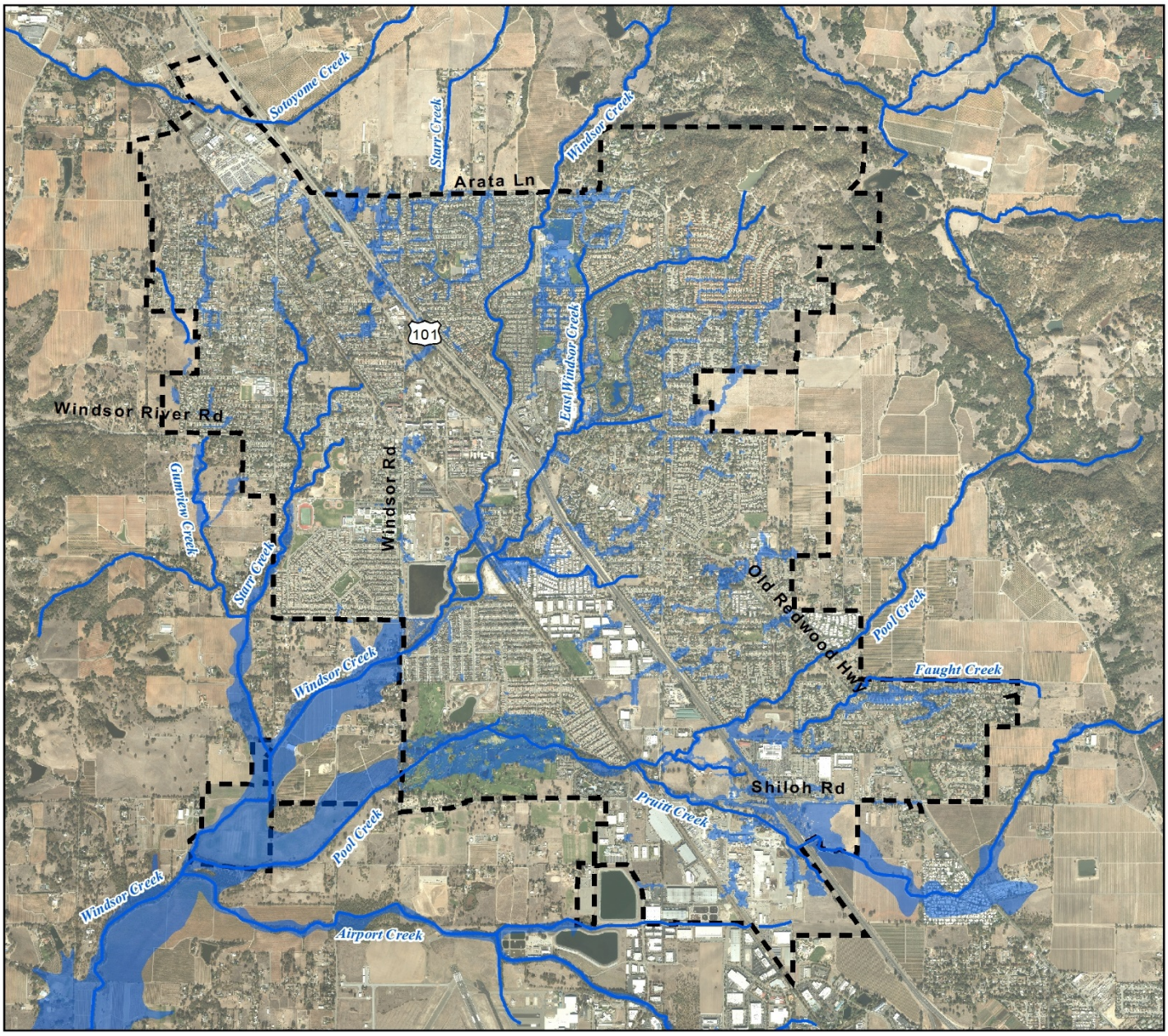
TOWN OF WINDSOR



Final Storm Drainage Master Plan

GHD

March 2020

Town of Windsor

Final Storm Drainage Master Plan

Project No. 11159126

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EXECUTIVE SUMMARY

The Town of Windsor (Town) is located approximately 20 miles east of the Pacific Ocean coastline. Highway 101 bisect the Town and provides regional access by connecting California's northern coastal counties with the San Francisco metropolitan area 60 miles south of Windsor.

This Storm Drainage Master Plan (SDMP) Phase II provides detailed analysis of the adequacy of the Town's major storm drainage facilities and provides recommended storm drainage improvement projects (SDIPs). Major storm drainage facilities are defined as the existing storm drainage pipeline network (equal to or greater than 24-inches in diameter); open channels; and the primary creeks and their tributaries located within the Town's watershed. This SDMP includes an updated analysis and is intended to supersede the Town's most recent drainage analyses in the 2017 SDMP (Phase 1)and the previous *Windsor Cumulative Drainage Impact Mitigation Program Update Report* by Boyle Engineering in 1999 (1999 Boyle Report).

Background and Purpose

Detailed analysis is focused on leveraging current analytical tools for hydrologic and hydraulic (H&H) planning to update the findings and conclusions from previous planning efforts, including the *Windsor Area Master Drainage Plan* prepared by the Sonoma County Water Agency (SCWA) in 1989, the *Windsor Cumulative Drainage Impact Mitigation Program Update Report* by Boyle Engineering in 1999, and the *Storm Drainage Master Plan Phase 1* in 2017. Updated findings and conclusions from the SDMP Phase 2 were used by the Town to update its Capital Improvement Program. Prior to the 2017 SDMP Phase 1, the Towns drainage CIP program was based primarily on the findings in the 1999 Boyle Report. This SDMP report recommends specific SDIPs and provides estimated costs. The Town will be prioritizing the SDIPs and determining which to pursue in the CIP program.

Phase 1

The SDMP Phase 1 scope of work was generally approached in three phases: 1) information gathering; 2) model development; and 3) SDIP determination. Information gathering included aerial imaging and preparation of a digital terrain model within Town limits (Woolpert Inc. 2011), review of Town and SCWA records, and enhancement of the Town's geographic information system (GIS) geodatabase through field data collection. Model development included the preparation of a two-dimensional (2-D) hydrology and hydraulic (H&H) model (MIKE software developed by DHI, Inc.), using draft guidelines from the Sonoma County Water Agency's Flood Control and Design Criteria (FCDC). This document is now named the Flood Management Design Manual (FMDM) and is anticipated to be finalized in January 2020. The Draft FMDM guidelines were used to represent flood limits and flood duration during 10, 25, and 100-year design storms. The model includes creeks and major tributaries (with the exception of Sotoyome Creek), all storm drains greater than or equal to 24-inches in diameter, and their associated open channels. Sotoyome Creek was not included in the model since it is located in a separate watershed and was evaluated in 2012 with a separate H&H model. Conclusions and recommendations for Sotoyome Creek are incorporated into the SDMP. SDIP determination focused on alleviating existing and projected hydraulic deficiencies within the storm drainage system, as noted by Town staff from observations during storm events and as simulated in the model results.

Phase 2

The SDMP Phase 2 scope of work builds off the work previously performed during Phase 1 to address a number of the recommended model updates, including:

- Update analysis and future SDIP projects to reflect the Town's new General Plan 2040 adopted in June 2018.
- Identify opportunities for stormwater retention in lieu of conveyance improvement projects within SDIPs.
- Finer delineation of upstream (eastern) subbasins.
- Model validation (open channels) using 2017 storm data collected by stream and rainfall gauges.
- Update the model with information from area-specific surveys and field observation for the following three areas:
  - Shiloh Road from the boundary of the Highway 101 on/off ramps to Conde Lane;
  - Arata Lane in the vicinities of Starr Creek and Starr Creek Tributary 5; and
  - Starr Creek Tributary #7, including verification of pipe information between Wild Oak Drive and Windsor River Road.

The study area and recommended SDIPs are shown in Figure ES-1 at the end of this Executive Summary.

Storm Drain Improvement Project (SDIP) Recommendations

During Phase 1, eleven baseline and five future projects were identified. During Phase 2, the projects identified in Phase 1 were re-evaluated. For consistency between Phase 1 and Phase 2, the SDIP IDs were kept consistent with those in Phase 1 so that there are no duplicate or missing SDIPs between the two phases and reports. The SDIPs are tabulate below in Table ES-1. The projects are not presented in a prioritized order. As noted in the table, several projects were identified during Phase 1 of this Report but have been removed for reasons which include: identification of alternative projects achieving the same goal, review of updated model results which do not support the urgency or need for the project, and reflection on recent Town experience during storm events which does not support a priority need for the project.

Table ES-1 Storm Drainage Improvement Projects

SDIP ID	SDIP Name	Estimated Cost
Existing Conditions (Baseline) SDIP Projects		
SDIP 1 – Phase 1	Arata Lane & North Windsor (Phase 1) **REMOVED DURING PHASE 2**	NA
SDIP 1	Conveyance Improvements along Biggs Way/Natalie Drive	$ 5,510,000
SDIP 2	Windsor Creek and East Windsor Creek Confluence **MOVED TO FUTURE DURING PHASE 2**	NA
SDIP 3	Hampshire Lane and Wellington Circle **REMOVED DURING PHASE 2**	NA

SDIP ID	SDIP Name	Estimated Cost
SDIP 4	Franklin Street and Leafhaven Lane **MOVED TO FUTURE DURING PHASE 2**	NA
SDIP 5	Gumview Drive, Berry Lane, and Starr View Drive	$ 3,950,000
SDIP 6	Hiram Lewis Park Detention Basin	$ 880,000
SDIP 7	Elsbree Lane **REMOVED DURING PHASE 2**	NA
SDIP 8	Old Redwood Highway at Dawn Way -Conveyance Improvements	$ 1,020,000
SDIP 8 – Phase 2	Old Redwood Highway at Dawn Way (Phase 2) **REMOVED DURING PHASE 2**	NA
SDIP 9	Old Redwood Highway and Pleasant Avenue	$ 1,810,000
SDIP 10	Brooks Road **REMOVED DURING PHASE 2**	NA
SDIP 11	Shiloh Road at Caletti Avenue	$ 247,000
SDIP 12	Hall Park Detention Basin	$ 1,900,000
SDIP 13	Starr Creek Tributary #5 – South of Arata Lane	$ 1,400,000
SDIP 14	East Windsor Creek Flood Control Project	$ 3,290,000
Total Cost of Existing (Baseline) SDIP Projects		$ 20,007,000
Future Conditions SDIP Projects		
F-SDIP 1	Old Redwood Highway Bridge at Sotoyome Creek	$ 3,750,000
F-SDIP 2	Proposed Detention Basin on Pruitt Creek on East Side of US HWY 101 **REMOVED DURING PHASE 2**	NA
F-SDIP 3	Proposed Detention Basin between Pool Creek and Faught Creek	$ 3,430,000
F-SDIP 4	Starr Road and Colleen Drive	$ 3,880,000
F-SDIP 5	Pool Creek at Windsor Road	$ 7,680,000
F-SDIP 6 (formerly SDIP 2)	Windsor Creek and East Windsor Creek Confluence	$ 2,940,000
F-SDIP 7 (formerly SDIP 4)	Jensen Lane Conveyance Improvements	$3,770,000
F-SDIP 8	Detention at Jensen Lane Development	$ 3,880,000
F-SDIP 9	North of Arata Lane Drainage Project	$ 6,330,000
Total Cost of Future SDIP Projects		$ 35,660,000

Costs shown in Table ES-1 are present design and construction costs. For future planning, costs should be adjusted to account for inflation, construction cost index, and other planning factors such as regulatory drivers and Town needs. The timing for implementation of future projects is unknown, but is assumed to be distributed over a 10 year or greater time period to spread the cost of projects for long-term budgeting. Project drivers for some future SDIP projects may be primarily based on future development needs (F-SDIP 3, F-SDIP 7, and F-SDIP 8). The project

cost for SDIP projects attributed to development needs should be considered when preparing development agreements, where the cost for improvements may be covered by the development project.

