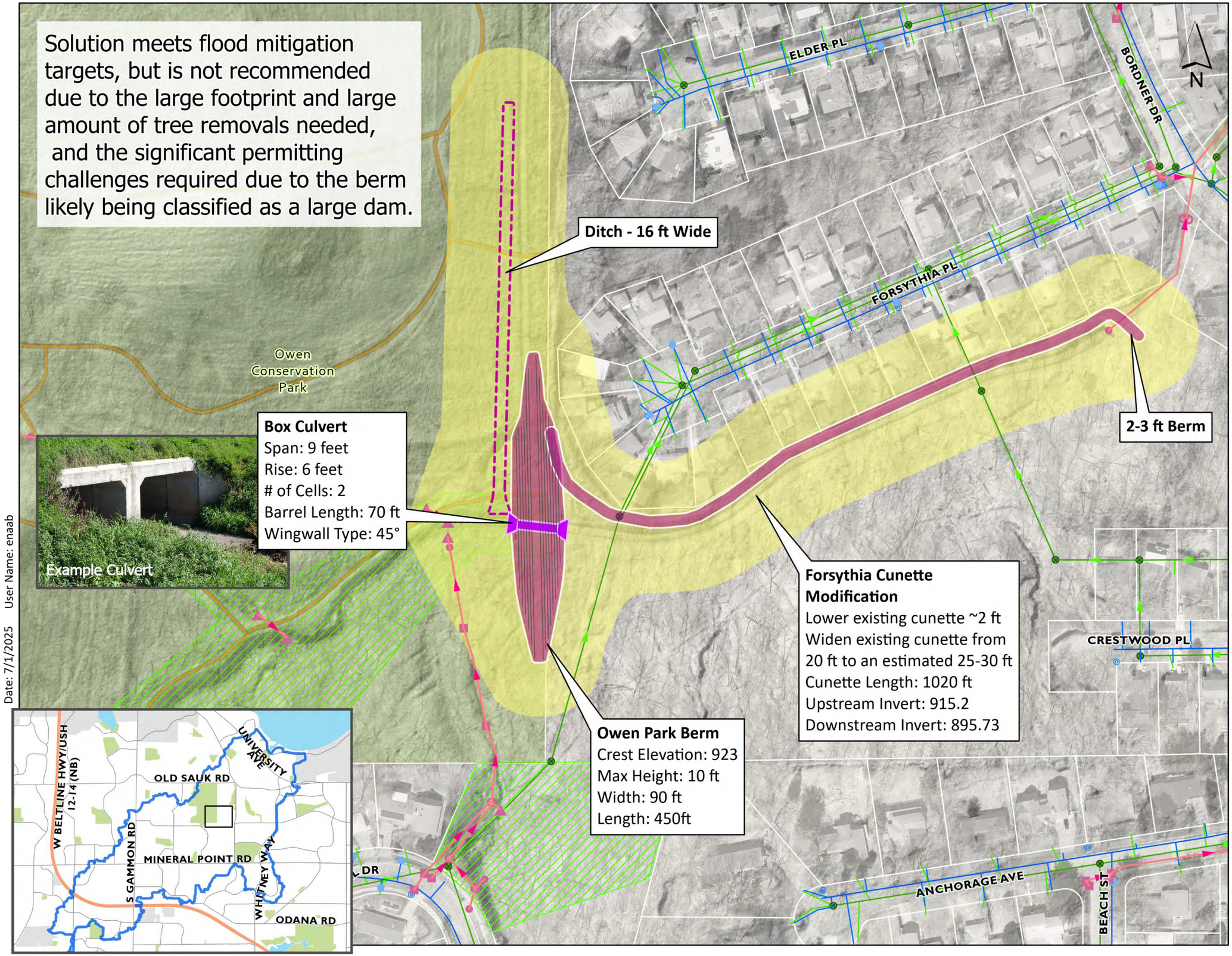

Not Recommended - Forsythia Berm

Amendment: 1
Figure: xxxvii

Spring Harbor Watershed Study
City of Madison

Recommended Solutions
- New Box
- Parallel Box
- Removal Box
- Special Box
- Upsize Box
- New Pipe
- Parallel Pipe
- Removal Pipe
- Special Pipe
- Upsize Pipe
- Channel
- Pond
- Berm
- Floodwall
- Other
- 1' Project Contour
- Project Area of Interest