In the Estimate of Probable Cost (Appendix D), for each project where future development is driving the project (in whole or in part), the portion of the project cost which is driven by future need is provided. The future portion is determined by calculating the increase in runoff from development and determining what volume detention is needed to mitigate that increase alone using California Stormwater Quality Association (CASQA) Best Management Practices (BMPs) for sizing detention. That volume is then compared to the overall project volume to determine the proportion of the estimate of probable cost attributable to future development.

The list of SDIPs should not exclude new priority projects based on future development impacts or the discovery of new flood conditions. Each of the SDIPs should be further developed in engineering detail prior to construction.

Recommended Next Steps

Prioritization of projects should be based on addressing maintenance needs during storm events, reports from citizens of flooding, and needed capacity and/or flow retention improvements to support new development. SDIPs also need to be fully developed in engineering detail prior to implementation. This includes looking for ways to prioritize stormwater detention to counteract capacity improvements that would otherwise convey peak storm flows to downstream parcels of the storm drainage system that may not be able to handle the flow increase.

This Report, with the associated model, is a living document and its findings and recommendations are subject to change given a variety of factors for planning and funding.

Recommended future model updates may include:

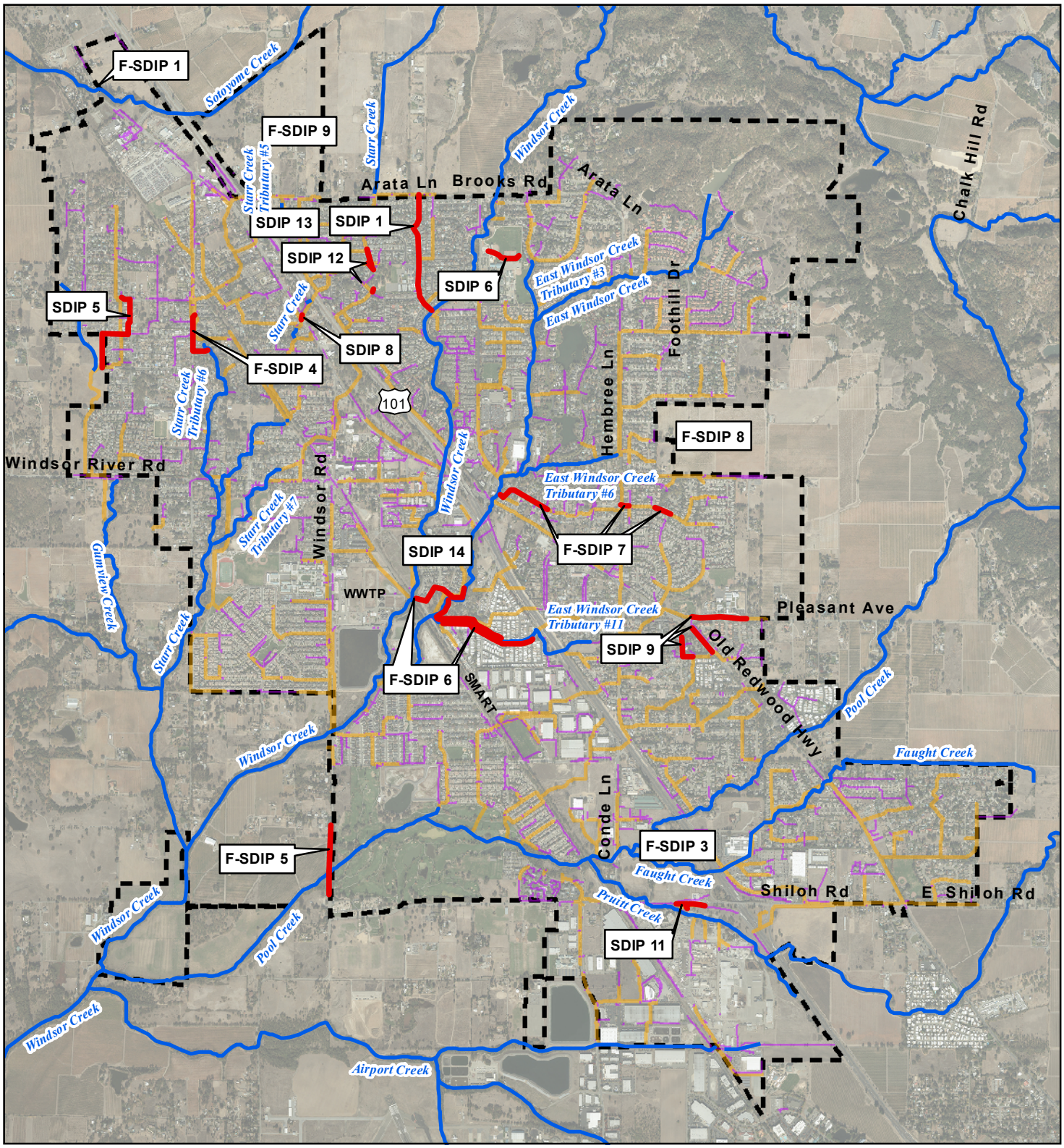
- Expansion of the model area beyond Town limits and the Town's Urban Growth Boundary.
- Model calibration (streams) using storm data collected by stream gauges (which the Town is currently considering to re-install) and rainfall gauges.
- Area specific surveys (as needed).
- Addition of smaller pipelines in known problem areas (as needed during engineering design of SDIPs).

The Town may also consider other factors in the future planning of its storm drainage conveyance system, including:

- Enhancements to the H&H Model: Updates to the current H&H model may provide a greater understanding of existing and future storm drainage system needs, which may result in modified projects. Model updates should comply with the new FMDM requirements.
- Land Development Changes: The current H&H model should be updated, when appropriate, as development occurs and be used as an analytical tool to assess local and watershed impacts from planned development. The model should also be updated, as necessary, to incorporate General Plan land use changes.

- Regulatory Drivers: Various policy and regulatory issues may affect the timing and budget for SDIP projects, which may include climate change planning and/or changed guidelines or policies in the California Environmental Quality Act (CEQA) or for resource agency permitting requirements.
- GIS Resources: Future updates for the SDMP should utilize current GIS geodatabase resources and available topographic data.

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Town Limits

Rivers and Creeks

Storm Drain System, Modeled

Storm Drain System, Not Modeled

SDIP = Baseline Storm Drain Improvement Project
F-SDIP = Future Storm Drain Improvement Project

Paper Size 8.5" x 11" (ANSI A)
0 650 1,300 1,950 2,600
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

GHD

ESA

TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

Job Number 11159126
Revision 3
Date 12 Feb 2020

Existing and Future SDIPs

Figure ES-1

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Data source: Sonoma County GIS, Town Limits, Imagery, Roads, 2013; GHD, Storm Drain System, 2019; GHD, Modeling Results, Modeded Creeks, 2019. USGS, Creeks, 2014. Created by:afisher2

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Chapter 5B - Hydrology Model Results

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Appendix D Planning-level Opinions of Probable Project Cost

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Acronyms

BCM	Basin Characterization Model
BMP	Best Management Practices
CASQA	California Stormwater Quality Association
CEQA	California Environment Quality Act
CIP	Capital Improvement Project
CIPP	Cast in Place Concrete Pipe
CM	Construction Management
CTS	California tiger salamander
DHI	Danish Hydraulic Institute
DTM	Digital Terrain Model
ENR CCI	Engineering News Record Construction Cost Index
ESDC	Engineering Services During Construction
FCDC	Flood Control Design Criteria
FMDM	Flood Management Design Manual
FEMA	Federal Emergency Management Agency
F-SDIP	Future Storm Drainage Improvement Project
FIRMS	Flood Insurance Rate Maps
FIS	Flood Insurance Study
ft	Feet; Foot
GIS	Geographic Information System
GSD	Ground Sample Distance
HEC-HMS	Hydrologic Engineering Center Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Centers River Analysis System
HGL	Hydraulic Grade Line
HMP	Hydromodification Management Plans
HMP	Hydrology Modeling Package
HSPF	Hydrological Simulation Program – Fortran
in	Inch
IRWM	Integrated Regional Water Management
LF	Linear Feet

LID	Low Impact Development
MF	MIKE Flood
MND	Mitigated Negative Declaration
MRLC	Multi-Resolution Land Characteristics Consortium
MU	MIKE Urban
NLCD	National Land Cover Dataset
NPDES	National Pollution Discharge Elimination System
NWPRR	Northwest Pacific Railroad
RCB	Reinforced Concrete Box
RWQC	Regional Water Quality Control Board
SCWA	Sonoma County Water Agency
SDIP	Storm Drainage Improvement Project
SDMP	Storm Drainage Master Plan
SMART	Sonoma-Marin Area Rail Transit
SUSMP	Standard Urban Storm Water Mitigation Plan
TMDL	Total Max Daily Load
TOWN	Town of Windsor
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
WSE	Water Surface Elevation
WWTP	Waste Water Treatment Plant

1. INTRODUCTION

1.1 Background

The Sonoma County Water Agency (SCWA), now rebranded as Sonoma Water,) prepared the *Windsor Area Master Drainage Plan* for Laguna de Santa Rosa-Mark West Creek Flood Control Zone 1A in June 1989 (i.e., "1989 SCWA Report"). The 1989 SCWA Report provided basic information on areas of flooding and drainage problems in the Town of Windsor (Town) and also identified structural solutions to those problems. The information provided was to be used by public agencies, planning and engineering consultants, land developers, and individuals to better understand the flood hazard to certain parcels and to plan for drainage improvements to mitigate those hazards. An overview of Windsor's storm drainage system is provided in Figure 1-1.

The 1989 SCWA Report completed engineering analysis and design in accordance with the SCWA Flood Control Design Criteria (FCDC) Manual. It identified a number of individual watersheds that contribute flow to various creeks and developed Project Reports for proposed drainage improvements within those watersheds. Currently, Sonoma Water is in the process of updating the FCDC, now called the Flood Management Design Manual (FMDM), which is anticipated to be adopted in January 2020.

In 1986 Sonoma County adopted the *Windsor Specific Plan* aimed at providing development policy. In 1992 Sonoma County established the *Windsor Cumulative Drainage Impact Mitigation Program* to mitigate cumulative drainage impacts resulting from the Specific Plan.

In 1999, the Town hired Boyle Engineering Corporation to prepare a study, *Windsor Cumulative Drainage Impact Mitigation Program Update Report* (i.e., "1999 Boyle Report"). This report was an update of the 1989 SCWA Report and was funded due to the following: changes in planned land use between the 1986 *Windsor Specific Plan* and the 1996 *Windsor General Plan*; the 1997 *Urban Growth Boundary Resolution*; and changes in environmental issues including riparian corridor protection and the listing of steelhead trout and coho salmon as threatened. The purpose of the program was to mitigate cumulative drainage impacts and not project-specific impacts.

Since the above analyses were completed, significant changes have occurred both within the Town boundary as well as in outlying areas within the watersheds that contribute flow to the creeks that flow through Windsor. There has been a change in approach to flood management (e.g. the FMDM) as well as stricter guidelines from the North Coast Regional Water Quality Control Board (RWQCB). Also, more recent sources of information are available for the Town to enhance the hydrologic and hydraulic analysis for the storm drainage system, including survey information for creeks, surface drainage conditions, and changes to storm drainage infrastructure that have occurred since the 1999 Boyle Report. In addition to the local studies described above, Federal Emergency Management Agency (FEMA) has prepared 100-year flood mapping of the major creeks flowing through the Town. Limits of flooding are indicated on Figure 1-2. Based on these changes, the Town decided to update its Storm Drainage Master Plan (SDMP). The SDMP was completed in two phases.

Phase 1 of the SDMP was prepared by GHD and ESA and was completed in September 2017. GHD collected field data, managed GIS resources, and developed new recommended storm

drainage improvement projects (SDIPs). ESA prepared a hydrologic and hydraulic model for various model scenarios to inform development of the SDMP.

Phase 2 of the SDMP expands on the work performed during Phase 1 and addresses a number of the Phase 1 recommendations, including additional survey work, updates to the modeled storm drainage network and runoff basins, validation of the model, re-evaluation of Phase 1 SDIPs as well as evaluation of new SDIPs identified during Phase 2. ESA provided data collection and processing for Phase 2 while GHD revised the model previously developed by ESA.

Various Town staff also contributed to the development of the SDMP, including Town Engineering and Operations staff.

1.2 Purpose

The Town seeks to reduce flooding within town limits during the 10-year, 25-year, and 100-year storm events as defined by the Sonoma Water FMDM. Therefore, the SDMP has three primary purposes:

1. First, locate and identify deficiencies within the Town's existing storm drainage system with respect to the Sonoma Water FMDM.
2. Second, develop an updated list of storm drainage improvement projects (SDIPs) and associated costs to address current (baseline) deficiencies.
3. And third, develop a short list of future, forward-thinking SDIPs and associated costs to accommodate full Town buildout per the 2040 General Plan.

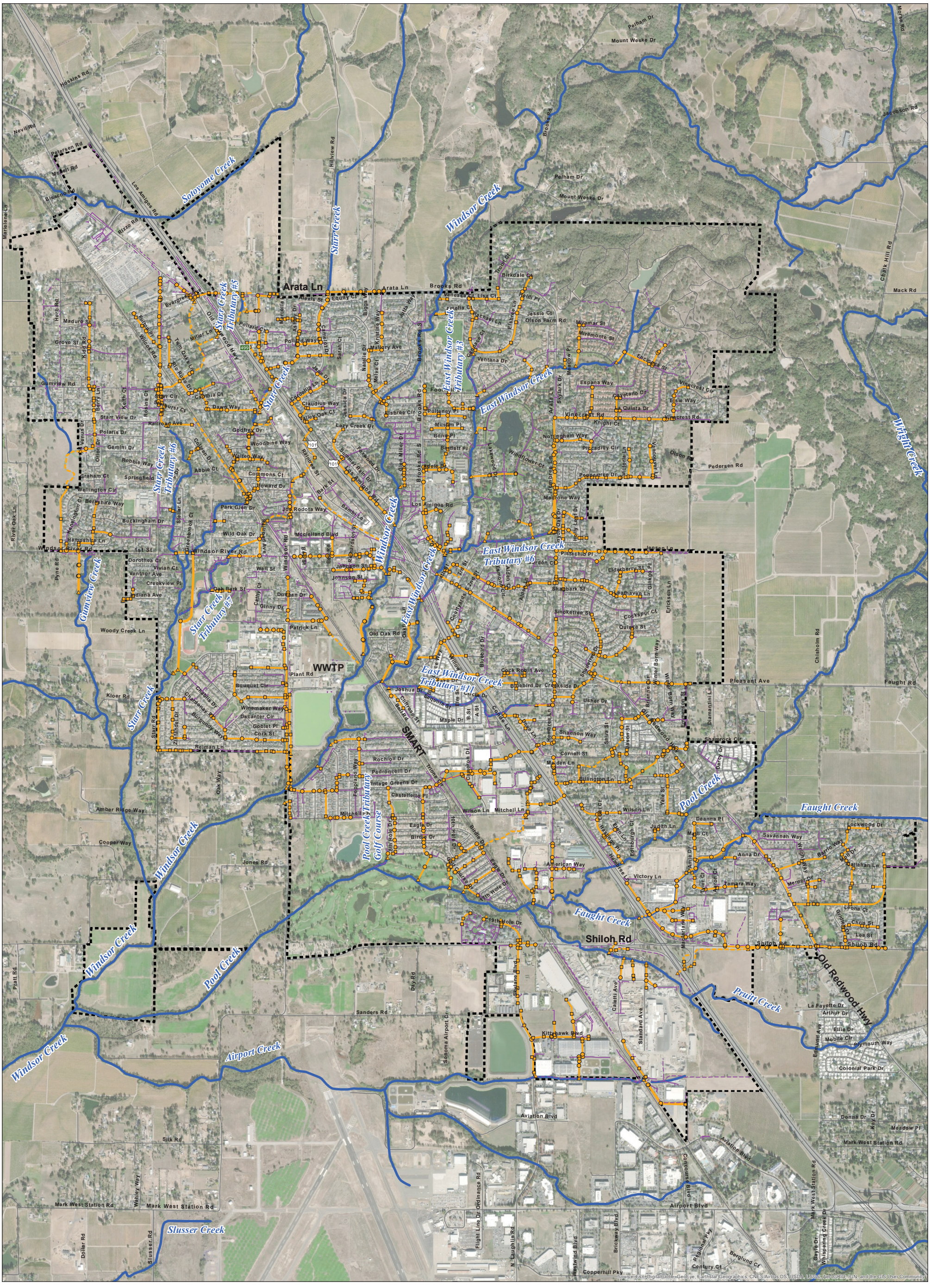
At the completion of this master planning effort, the Town will possess a detailed hydrologic surface model that can be used to design future projects, and new water surface elevation benchmarks for design use in the Windsor area. The final SDMP will supplant, for drainage design purposes, the 1989 SCWA Report , the1999 Boyle Report, and the 2017 Phase 1 SDMP Report. As a planning study, this SDMP is not subject to California Environmental Quality Act (CEQA) requirements; however, many of the suggested projects would be subject to CEQA if they are to be implemented.

1.3 Scope of Work

This SDMP provides detailed analysis of the adequacy of the Town's major storm drainage facilities and provides recommended SDIPs. Major storm drainage facilities are defined as the existing storm drainage pipeline network (equal to or greater than 24-inches in diameter); open channels[1] with cross culvert; and the primary creeks and their tributaries. The study area is shown in Figure 1-1.

The SDMP scope of work was generally approached in three phases: 1) information gathering; 2) model development; and 3) SDIP determination. The three phases are described in detail below.

[1] Open channels are defined as open drainage ditches or open roadside ditches. Generally open channels are too small to be considered a tributary to a primary creek.



Town Limits
Streets
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Modeled
Manholes, Modeled
Discharge Points, Modeled

Paper Size 22" x 34" (ANSI D)
0 450 900 1,350 1,800
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

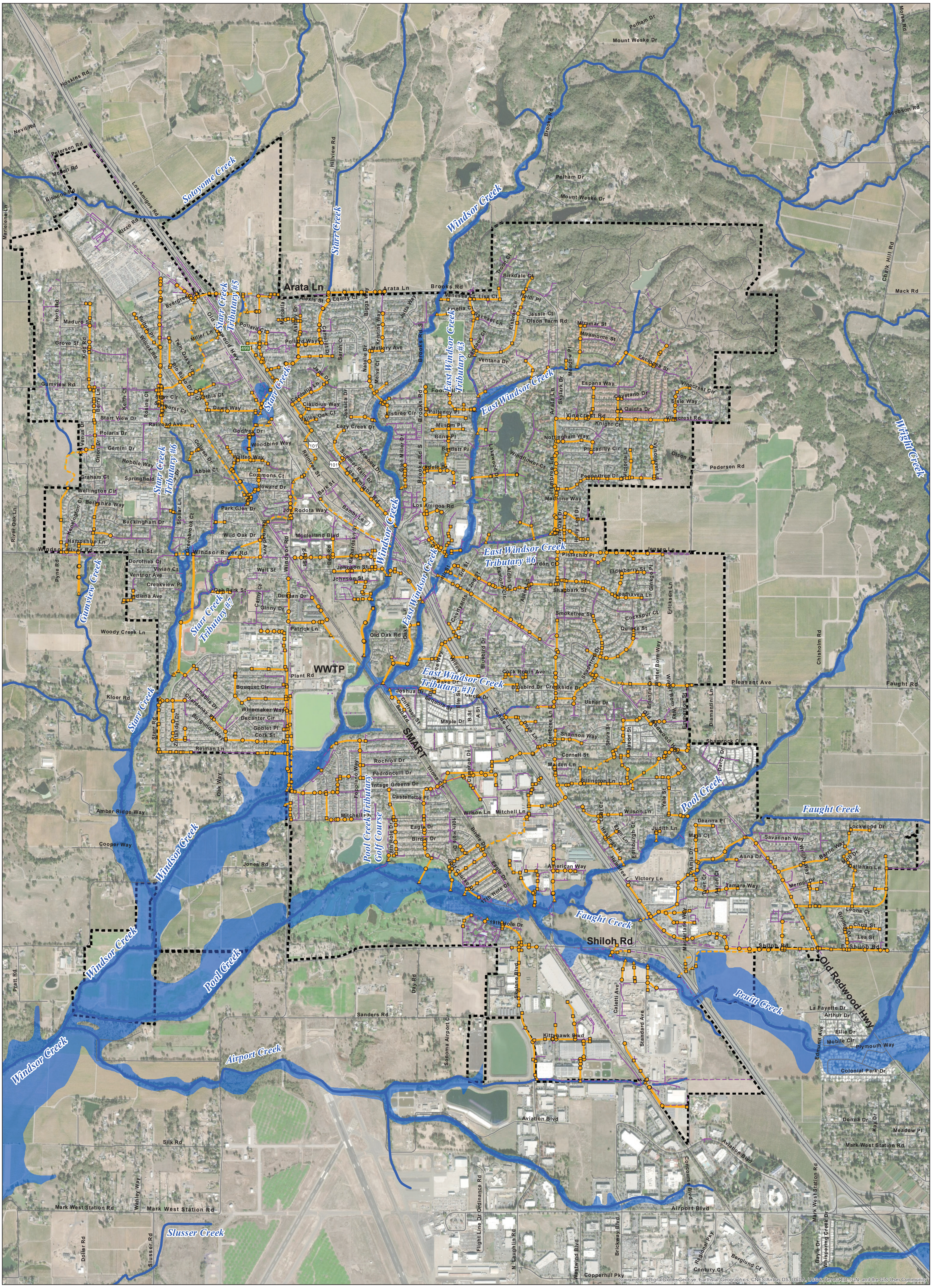
Job Number 11159126
Revision 5
Date 07 Feb 2020