Other Data
- Ponds and Greenways
- Parks
- Railroads
- Park Paths

Storm Sewer
- Storm Pipe
- Inlet
- Headwall
- Other
- Apron End
- Access Structures
- Storm_Lift_Stations
- PVT Storm Structure -Approx.
- PVT Storm Pipe -Approx.

Other Utilities
- Water Value
- Water Main
- Water Service
- Water Hydrant
- SAS
- Sanitary Main
- Sanitary Lateral
- MMSD SAS
- MMSD Main

0 25 50 100 Feet

CITY OF MADISON ENGINEERING

User Name: enaab

Date: 7/1/2025

Appendix P – Comments & Questions from the Watershed Study Amendment 1 Comment Period

Public Comments and Questions from the Spring Harbor Watershed Study Report Amendment Comment Period

Following the completion of the Amendment to the Spring Harbor Watershed Study Report, the City held a Public Comment Period from February 28, 2025 - March 30th, 2025 asking residents to provide feedback through survey which posed specific questions and allowed open-ended comments. The City received 4 responses through the survey. Additionally, the City received several comments and questions through email. All those questions and comments are organized below with responses from the City.

Comments/Questions and City Responses

Question/Comment:

"*Would the WCHA have any say in the Forsythia flood wall or would the easement allow for the city to do what it wants?"*

City Response:

The flood wall is considered as part of the Future Hypothetical Solutions. The hypothetical projects presented are being used to demonstrate the size and type of project that would be needed at a certain location. These projects will be reevaluated, and public input collected as different opportunities become available in the watershed. The WCHA will be able to provide input on the flood wall. You can learn more about conceptual projects here: Conceptual Projects that Come From the Watershed Studies

Question/Comment:

"[the Amendment] said [the City] lowered the size of the Forsythia wall but it looks the same to me."

Similar Question:

"*The new plans say the Forsythia flood wall would be smaller but in image xxix it shows the same height of the previous report in figure 27. Is that correct or are there different heights to be updated?"*

City Response:

You are correct that there was a typo on the figure. This figure was updated in the final report, and now shows that the updated conceptual solution for the flood wall will be 7 ft high, whereas the previous solution showed a max height of 10 ft.

Question/Comment:

"In 2021 when you attended our annual meeting you mentioned expanding The cunette south into the woods wasn't an option, does that mean expanding the cunette in the new plans only expands it towards the properties to the north? Or would it be expanded on both sides?"

Similar Question/Comment:

"How can [the City] widen the cunette? They mentioned it wasn't possible bc of the woods?"

City Response:

The original study assumed that the sanitary sewer underneath the cunette could not be relocated, and with that assumption the cunette would need to be widened significantly into the woods to reduce flooding. Due to the steep slopes south of the cunette, there would need to be significant grading, and likely a retaining wall, which we determined would be too large of an impact on the overall wooded area.

During the additional modeling process, the City collected more detailed information on the sanitary sewer and completed a more thorough analysis of how the cunette modifications impacted that system. We found that the sanitary sewer could be re-routed from underneath the cunette, which allows the cunette to be lowered. The model showed that a very moderate expansion of the cunette, widening about 5 to 10 feet, was helpful in the Near-Term Solutions where upstream culverts are not upsized. The stormwater model is not detailed enough to show where the specific expansion of the cunette would need to be, but the City's assumption is that most of the expansion would be to the south.

Question/Comment:

"*If expanding the cunette is only to the north towards the properties would that ruin our walking paths? These are well loved and used paths.*"

City Response:

The City has noted that the walking paths are important and during the design process, the City would explore how the paths could be preserved.