System Overview

Figure 1-1

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 1-1 Overview.mxd
2235 Mercury Way Suite 150 Santa Rosa CA 95407 USA T 707 523 1010 F 707 527 8679 E santarosa@ghd.com W www.ghd.com
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Data source: PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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Town Limits	Streets
Rivers and Creeks	Culverts, Modeled
Culverts, Not Modeled	Gravity Mains, Modeled
Gravity Mains, Not Modeled	Open Channels, Modeled
Open Channels, Not Modeled	Inlets, Modeled
Manholes, Modeled	Discharge Points, Modeled
FEMA 100 Year Flood Zone	

Paper Size 22" x 34" (ANSI D)

0 450 900 1,350 1,800

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

GHD ESA TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

Job Number 11159126
Revision 3
Date 07 Feb 2020

FEMA Mapping for Major Creeks

Figure 1-2

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 1-2 FEMA Mapping for Major Creeks.mxd

2235 Mercury Way Suite 150 Santa Rosa CA 95407 USA T 707 523 1010 F 707 527 8679 E santarosa@ghd.com W www.ghd.com

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Data source: FEMA, Flood Zone, December 2019; PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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1.3.1 Information Gathering

GHD collected new and existing data from a variety of sources as listed below:

- Final Storm Drainage Master Plan Phase 1 (GHD & ESA, September 2017);
- SDMP Phase 1 MIKE model runs (ESA 2017);
- Existing aerial imagery (Woolpert Inc. 2011);
- Existing Digital Terrain Model (DTM) (Woolpert Inc. 2011);
- Sonoma Water and Town record drawings;
- Existing Town Geographic Information System (GIS) geodatabase (GTG Consultants 2013);
- Anecdotal information provided by Town and Sonoma Water staff for areas with existing flooding and details for storm drainage system components;
- Existing FEMA background data (March 2017) and FEMA HEC-2 models;
- Windsor Area Master Drainage Plan (SCWA 1989);
- Windsor Cumulative Drainage Impact Mitigation Program Update (Boyle 1999);
- Existing Hydraulic Calculations from the Windsor Cumulative Drainage Impact Mitigation Program Update (Boyle 1999);
- Existing Boyle HEC-RAS model runs;
- New profile and geomorphology survey data from the primary creeks and tributaries; and
- New inlet elevation and inlet structure characteristic survey data from existing pipelines and open channels.

Using the information gathered, GHD created up-to-date data sets to assess the capacity and effectiveness of the major storm drainage facilities. This includes a delineation of contributing watershed and sub-watershed boundaries, update of the Town's storm drainage GIS database, and comprehensive mapping of the Town's storm drainage system.

1.3.2 Model Development

Based on discussions with Town staff, it was recommended to use a two-dimensional (2-D) hydraulic model, as opposed to a more traditional one-dimensional (1-D) model, to better represent flood limits and flood duration. When accurate topographic mapping is available, a 2-D model can represent limits of flooding when creeks overtop their banks or when storm drain capacities are exceeded.

The selected platform was MIKE software developed by DHI, Inc. Three separate computational models were dynamically coupled to provide a representation of flood limits under various storm events, simulating 2-D floodplain and overland hydraulics:

- MIKE URBAN which includes a robust hydrologic component as well as a 1-D routing for storm flows through the pipe network.
- MIKE 11 which provides a 1-D representation of open channel flow.

- MIKE 21 which provides a 2-D representation of overland flow once storm flows exceed pipe capacity and/or overtop open channel banks.

When the above three computational models are coupled together as shown in the figure below, the model is collectively referred to as MIKE FLOOD. See Chapter 6 for more detail.



1.3.3 SDIP Determination

This SDMP recommends and describes nine SDIP projects that are focused on alleviating existing hydraulic deficiencies within the storm drainage system, as noted by Town staff from observations during storm events and as simulated in the model results. The SDMP also recommends and describes eight “Future SDIP” projects based on future Town buildout conditions. Opinions of probable project costs are provided for all existing and future SDIP projects. In addition to these SDIP projects, the report recommends several additional repair and rehabilitation projects for consideration. SDIPs are not fully-engineered designs and other solutions may be viable. However, the SDIPs are possible solutions to drainage problem areas and are vetted through the hydraulic model.

Though up to date at the time of publication, the SDMP model is a living model. If the model is significantly updated, the Town should provide updates to the SDMP to reflect these changes. The Town may update the hydraulic model when necessary to further define, evaluate, or design a SDIP project; incorporate new storm drainage system information; or enhance the model by extending modeling limits or including additional, smaller diameter pipelines.

The SDMP may also be used by the Town as the basis for SDIP planning and hydraulic analyses for future developments. GIS geodatabase enhancements that result from model updates may be utilized for other Town planning objectives such as utility planning for Specific Plan areas or for asset management. Formal update of this SDMP should be considered by Town staff as the regulatory framework changes and in conjunction with General Plan updates, as well as when development project planning needs arise.

2. SUMMARY OF EXISTING STORM DRAIN SYSTEM

2.1 Existing Creek Network

The main drainage in the Town is Windsor Creek, which flows through the Town, from the northeast to southwest, and discharges to Mark West Creek at a confluence approximately 3.7 miles southwest of the Town limits. Four primary creeks discharging to Windsor Creek are described in detail in this section. From downstream to upstream, they are: Airport Creek, Pool Creek, Starr Creek and East Windsor Creek. Secondary named creeks and minor creeks discharge to these primary creeks within the Town limits and are also included in the SDMP model. The complete list of modeled creeks is presented below. These creeks are shown on Figure 2-1.

- Windsor Creek
- Airport Creek
- Pool Creek
- Pruitt Creek – tributary to Pool Creek
- Faught Creek – tributary to Pool Creek
- Starr Creek
- Gumview Creek – tributary to Starr Creek
- Starr Creek Tributary #6
- Starr Creek Tributary #7
- East Windsor Creek
- East Windsor Creek Tributary #3
- East Windsor Creek Tributary #6
- East Windsor Creek Tributary #11
- Sotoyome Creek [2]

The creeks and tributaries are generally described from downstream to upstream in the following sections.

2.1.1 Windsor Creek

Windsor Creek begins downstream of the Town at the confluence with Mark West Creek and extends upstream, through the Town and approximately 6.5 miles beyond the northern boundary of the Town. This creek does not include any closed conduits other than bridge and box culvert

[2] Sotoyome Creek is located in a separate watershed, and crosses the Town limits near the northern edge of the Town and eventually discharges directly to the Russian River. Sotoyome Creek was not included in the model.

crossings of roads and railways within the Town limits. Its watershed is approximately 7.9 square miles.

Windsor Creek has been known to flood in the vicinity of the Sonoma-Marin Area Rail Transit (SMART) railroad crossing and the Town wastewater treatment plant (WWTP). It also intentionally floods to the Hiram Lewis Park Detention Basin located at the north end of Brooks Road, which includes an overflow spillway.

2.1.2 Airport Creek

Airport Creek begins downstream of the Town at the confluence with Windsor Creek and extends upstream approximately 2.5 miles easterly to the south of the Town's incorporated limits. Its watershed is approximately 2.6 square miles upstream of the confluence with Windsor Creek.

2.1.3 Pool Creek

Pool Creek begins downstream of the Town at the confluence with Windsor Creek and extends upstream approximately 3.3 miles easterly, traversing the Windsor Golf Course, the SMART railway, and Highway 101 to beyond the Town's limits. Its watershed is approximately 5.0 square miles upstream of the confluence with Windsor Creek. Pool Creek has been known to flood at Windsor Road and through the golf course.

Pool Creek has an unnamed tributary (POOLGOLFTRB) that begins downstream at the confluence with Pool Creek and extends upstream approximately 0.1 miles. Pool Creek's named tributaries include Pruit Creek and Faught Creek, as described below.

2.1.4 Pruitt Creek (Pool Creek Tributary)

Pruitt Creek begins downstream at the confluence with Pool Creek, immediately upstream of the Pool Creek and SMART railway crossing, and extends upstream approximately 1 mile southeasterly, traversing Shiloh Road and Highway 101 to beyond the Town's limits. Its watershed is approximately 3.7 square miles upstream of the confluence with Pool Creek. Pruitt Creek has been known to flood at the crossing of Shiloh Road, and at the Caltrans Highway 101 Shiloh Road northbound off-ramp.

2.1.5 Faught Creek (Pool Creek Tributary)

Faught Creek begins downstream at the confluence with Pool Creek, just downstream of the Pool Creek and Highway 101 crossing, and extends upstream approximately 0.3 miles easterly, traversing an open field and Highway 101, ending at Old Redwood Highway. The portion of Faught Creek between Highway 101 and Old Redwood Highway that is located in a commercial area (The Shiloh [shopping] Center) has been contained in a closed conduit system. Its watershed is approximately 1.2 square miles upstream of the confluence with Pool Creek.

2.1.6 Starr Creek

Starr Creek begins downstream at the confluence with Windsor Creek approximately 0.5 mile west (outside of) the Town's limits. The creek extends upstream approximately 1.8 miles northerly, traversing through undeveloped parcels up to the Town boundary at Starr Road where

the creek and a bypass pipeline run parallel to the Windsor High School sports stadium. The creek then traverses through the eastern edge of Keiser Community Park up to the crossing with Windsor River Road. North of Windsor River Road, the creek extends northeasterly through developed residential portions of Town using a series of various open channels and closed conduits, traversing the SMART railway, Highway 101, and Arata Lane to the north beyond the Town's limits. Starr Creek is mostly contained in closed conduits upstream of Highway 101 to the northern Town limits along Arata Lane. The overall Starr Creek watershed is approximately 1.3 square miles upstream of the confluence with Windsor Creek. Starr Creek has been known to flood near Windsor High School.

Starr Creek Tributaries #6 and #7 were also included in the hydraulic model, which are defined in Chapters 5 and 6. Starr Creek Tributary #6 branches off Starr Creek immediately south of Windsor River Road and generally heads northward to the east of Starr Road. Starr Creek Tributary #7 branches off Starr Creek in between Keiser Community Park and Windsor High School and generally heads northeastward into residential property across Windsor River Road.

Starr Creek Tributary #5 is a short open channel system segment of Starr Creek Tributary #6 that consists of overland flow across undeveloped parcels between Highway 101 and Arata Lane. One of these parcels is owned by the Town.

2.1.7 Gumview Creek (Starr Creek Tributary)

Gumview Creek begins downstream at the confluence with Starr Creek, just outside of Town limits, near (west of) the intersection of Starr Road and Reiman Lane. The creek extends approximately 0.9 miles northerly, traversing undeveloped parcels outside of Town limits, to the Town boundary at Windsor River Road. The creek then transitions to a combination of open channels and closed conduits through developed residential property. The creek again crosses into the western Town boundary and residential property just before terminating in undeveloped land along the Town boundary (note this final stretch of Gumview Creek is not included in the model). Gumview Creek's watershed is approximately 1.3 square miles upstream of the confluence with Windsor Creek.

2.1.8 East Windsor Creek

East Windsor Creek begins downstream at the confluence with Windsor Creek at the Town's WWTP. The creek then extends upstream approximately 1.6 miles northeasterly through the Town up to Foothill Regional Park. The East Windsor Creek watershed is approximately 1.2 square miles upstream of the confluence with Windsor Creek. East Windsor Creek has been known to flood in the vicinity of the SMART railroad crossing adjacent to the Town's WWTP.

Three tributaries of East Windsor Creek were also included in the SDMP model (Tributary #3, Tributary #6, and Tributary #11), which are defined in Chapters 5 and 6.

2.1.9 Sotoyome Creek (not included in SDMP model)

A small portion of the 3.2 square mile Sotoyome Creek watershed crosses the northwestern corner of the Town's incorporated limits. The creek extends from its confluence with the Russian River to the west of the Town, and traverses the SMART railway, the north portion of Town, and Highway 101 to its upstream limit north of the Town limits. Sotoyome Creek has been known to

flood between Highway 101 and Old Redwood Highway. There have also been reports of sedimentation of the creek at the Old Redwood Highway Bridge.

Sotoyome Creek is an isolated watershed not hydraulically connected with watersheds to the south and was therefore not modeled in the overall hydrologic/hydraulic model for the Town. Previous analyses of the Sotoyome Creek watershed were completed for the Town and for SMART. For the SMART project (Winzler & Kelly, 2009), a HEC-RAS model was developed beginning upstream of the SMART railway crossing, and extending upstream approximately 1,720 feet to just downstream of Highway 101. The *North Old Redwood Highway Area Utility Infrastructure Study* (Winzler & Kelly, 2012) provided the Town with an assessment of the storm drainage system within the planning area generally located north of Arata Lane and west of Highway 101. Modeling for the 2012 study utilized Sonoma Water HEC-RAS creek cross sections and Winzler & Kelly creek cross sections. The bridge crossing on Old Redwood Highway, located approximately 770 feet upstream of the downstream model limits, was included in the 2012 study. Recommended SDIPs from the 2012 study are incorporated into this SDMP.

2.1.10Watershed System Overview

Using GIS and topographic maps (seeSection 5.3 for details), GHD delineated the contributing watershed and sub-watershed boundaries for each of the creeks and tributaries listed above that were included in the SDMP model. As can be seen on Figure 2-1 much of the overall contributing watershed, especially east of Highway 101, is located outside of the Town limits where runoff is generated in rural areas and generally flows overland to open channels. The information was used to estimate respective flows within each watershed and route flows into the existing storm drainage pipe network and associated open channels. The watershed area and FMDM waterway designations for each creek and tributary included in the SDMP model are summarized in Table 2-1 below.

Table 2-1 Characteristics of Creeks included in the SDMP Model

Creek/Tributary	Watershed Area (square miles)	FCDC Waterway Designation [1]
Windsor Creek	7.9	Major
Airport Creek	2.6	Secondary
Pool Creek	5.0	Major
Pruitt Creek	3.7	Secondary
Faught Creek	1.2	Secondary
Starr Creek	1.3	Secondary
Gumview Creek	1.3	Secondary
Starr Creek Tributary #6	0.69	Minor
Starr Creek Tributary #7	0.20	Minor
East Windsor Creek	1.23	Secondary
East Windsor Creek Tributary #11	0.71	Minor
East Windsor Creek Tributary #6	0.66	Minor
East Windsor Creek Tributary #3	0.19	Minor
Excluded [2]	0.17	Minor
Grand Total	26.94	

Notes: (1) See Chapter 5 – Hydrology – for significance of FMDM waterway designation

(2) Sotoyome Creek watershed evaluated in the North Old Redwood Highway Area Utility infrastructure Study (Winzler & Kelly, 2012)

2.2 Existing Storm Drain Pipeline and Open Channel Network

GHD reviewed hard copy Town utility maps and GIS maps of the Town's existing storm drainage network. The storm drainage network is shown on Figure 1-1. The Town's overall storm drainage system consists of approximately 100 miles of 4- to 72-inch diameter pipelines, irregularly shaped culverts, and associated structures; and 20 miles of open channels of various sizes and shapes, draining to the creek network. Generally, the SDMP only includes the major storm drainage facilities (defined herein as pipelines equal to or greater than 24-inches in diameter, and their associated open channels) in the hydraulic model. In certain cases, to realistically connect certain drainage facilities, smaller 18-inch pipelines were incorporated into the model. The hydraulic model is discussed in more detail in Chapter 6. Modeled elements of the storm drain network are distinguished in Figure 1-1.

A summary of storm drainage system data based on the Town's GIS geodatabase is provided in Table 2-2. Pipelines smaller than 24-inches in diameter (with the exception of 18-inch diameter pipelines used for model continuity), were not included in the hydraulic model.

Table 2-2 Storm Drainage System Data

Pipe Diameter (in)	Modeled Length (ft) [1]	Total Length (ft) [2]
<18	0	98,211
18	1,758	136,813
24	77,493	83,913
30	45,811	47,467
36	53,629	53,629
42	15,441	15,951
48	23,614	23,614
54	7,093	7,093
60	23,514	23,514
66	6,879	6,879
72	23,356	24,094
Other [3]	3,651	13,300
Open Channels [4]	17,704	102,702
Creeks [5]	113,861	[6]

Notes:
(1) See Chapter 3 for discussion regarding data collection for storm drainage system elements to be modeled
(2) Total length based on Town storm drainage system GIS geodatabase
(3) "Other" includes irregular shaped culverts
(4) "Open Channels" includes drainage ditches
(5) "Creeks" includes primary and tributary creeks (Table 2-1)
(6) Creek total length not calculated beyond upstream Town limits; see Figure 3-1 in Chapter 3 for model extents

2.3 Other Storm Drainage System Components

The Town's existing storm drainage system only consists of pipelines, open channels, and creeks, as described earlier in this chapter. The storm drainage system does not include publicly-owned storm water pump stations or dedicated detention/retention ponds, with the exception of Hiram Lewis Park where the park area is used to manage flows from Windsor Creek that are diverted during larger storm events.

2.4 Opinion of Probable Cost for Storm Drainage Assets

As part of their fee study, the Town requested that GHD prepare an opinion of probable cost to replace all of the Town storm drainage assets. This information was used for the development of the 2019 Storm Drainage Impact Fee Study.

2.4.1 Opinion of Asset Costs

This section describes the costs and assumptions used to generate an opinion of probable costs for stormdrain pipes, manholes, road crossings, and other stormdrain infrastructure within the Town. Items not directly included in the Opinion of Probable Costs (see Section 7.1) were estimated based on a comparable size and conservatively rounded. The costs presented below

do not include any associated installation or construction costs and are dated July 8, 2019. Replacement Costs are presented in Table 2-3.

Pipe Replacement Costs

The MIKE URBAN storm drain model was quarried to quantify total length and diameter of pipes in the modeled storm drain network. All pipes with a diameter greater than 24 inches are included in the cost summary. Replacement costs are based solely on the pipe material only (assumed to be RCP) and does not represent any associated installation costs. Old Castle Infrastructure, Stockton California, provided material costs for the various pipe diameters.

Manhole Replacement Costs

The MIKE URBAN storm drain model was quarried to quantify the total number of, and diameter of, manholes in the storm drain network. Replacement costs are based solely on the manhole costs only and does not represent any associated installation costs. Old Castle Infrastructure, Stockton California, provided material costs for the various manhole diameters.

Culvert Replacement Costs

The MIKE 11 storm drain model was quarried to quantify the total number of, and diameter of, culverts located within the Town limits. The majority of culverts identified in the model fell into two categories, circular and box.

In order to develop a replacement cost for both the circular and box culverts, an average cross sectional flow area was determined for both circular and box culverts. The average circular culvert size was found to be 54 inches. Circular culvert costs are based on the pipe replacement costs for RCP pipe discussed previously.

The average box culvert size was found to be 12 feet wide by 8 feet tall. In general, box culverts are priced on a per project basis. In order to determine an approximate replacement cost, prior construction bid submittals were researched and an approximate cost was scaled to 2019 using Engineering News-Record (ENR) scaling coefficients.

Specific Stormdrain Project Costs

The Town of Windsor provided project costs for the Hiram Lewis Detention Basin project. The total cost was scaled to estimated 2019 values using the aforementioned ENR scaling coefficients.

The Starr Creek Inlet project costs were provided by the Town of Windsor and scaled to 2019 estimated costs using the ENR scaling coefficients. The cost per linear foot for the Starr Creek project was used to estimate the replacement costs for the Windsor Creek Inlets and the East Windsor Creek Inlet projects.