Question/Comment:

"*Does the WCHA have any say in the changes made to the cunette or does the easement make it so the city can do what it wants without approval?"*

City Response:

The City would seek input from WCHA during the design process of any project occurring within the easement. You can learn more about conceptual projects here: Conceptual Projects that Come From the Watershed Studies.

Question/Comment:

"The Forsythia concrete channel needs a larger exit grating to lessen blockage by debris. The Forsythia "Great Wall" is opposed by the Crestwood neighborhood. Instead the north side of the Owen Park section of the stream could be built up and a detention pond could be dug on the south side of the Owen Park stream for overflow and for the South Hill runoff.

Similar Question/Comment:

"I also wonder if you ever modeled creating a new large detention pond upstream of the Forsythia cunette? After listening carefully to your presentations I understand that there is a choke point at the cunette which makes the flood wall necessary. I wonder if building a big detention pond in the area before the cunette would help in managing flood water before it reached the cunette.

The area upstream of the cunette is Owen Park property. The homes to the south are up on a hill and the area north is in Owen Park. I can imagine a berm or flood wall that would retain water and have an outlet that would only let a manageable amount of water into the cunette. This solution would eliminate the need to rebuild the cunette which necessitates moving the sewer and rebuilding streets, etc. which may be more cost effective. Might this work?"

City Response:

In addition to the Forsythia Wall, two alternative future hypothetical solutions for the Owen Park/Forsythia Pl area were evaluated during the modeling completed for the Amendment. Details on these can be found in section 5.2 of the Amendment.

Additionally, upon the request of residents, the City completed an additional analysis, following the completion of the Amendment. Using a footprint provided by residents, the City worked to address questions regarding the viability of a detention pond in Owen Park upstream of the cunette near Forsythia Pl. For several reasons this option is not viable due to the pond size necessary to meet the flood targets and for the topographical constraints of the site. The City's technical response summarizing the results of that analysis can be found below:

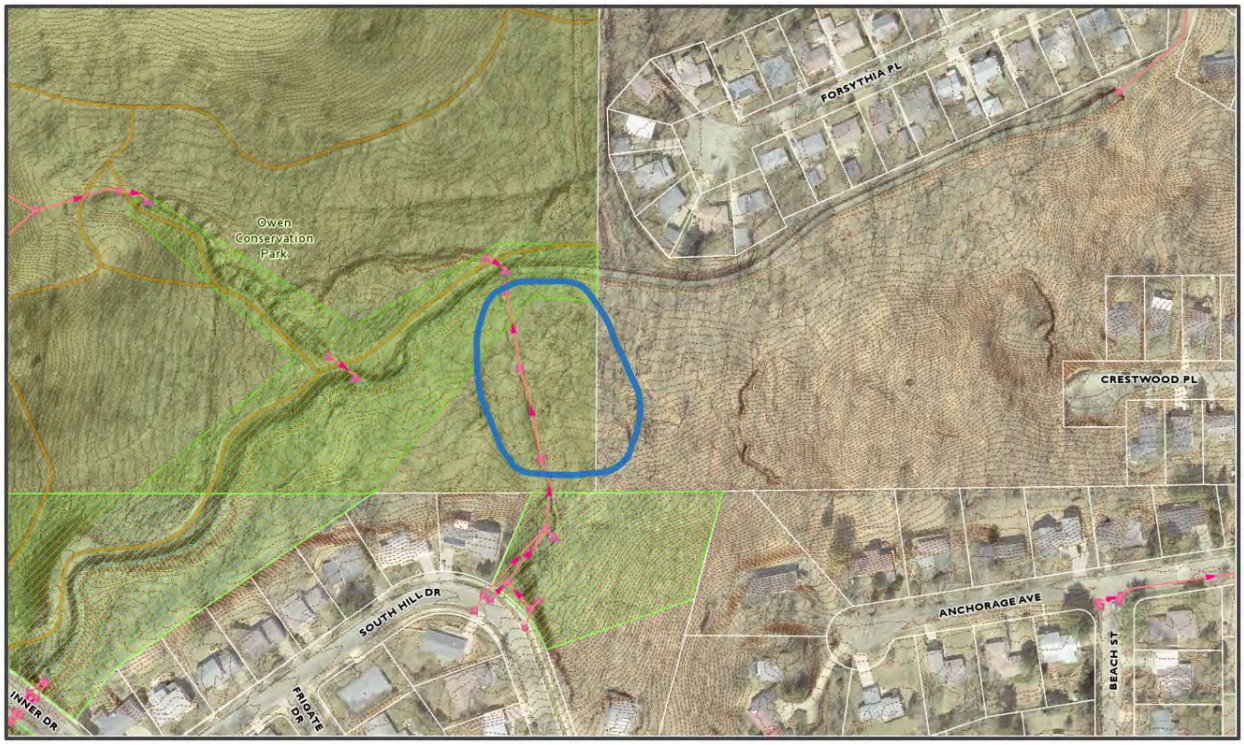

Figure shows Resident Provided Proposed Owen Park Pond Footprint in Blue

Technical Response: For some background, we consider different types of flood events while coming up with stormwater solutions so that our solutions can provided the greatest resiliency to the communities they protect. Specifically, we look at both short-duration

storms (short, very intense storm cells) and long-duration storms (very long storm systems that can contain high intensity pockets of rainfall). Both types of storms can cause severe flooding. In the area near Crestwood, we found that a pond would only have benefits if it "only fills when flooding is imminent." This is because with a standard pond, there would be potential to fill up its stormwater storage area early in the storm and thus would be full before the highest intensity part of the storm arrives (which is when the storage is most needed).

- When developing the Forsythia Pond Alternative Hypothetical Solution (Figure xxxvi), the proposed storage areas were located across from Forsythia Pl with a top pond elevation that would only be crested (and thus they would begin to fill) once the stormwater was deep enough in the channel. This was done by creating a small berm on the north side of the concrete channel. This allows the water to rise in the concrete channel and reach a near-flood elevation before it begins filling in the ponds, thereby providing flood protection at that key moment in the storm.
- However, upstream of Forsythia, where the resident-recommended proposed pond footprint showed storage, we cannot use berms to raise up the water – it would just flow downstream. This is because there isn't an immediate downstream restriction (such as the box culvert that heads to Bordner Park) that raises the elevation of water in the channel allowing it to "overflow" into the proposed basin. Therefore, to only let stormwater into a pond at the proposed footprint, during the high-intensity rainfall portion of the storm, we would need to design in an automated movable control structure. This would be a wall-like structure that would stay up and block the flow path to the basin most of the storm and lower when that storage is truly needed to protect against flooding. This movable structure is typically designed with monitoring equipment and automated systems. It is not something that the City of Madison has within its stormwater management network, and it would be a large, expensive effort to build the movable structure and install the real-time monitoring and response system. In the future, as technologies evolve and these systems become more reliable, this type of solution could be evaluated further.

Our modeling indicates that the size of the resident-recommended proposed pond footprint is too small to provide flood protection in the 1% annual chance storm to the homes on Forsythia. We found that about 6.6 acre-ft of stormwater storage, along with the other improvements, such as lowering the concrete channel, and building a 2-3 ft berm on the north side of the channel, are necessary to restrict the peak flows of the storm. The measured footprint provided to Engineering, is about 1.3 acres. To get the required 6.6 acre-ft of storage, the whole footprint would need to hold water at a depth of 5ft. However, that depth assumes that we would create 5 ft vertical walls straight down on all the edges

of the pond. The City cannot build a pond this way, for safety and stability reasons. Therefore, the pond in this area would need to be much deeper than 5' or take up a significantly larger footprint.

- Additionally, the topography becomes a significant challenge as we propose storage farther south of the channel. This is because the area slopes uphill very quickly. The southern side of the proposed pond footprint is 14-15 ft higher than the northern edge. To hold water in the pond, we would need to cut into the hill 14-15 vertical feet, plus the depth of the pond. This would have significant grading impacts past the proposed pond footprint into the wooded area, even if we designed part of it to include a retaining wall (and fencing along the top edge of the wall for safety).