Assumptions

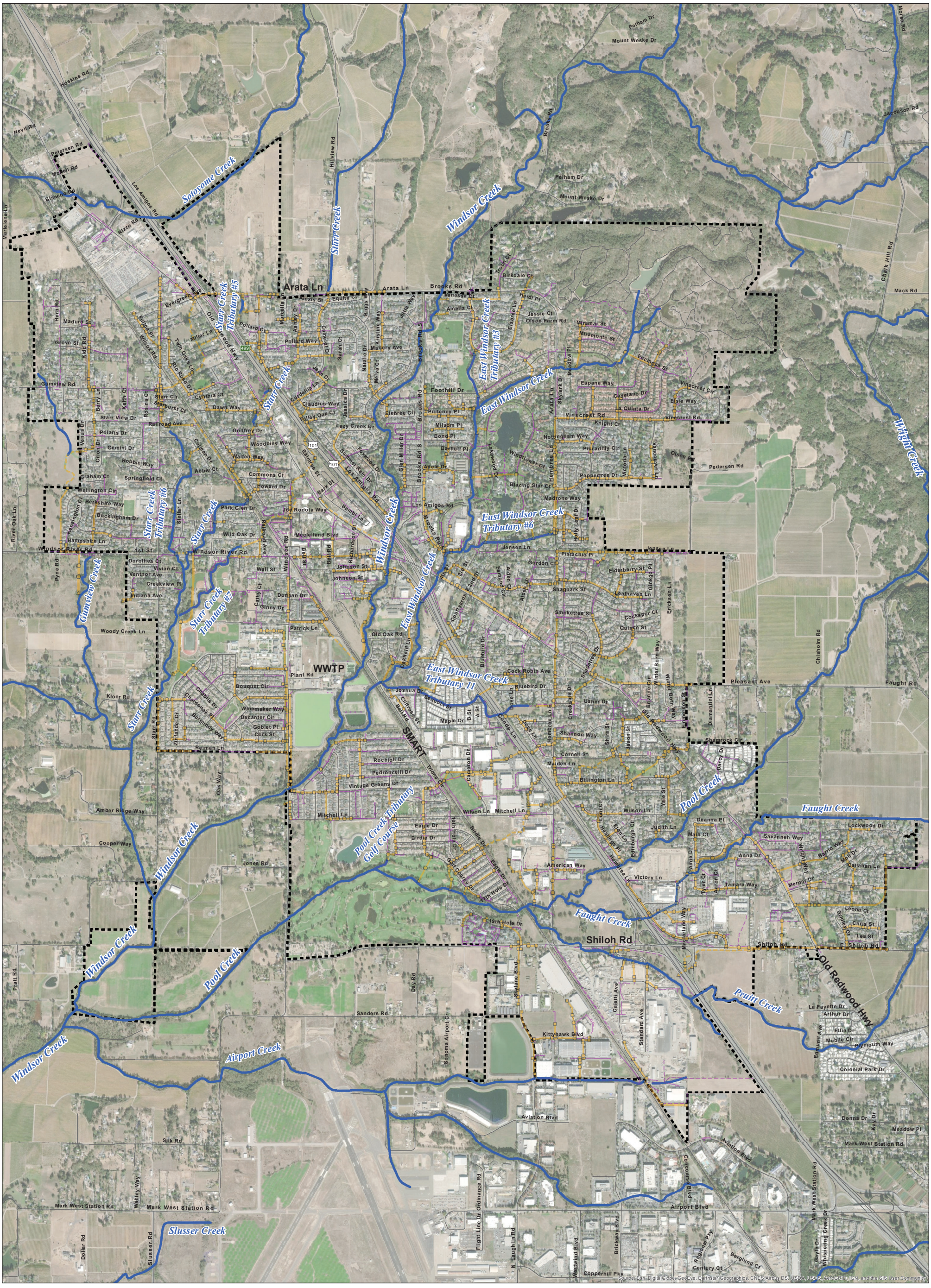
The following assumptions were made:

- Quantities for pipes, manholes, and outlets were estimated using the Town's GIS database and the SDMP storm drainage model

- Only pipes 24-inch diameter and larger were included
- Costs provided reflect material costs and do not include any installation costs or associated construction costs
- Replacement costs provided may vary based on the sourcing location of the material and the vendor supplier

Table 2-3 Replacement Costs

Stormdrain Pipes					
Pipe Dia. (in)	Quantity	Unit	Pipe Value ($/LF)	Total Pipe Cost	
24	77,507	LF	31	2,363,963	
30	51,367	LF	46	2,337,190	
33	1,006	LF	54	54,327	
36	53,629	LF	64	3,432,245	
39	524	LF	82	42,976	
42	16,232	LF	102	1,655,683	
48	22,452	LF	125	2,806,461	
54	7,093	LF	171	1,212,933	
60	23,563	LF	203	4,771,552	
66	6,879	LF	264	1,812,542	
72	23,356	LF	329	7,677,262	
			Sub Total	$	28,167,133
Manholes					
Manhole Diameter Size (in)	Quantity	Unit	Manhole Value ($)	Total Manhole Cost	
36	2	EA	960	1,920	
48	1,092	EA	1,270	1,386,840	
54	23	EA	1,450	33,350	
60	80	EA	1,600	128,000	
66	22	EA	1,990	43,780	
72	51	EA	2,300	117,300	
80	1	EA	2,800	2,800	
			Sub Total	$	1,713,990
Additional Infrastructure Items					
Additional Infrastructure Items	Quantity	Unit	Infrastructure Item Value ($/LF)	Total Infrastructure Cost	
Circular Culverts	1,535	LF	171	262,485	
Box Culverts	2,220	LF	1,200	2,664,000	
Outlet Structures	108	EA	1,410	152,280	
Hiram Lewis Detention Basin	1	EA	-	2,219,184	
Starr Creek Inlet 1	118	LF	992	117,041	
Starr Creek Inlet 2	20	LF	1,384	27,674	
Windsor Creek Inlet 1	120	LF	992	119,040	
Windsor Creek Outlet 1	39	LF	229	9,000	
East Windsor Creek Inlet 1	30	LF	992	29,760	
East Windsor Creek Outlet 1	39	LF	229	9,000	
			Sub Total	$	5,609,463
Total				$	35,490,586



Town Limits
Streets
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Modeled
Manholes, Modeled
Discharge Points, Modeled

Paper Size 22" x 34" (ANSI D)
0 450 900 1,350 1,800
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

Job Number 11159126
Revision 4
Date 07 Feb 2020

Creek Network

Figure 2-1

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 2-1 Creek Network.mxd
2235 Mercury Way Suite 150 Santa Rosa CA 95407 USA T 707 523 1010 F 707 527 8679 E santarosa@ghd.com W www.ghd.com
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Data source: PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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3. DATA COLLECTION AND FIELD SURVEY

This chapter describes the various tasks completed for the collection and preparation of data to be used for the SDMP. Tasks included the collection and review of existing records and collection and evaluation of new field data.

The Town's existing storm drainage system includes a network of closed conduits (i.e., pipelines and structures) and open channels (i.e., creeks and open channels). Figure 1-1 shows the Town's storm drainage system. Pipelines and open channels (including inlets and manholes) that are used in the hydraulic analyses are shown in orange. These pipelines are generally 24-inches or larger in diameter. Creeks and creek tributaries are shown on Figure 2-1. Unmodeled portions of the storm drainage system are shown in purple on Figure 1-1.

3.1 Data Collection and Field Survey Overview

In 2011, the Town contracted with Woolpert Inc. to develop a Digital Terrain Model (DTM) based on aerial imagery prepared by Woolpert Inc. for the United States Geologic Survey (USGS) in 2011. In 2013, the Town contracted with Geographic Technologies Group (GTG) to create a GIS geodatabase for the Town's pipeline network (one component of the storm drainage system) that utilized the DTM. The DTM and GIS geodatabase, along with the aerial imagery prepared by Woolpert Inc. in 2011, provide the foundation for the Town's ongoing engineering evaluation of the storm drainage system.

To develop the dataset for the SDMP hydrologic and hydraulic model, GHD and ESA collected and reviewed existing data and conducted new field surveys. Primary data sources for the pipeline network included Town records, and primary data sources for creeks included prior studies prepared by and Boyle. First, GHD and ESA obtained existing resources from the Town and Sonoma Water, as well as other sources including:

- Town aerial imagery (Woolpert Inc. 2011) and DTM (Woolpert Inc. 2011);
- Town GIS geodatabase (GTG, 2013);
- Town Storm Drain Utility Basemap (Town, last update 2011);
- FEMA Flood Insurance Rate Maps (FIRMS) (FEMA);
- Prior creek surveys and model results (SCWA 1989; Boyle 1999);
- Town record drawings (various years); and
- Other Planning Documents (various years).

See Section 3.5 for a complete list of resources reviewed during the data collection process.

Storm drainage features in the GIS geodatabase that were relevant to the SDMP hydrologic and hydraulic model were identified and flagged for field verification and additional data collection. Site reconnaissance and field surveys were conducted to observe the condition of the various pipeline and creek network features, confirm existing data, and collect additional data required for the model.

Field surveys included the following components:

- Creek cross section surveys: Measurement of the creeks at targeted locations. Measurements from top of bank to top of bank augment the Town's DTM. Measurements were also taken at bridge structures located on the creeks to provide inlet and outlet dimensions (see Figure 3-1);
- Storm drainage structure (e.g., inlets, manholes) surveys: Measurements and observations of below-grade structures; and
- Pipelines and open channel surveys: Measurements and observations for the ends of pipelines and typical cross section observations for open channels.

The field surveys sometimes revealed inconsistencies in the existing datasets. GHD and ESA worked with the Town to conduct additional site-specific field investigations to clarify data gaps and resolve discrepancies found between the GIS geodatabase, field observations, and record drawings.

At the completion of the field survey work, the GIS geodatabase was updated to reflect field survey collected by GHD and delivered to ESA for preparation of the hydrologic and hydraulic model. Detailed accounting of the original available data and field survey data is discussed in Chapters 5 and 6. Data collection and field survey data activities are discussed in detail below.

3.2 Review of Existing Available Data

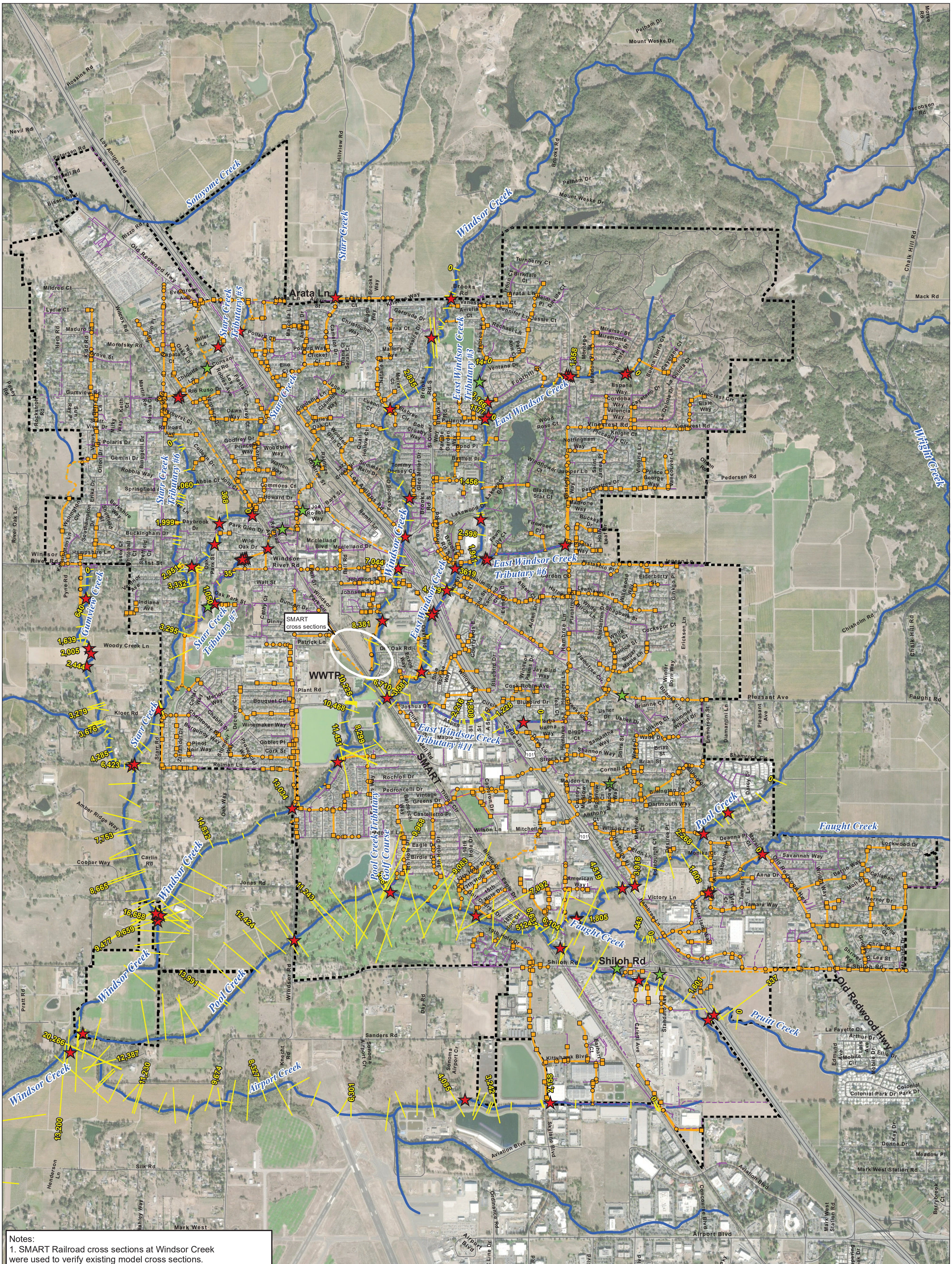
3.2.1 Aerial Imagery

The aerial imagery used for the SDMP was prepared for the Town by Woolpert Inc. in 2011 via its contract with the USGS[3]. The image was prepared by color digital aerial imagery acquisition and color digital orthophoto production at a 0.25-foot ground sample distance (GSD) for approximately 25 square miles of the San Francisco, CA 133UA. The aerial photography plan and the 1,250-feet by 1,250-feet digital orthophoto tiles were based on the *U.S. National Grid*. The final product consists of color digital orthophoto tiles at 0.25-foot pixels in TIFF format with ASCII TFW file.

3.2.2 Digital Terrain Model (DTM)

The Town's DTM dataset, prepared by Woolpert Inc. in 2011 following completion of the aerial survey, is a surface elevation model made up of a collection of points with x-, y-, and associated z-values. The DTM data was delivered to the Town as a terrain dataset and ArcGRIDs at a one foot pixel resolution. It includes a series of points representing the high and low extremes in the terrain that define topographic features such as streams, levees, ridges, and other phenomena. The DTM, which is generated from photogrammetrically compiled mass points and break lines, was used to generate one foot contours and has the following accuracy: 0.5-ft horizontal and 0.6-ft vertical. These contours were used for the SDMP model. Spot heights are provided as a separate feature in areas where the contours do not properly depict the surface.

[3] USGS Contract: San Francisco, Sacramento, Stockton, Modesto, Windsor, CA 133UA 0.25-Foot Ortho with Upgrades Aerial Imagery Acquisition and Digital Orthophoto Production Task USGS CONTRACT NO: G10PC00057 TASK ORDER NO: G11PD00296.



Notes:
1. SMART Railroad cross sections at Windsor Creek were used to verify existing model cross sections.
2. Creek stations begin at 0 at the upstream end of the creek, consistent with the hydraulic model.
3. For clarity, not all cross sections are labeled with creek stations. The first, last and every fifth cross sections are labeled.

Town Limits
Streets
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Modeled
Manholes, Modeled
Discharge Points, Modeled
Surveyed Cross Sections
Open Channel Hand Sketches
Model Cross Sections & Stations (ft)

Paper Size 22" x 34" (ANSI D)
0 450 900 1,350 1,800
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

Stream and Creek Cross Sections

Job Number	11159126
Revision	5
Date	07 Feb 2020

Figure 3-1

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 3-1 Cross Sections.mxd

2235 Mercury Way Suite 150 Santa Rosa CA 95407 USA T 707 523 1010 F 707 527 8679 E santarosa@ghd.com W www.ghd.com

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Data source: PRMD, Town Limits, 2013; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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The DTM horizontal datum is NAD 83 HARN State Plane CA2 (US-Feet); the vertical datum is NAVD 88.

3.2.3 FEMA Flood Insurance Rate Maps

GHD obtained FEMA Flood Insurance Rate Maps (FIRMS) from the FEMA website. The main creeks within the overall Windsor watershed, excluding Faught Creek and Sotoyome Creek, have been modeled by FEMA. Hydraulic modeling results for the SDMP were compared with the floodplain extent and floodplain areas were generally consistent between the FIRMS and modeling results. FEMA information was also used to confirm the downstream water surface elevation for Windsor Creek, which was used as a boundary condition for the modeling. The FEMA 100-year event flooding extent is shown in Figure 1-2 presented in Chapter 1. Modeling results are presented in Chapter 6.

3.2.4 Existing Creek Surveys and Model Cross Sections

There are four primary creeks (plus tributaries) that discharge to Windsor Creek and route storm water through the Town of Windsor:

- Windsor Creek
- Airport Creek
- Pool Creek
- Pool Creek Tributary Golf Course (designated in model as POOLGOLFTRB)
- Pruitt Creek – tributary to Pool Creek
- Faught Creek – tributary to Pool Creek
- Starr Creek
- Gumview Creek – tributary to Starr Creek
- Starr Creek Tributary #6
- Starr Creek Tributary #7 (designated in model as STARRTRB and STARRTRB_Upper)
- East Windsor Creek
- East Windsor Creek Tributary #11
- East Windsor Creek Tributary #6 (designated in model as EWTRB_X)
- Unnamed East Windsor Creek Tributary #3 (designated in model as EW_OD)
- Sotoyome Creek[4] (Note that analysis for this creek was provided in a separate study: *North Old Redwood Highway Area Utility Infrastructure Study*, Winzler & Kelly, March 2012)

[4] Sotoyome Creek is located in a separate watershed, and crosses the Town limits near the northern edge of the Town and eventually discharges directly to the Russian River.

These primary creeks and select tributaries were included in the hydraulic model (with the exception of Sotoyome Creek). See Section 2.1 for a discussion of the existing creek network.

Existing Model Creek Cross Section Review

Hard copies of prior creek models and work maps were collected from the Town and Sonoma Water and reviewed for relevance to the SDMP analyses. Many of the creeks studied in the SDMP were modeled by Sonoma Water (formerly SCWA) for the 1989 *Windsor Area Master Drainage Plan* (HEC-2 model) and/or Boyle Engineering for the 1999 *Cumulative Drainage Impact Mitigation Program Update Report* (HEC-RAS model)

Based on an initial comparison of the available HEC-RAS cross sections with the Town's aerial topography, it was apparent that the HEC-RAS stationing established by the former model's downstream reach lengths did not entirely match the channel lengths identified by current aerial mapping. Cross sections at known locations were identified and intermediate HEC-RAS cross sections between structures were then best fit using the following steps: 1) developing a "model length" to "actual channel length" ratio; and 2) then georeferencing the cross section into the aerial mapping to allow for field verification of cross sections.

The Boyle HEC-RAS models indicate that the HEC-2 and later HEC-RAS model cross sections may not have been entered in the current conventional HEC-RAS format (i.e., left to right looking downstream) in all cases. To try and better understand this issue, a representative amount of cross sections were reviewed for each creek by comparing left and right cross section end elevations between the HEC-2 and HEC-RAS models, as well as against the elevations shown on the georeferenced section locations on the aerial mapping. The comparison was prepared in spreadsheet format and provided to ESA for use in preparing the creek model (MIKE 11). Modeling use of creek cross sections is described further in Chapter 6. Model cross sections that were a poor match were not used for the SDMP creek model, especially where adequate cross sections information was otherwise available at the location of the poor match.

In addition to the 1989 Sonoma Water HEC-2 model and 1999 Boyle HEC-RAS model, cross sections from a previous study for the SMART railroad crossing of Windsor Creek (Winzler & Kelly, 2009) were incorporated into the SDMP model.

GHD and ESA also reviewed Town and Sonoma Water record drawings for creek and channel improvements, including constructed bypass systems, which would impact flow routing.

Existing Sotoyome Creek Information

Hydraulic evaluation of Sotoyome Creek was prepared by Winzler & Kelly in 2012 for the North Old Redwood Highway Area Utility Infrastructure Study. Evaluation included assessment of utility infrastructure within the study boundary, including the storm drainage system, and preparation of recommended utility infrastructure improvements within the study boundary. Recommendations from the study were used for preparation of the storm drainage improvement projects (SDIPs) for this SDMP, including hydraulic improvements for Sotoyome Creek in the vicinity of the existing bridge structure at Old Redwood Highway.

The study included preparation of creek cross sections and characterization of flooding in the Sotoyome Creek watershed located between Highway 101 and the SMART railway. Detailed

hydraulic evaluation for the Sotoyome Creek watershed was not completed for the SDMP for two primary reasons, which were discussed during scoping of the SDMP project: 1) Detailed analysis was already completed for Sotoyome Creek, including recommendations for improvements to the creek and tributary watershed; and 2) the Sotoyome Creek watershed has little overlap within Town limits and is separate from the Windsor Creek watershed that encompasses the majority of the Town.

3.2.5 Town Storm Drain Utility Basemap

The Town maintains a CAD storm drain utility basemap that provides non-spatially located pipe and structure information for the storm drainage system. Map information is used for field work or in project planning by various Town and consultant staff. The aerial imagery completed by Woolpert Inc. in 2011 superseded much of the information in the storm drain utility basemap, with the aerial mapping creating spatially located structures for storm drainage system features (i.e., structures). The storm drainage system features provided a basis for preparation of the storm drainage system GIS geodatabase, which is described in the following section.