With our watershed study, we completed many iterations to determine if there were lower impact solutions to the Crestwood neighborhood. The solutions included in the report proved to be the least-invasive while meeting the City's flood targets. We understand there are significant drawbacks to the solutions offered. This is why for the Spring Harbor Watershed, the City developed two sets or "suites" of solutions: the All Solutions suite and the Near-Term Solutions suite. The All Solutions suite was developed to include all the hypothetical solutions that would be needed in the watershed to meet the City's Flood Mitigation Targets. This suite of solutions was included in the report as a document to guide future engineers. It shows which types of projects will be needed based on the information we have today, in all the different areas of the watershed, to meet the Flood Mitigation Targets. The Near-Term (~0-25 years) Solutions suite was developed to increase the flood resiliency of the watershed in the near-term while excluding many of the more controversial solutions. This suite of solutions does not mitigate flooding enough to meet all of the City's Flood Mitigation Targets, but it does increase flood resiliency in some of the most flood-prone areas of the watershed. Developing two suites of solutions provides a framework to make progress towards flood resiliency, and acknowledges that we'd like to re-evaluate our options for this area and others in the future.

The City's goal is to provide the most flood resiliency that we can to the community while considering the needs and desires of residents and the limited funds that the City has available for these projects. At this point, for the reasons above, we do not plan to revise the report. However, the option outlined could be looked at in more detail in the future.

Question/Comment:

"*I asked a clarifying question about modeling retention ponds in hopes they would eliminate the need for a flood wall behind homes on Forsythia place. I remember you*

telling me that you modeled digging the whole of Bordner Park down 7 feet (?) and making the existing ponds in Owen deeper and those interventions would not eliminate the need for the flood wall. Did I get this right?

City Response:

The initial study included the following analyses:

- Expanding the storage in Bordner Park by creating a larger footprint: Preliminary modeling of this alternative indicated that an area double the size of the entire current park would be needed to avoid downstream conveyance improvements. This alternative was eliminated from further consideration because of the impacts to the park and the property buyouts that would need to occur to obtain the necessary footprint.
- Expanding the storage in Bordner Park by excavating below the existing box storm sewer invert and installing a lift station to drain the pond down between storms: Preliminary modeling of this alternative indicated that with a 3H:1V side slope, the pond bottom would have to be about 20 feet below the existing box storm sewer invert to provide sufficient storage within the existing park footprint. This alternative was eliminated from further consideration because of the impacts to the park, the likely aesthetic issues associated with a pond this deep, and the engineering challenges associated with excavating a pond this deep.

With regards to expanding the size of the existing basins in Owen Park, only a small portion of the flows through the main "spine" of the watershed come from the Owen Park Ponds (as described in Figure v of the Amendment). Increasing the storage of those ponds would result in very limited reductions in discharges at Forsythia or Border Park and therefore not drastically change the recommended solutions near Forsythia Pl.

Question/Comment:

"Mature trees were removed at great cost to flood mitigation and to the climate and the watershed. Now there needs to be many more planted to mitigate flooding."

City Response:

Wherever possible the City avoids tree loss. However, in developed watersheds, there is minimal additional space that the stormwater utility can utilize to either detain/pond or convey stormwater. While trees are beneficial for the environment and habitat, they can impede stormwater conveyance—a large forested area slows the water down, which can

add to flooding by causing increased backwater elevations. Additionally, channels with too much tree canopy tend to have erosion issues as the grasses and other dense ground cover vegetation, that are necessary to stabilize the ground, cannot grow effectively due to the lack of light, resulting in erodible bare ground. When we cannot purchase sufficient areas of land to store/pond more floodwater in a controlled location and slow/detain the water down, another option can be to improve conveyance and speed the water up. In order to convey water more quickly, our options are often to deepen and/or widen a channel and this can impact existing trees adjacent to the channel.

When a flood-related project is budgeted, has been through the detailed design process, and has been constructed, the City works to establish native vegetation which includes a mix of herbaceous plants, trees and shrubs. This native vegetation has deep roots that help stormwater infiltrate, as well as hold soil in place to prevent erosion. It is also very beneficial for supporting the bottom of the food chain in our ecosystem. Insects need native vegetation to survive and when we have healthier insect populations by providing native vegetation for them to eat, live and nest, we support the bird and small mammal population as well. Over the last six years, the Stormwater Ecological Restoration team has planted an average of 130 trees and 135 shrubs each year on Stormwater Utility land.

Please see the Ecological Restoration in Stormwater Ponds and Greenways Storymap and Engineering's Stormwater Utility Vegetation Management Plan for more information.

Question/Comment:

"Overall – My comments haven't changed much from three and four years ago (2021, 2022) when I commented previously on this plan. As I stated previously, the flood mitigations targets are narrowly focused on reducing flood inundation hazards without recognizing that the hard infrastructure solutions will cause further damage to riparian and aquatic habitat, human health and comfort, urban heat island effects, aesthetics, and water quality. There are so many techniques available to reduce flood peaks and increase infiltration that are nature-based and much less expensive. One example of many describing Nature-Based-Solutions https://www.doi.gov/sites/doi.gov/files/doi-nbs-roadmap.pdf.

I appreciated a further look at infiltration capacity, but was left questioning why it didn't take into account all the areas that could have increased infiltration, including in the parks, and how to reduce the speed of water moving through those miles of headwater concrete lined channels. It would be a tragedy to spend $46M+ on flood mitigation and not be better off in terms of the main goals for stormwater in a time of a high degree of hydrologic and temperature variability.

The modeling should look at existing and projected conditions, including not only more extreme floods but extreme hydrologic variability including droughts, and increased air and water temperatures. Given the importance of surface water/groundwater interactions in the lower portion of the watershed, including contributions to well 14's draw from the shallow aquifer fed by groundwater in the watershed, the modeling should have been a full watershed model and not just stormwater. This was a perfect opportunity to take a look at how both interact under a changing hydrologic regime. Instead, this study and the addendum are narrowly focused on expanded hard structures and ponds, many of which increase the amount of dirty stormwater for all floods, not just the extreme. This will cause further damage to downstream water quality and sedimentation. Even though the watershed has been "built out" the extensive green ways are connected to many City Parks (Mineral Point Park, Nautilus Point Park, Owens Conservation Park, Garner Park, Glen Oak Hills Park, Bordner Park, and Spring Harbor Park). In addition, many neighborhoods have large lots, such as the Highlands, which help recharge the shallow aquifer used for drinking water. There are also mowed adjacent lands to public schools that can be utilized for stormwater management. There needs to be a more holistic approach to stormwater management that includes restoring the channel network, taking into account soils and active recharge areas.

The targets of the study (1.2) should be to mitigate flooding without adding to downstream water quality problems, including water quality issues in Spring Harbor and Lake Mendota, especially the nearshore.

Like other surveys and plans that City Engineering has done recently, they all seem to put woods at odds with storage (wet detention basins). Which of course no one wants to lose their trees. This simplistic question does not do justice to the complexity of the hydrologic issues at hand, and the potential expanded listed of alternatives that can be used that saves trees and preserves the natural feel of the area (p. 14). These things are not at odds with each other. Other cities are planting trees for their benefits 50 years from now. I really can't understand why the City of Madison puts them at odds with flood control.

2.1.1 The Spring Harbor Watershed is definitely unique given its size and lack of a natural runoff network to Spring Harbor until pipes were added to connect large disconnected areas of the watershed. Before the short section of Spring Harbor creek was from spring flow, coming from the surrounding highlands. Nowhere in this section does it describe this important feature – that there were enough sandy areas and thick vegetation to absorb runoff before it made it to the lake. It is understandable that we can't totally get back to that time, but there is much that can be done to reduce stormwater before it gets to the pipes.

The steepness of the watershed makes it especially vulnerable to floods once all rainwater is routed as surface water through the 2,400 acres.

6.1 Recommending that the only solution is to upsize the Spring Harbor storm sewer box at the outlet, along with other pipes and boxes, shows that the City did not fully look at options for how to reduce stormwater in the headwaters. It is in very rare cases that one starts at the bottom of a watershed and works upstream with improvements. Sending more dirty water faster to Spring Harbor is not the answer to the watershed's flood problems. The ultimate goal should be to see how Spring Harbor's Creek (wrongly called a storm drain) can be daylighted and returned to its original creek form, instead of sealing its fate underground for another 50 years. If this is the goal, it would also save water quality in Lake Mendota. It would also reduce the frequency of dredging in the harbor. The 2023 dredged channel in the harbor is now contributing to more sediment making it out to the lake, since Spring Harbor no longer acts as a sediment trap.

7 Flood mitigation questions

– greenspaces used for infiltration – why weren't parks and other publicly owned land considered in the analyses? Why was only the Engineering greenspace considered?

–More sand in the harbor? – I disagree with the answers as a geomorphologist and witness to just about every event that brings sediment-laden stormwater to the harbor. Are you tracking what is coming in from the many construction projects in the research park area? Including road projects? There was at least a truckload of sediment delivered from the dewatering associated with LMD. Huge amounts were delivered when University Avenue was reconstructed a fews years back. You've got the data at the gage – what is the sediment loading showing?

8.2 Solutions order

It makes sense to fix failing culverts. Please look at why they are failing. Are they perched? How can vertical grade control and the channel be built back up to keep the trees from falling in and reduce channel erosion/knickpoint migration? Grade control steps, that are passable by aquatic life, should be considered to make sure that the culvert doesn't fail or start more knickpoints moving upstream. Make sure storm sewer outlets are not failing where the channel has downcut in steep tree-lined ravines. Work from downstream to upstream, regrading and providing naturalized steps that decrease flow energy and slow flows to downstream areas without causing flooding. Use Ann Arundel County methods. See more recent report for urban areas in the southwest, which have flash floods but need to conserve and save as much stormwater as possible. One example:

https://www.usgs.gov/media/videos/lessons-learned-using-stream-morphology-and-simple-erosion-control-structures-past

10. Consider the cost for all the hard structures -- $46 M – spend $100,000 and have a consultant present you with alternatives to flood mitigation that also improve stormwater quality, recharge our aquifers, and keep water as cool as possible before it goes to the lake. I bet we can get a lot done, using nature, for <$45 million. And they can be started now, instead of waiting 25-50 years.

11. Additional modeling engagement – I would be glad to meet about these plans and considerations to the public comments from this round. It would be great to get Ken Potter involved if he is able."

City Response:

Thank you for the time you took to review the Amendment and provide feedback.

Both gray and green infrastructure designs and nature-based solutions are part of the City's goals for flood mitigation throughout the City. The City will continue to watch for opportunities to arise to acquire property or work with property owners on flood mitigation and water quality efforts. However, at this time the report is based on what we are able to address with the resources we control else providing hypothetical solutions that are not realistic based on funding levels, community support and permitting hurdles would not serve the community or the purpose of these studies. As factors in the watershed change the reports will be updated to take those changes into consideration. The City's watershed study program was specifically designed and funded to look at flood mitigation, including identifying existing deficiencies and looking at high level conceptual projects. In the future these studies could be used as building blocks for more comprehensive studies when more time and resources are available.

Learn about many of the initiatives the City is involved in below:

City Engineering and USGS Green Infrastructure Study

City Engineering Green Infrastructure Effectiveness Analysis

City Engineering Terrace Rain Garden Program

City of Madison Development Standards for Stormwater

City Engineering Stormwater Utility Vegetation Management Plan

Madison Area Municipal Stormwater Partnership (MAMSWaP)

Learn about Wisconsin Geological and Natural History Survey Dane County Groundwater analysis:

The 2016 Groundwater Flow Model for Dane County, Wisconsin

Visit the Watershed Study Learning Hub where we have provided answers to many of the questions about the City's approach to the Watershed Studies:

Watershed Study Learning Hub