GHD and ESA used the most recent version of the existing storm drain utility basemap (2008) to clarify field work for the SDMP and connectivity of storm drain system components in the model.

3.2.6 Town GIS Geodatabase

Before initiating field surveys, GHD reviewed and updated the Town's existing GIS geodatabase (GTG, 2013). The geodatabase serves as the primary dataset for the Town's storm drainage system features and also serves as the primary dataset for the SDMP model.

First, GHD identified all features (i.e., inlets, outlets, pipelines, etc.) in the GIS geodatabase to be modeled; all features flagged for modeling would require field surveys. The logic for selecting features for survey and modeling was as follows:

- Identify pipelines greater than or equal to 24-inches in diameter;
- Identify associated inlets, manholes, and outlets;
- Identify additional open channels and culverts needed for connectivity in the modeling;
- Identify pipelines equal to or less than 50 linear feet (LF). The following rules were established for these pipelines to ensure that new field survey data would be consistent with model requirements:
  - If the subject pipeline is between two other pipelines that will be included in the model, or is the last section before the discharge point, field data will be collected and it will be included in the model. Once the pipeline slope is understood, the subject pipeline data will be merged in the GIS database with the upstream or downstream pipeline as is most appropriate for modeling; and
  - If the pipeline is at the upstream part of the run, it is eliminated from the GIS database and field data is not collected.

Second, GHD prepared the model GIS dataset to accept new field survey data by completing the following steps:

- Identify missing line and point features (i.e., features that do not exist in the GIS geodatabase);
- Confirm all lines and points are joined together; and
- Identify areas that are shown conceptually in the GIS geodatabase and flag for survey.

The GIS data review identified several areas that needed input from the Town. GHD produced maps of these areas, the Town marked up the maps, and GHD incorporated the changes into the model GIS database.

3.3 New Creek Field Surveys

As can be seen from the overall contributing watershed boundary surrounding the Town (see Figure 3-2), much of the watershed, especially east of Highway 101, is rural with runoff flowing to open channels. Understanding the interaction between creeks and the closed conduit storm drainage system is critical in developing meaningful recommendations for the SDMP. Therefore, accurate information about the creeks was needed to develop the SDMP hydraulic model.

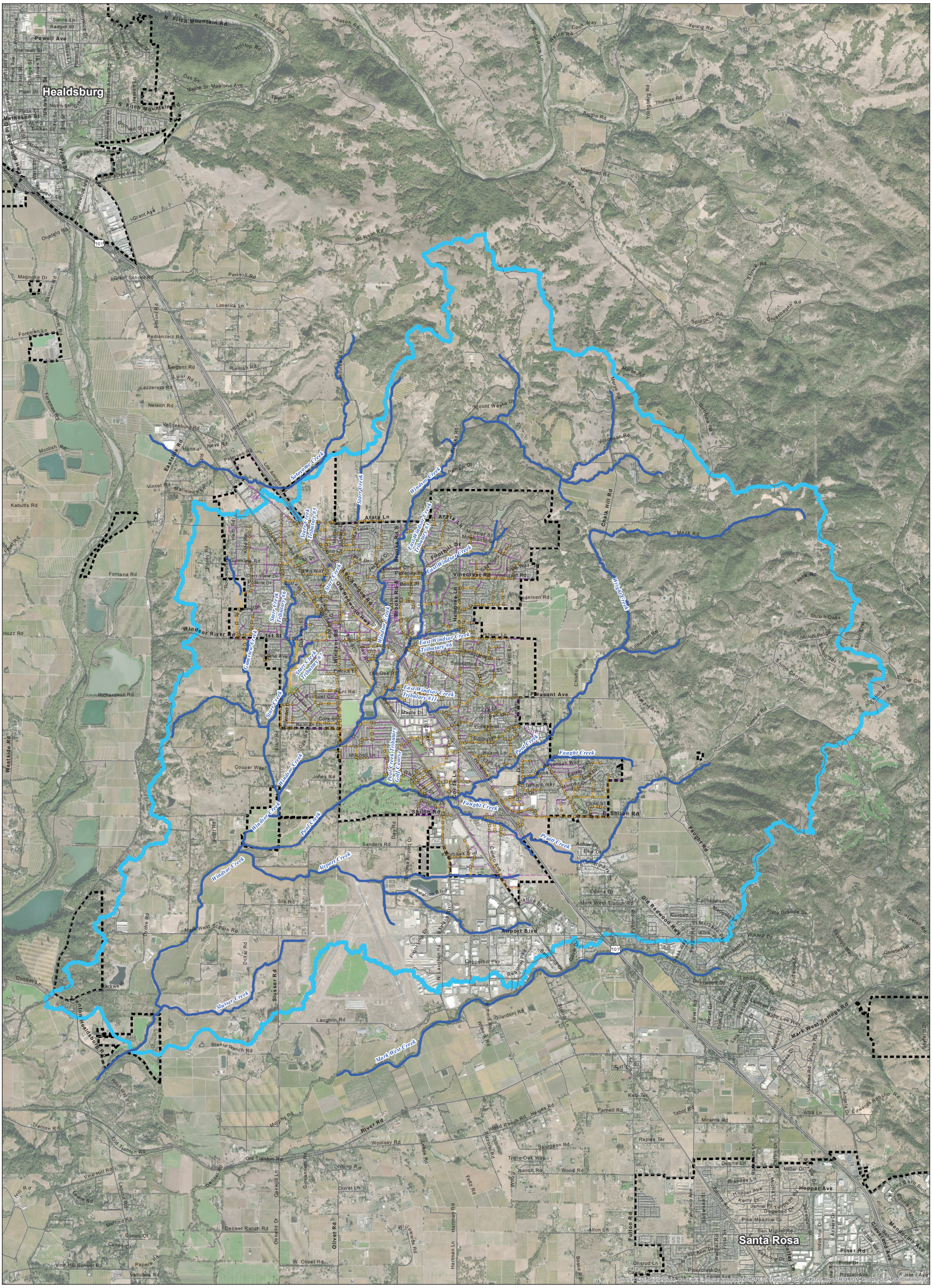
The two most important elements in accurately defining the creeks are creek cross sections and channel roughness, which is estimated using Manning's "n". This value is dependent on a number of factors, most notably channel bottom and bank material characteristics, channel meander and shape, and channel vegetation/obstructions. Typically, in modeling open channels, the Manning's "n" value is separately defined for the main channel and its right and left overbank. The methodology for collecting creek data needed to develop the hydraulic model is described below.

3.3.1 Creek Data Collection Methodology

First, a work plan was prepared prior to commencing field surveys to achieve consensus among the project team for field survey objectives, data needs, and field procedures. The Creek Survey Work Plan was organized into two sections: Data Review and Model Development.

Following review of the Creek Survey Work Plan, GHD used a combination of conventional (total station) and GPS survey methods to collect 54 cross sections throughout the Town's creek network, as well as 12 hand sketches for smaller open channels. The focus of the creek cross section survey was to verify existing HEC-RAS cross sections at approximate 2,000-foot intervals to: determine if the existing HEC-RAS cross sections should be used in the SDMP MIKE 11 model or be discarded; and augment the existing cross section dataset for development of the MIKE 11 model. See Section 1.2.2 for a summary of the MIKE 11 model and Chapters 5 and 6 for detailed description of the model.

The major portion of field creek survey work began on August 12, 2013 and was substantially completed in October 2013. Additional follow up field work for the creeks was completed in March and April 2014 during Phase 1 and in August 2018 during Phase 2.



Paper Size 22" x 34" (ANSI D)

0 1,000 2,000 3,000 4,000

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drain Master Plan

Watershed

Job Number	11159126
Revision	5
Date	07 Feb 2020

Figure 3-2

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N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 3-2 Watershed.mxd
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Data source: PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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Figure 3-1 indicates the location of cross sections used for hydraulic modeling, as described in Chapters 5 and 6. Reference cross sections from prior modeling analyses (i.e., 1999 Boyle Report) are shown on the figure in yellow. Field-surveyed cross sections are shown on the figure with red stars. The location for hand sketches is also noted on the figure with green stars. The combination of these surveyed cross sections and the additional cross sectional data noted above was used by ESA for development of the MIKE 11 model.

Figure 3-1 indexes the creek station for the cross sections (i.e., unique location with distance from upstream end of creek noted in feet), with the first, last, and every fifth cross section labeled. Creek station information provided on Figure 3-1 correlates to tabular cross section data that is provided in Appendix C (6A and 6D).

3.3.2 Geomorphology Site Reconnaissance

First, ESA conducted site reconnaissance of the creeks on July 18 and 26, 2013 to observe channel conditions and to obtain georeferenced photographs of the creeks. The site reconnaissance was conducted by the project's lead modeling engineer and fluvial geomorphologist. The georeferenced photos were compiled for use in development of the hydraulic model and in assigning channel roughness values to each creek. The project team noted significant hydraulic structures and bypasses present within the creeks, which are confirmed to be present within the storm drain system portion of the hydraulic model. These include storm drain bypasses on Starr Creek upstream of Windsor River Rd, on Faught Creek immediately downstream of Old Redwood Highway, and on both Windsor Creek and East Windsor Creek upstream of the railroad tracks.The reconnaissance was also useful in understanding connectivity with the Town's storm drainage system, and in understanding changes in conditions since the development of the Sonoma Water and Boyle hydraulic models. Results of the site reconnaissance are incorporated into the same model analyses.

3.3.3 Field Verification of Pipe Outlets from the Pipe Network

During surveys of the creek cross sections, field data was collected for pipe outlets where the field crew was able to access the pipe end (despite heavy vegetation or other barriers). Where feasible, vegetation was cleared by Town staff and GHD collected pipe outlet data. Outlet data was added to the GIS geodatabase that was prepared for this SDMP. Outlet locations are shown on Figure 1-1 (noted as "discharge points").

For pipe outlets that could not be accessed in the field, assumptions were made for modeling purposes. Pipe outlets to creeks were generally assumed to be located near the creek thalweg elevation and the final pipe reach in the pipe network surcharged during high flow events in the creeks (i.e., the hydraulic grade line is not impacted by the elevation of the pipe outfall when submerged).

3.3.4 Field Verification of Existing Cross Sections

Preliminary cross section surveys were obtained, generally at or near structures where it was believed that HEC-RAS cross sections could most easily be replicated by field survey data. These were compared against the past HEC-RAS model cross sections for accuracy. A preliminary decision matrix was developed depending on results that ranged from accepting past

HEC-RAS model cross sections if the comparison was good, to abandoning the HEC-RAS cross sections that were a poor match and surveying additional cross sections and interpolating between them. The actual methodology used in evaluating cross sections for use in the MIKE 11 model is described in Chapter 6.

Figures 3-3 and 3-4 represent good and poor matches between surveyed cross sections and HEC-RAS model cross sections, respectively. As shown in Figure 3-3, the top of bank elevations (furthest left and right points on the blue section) are several feet lower compared to the HEC-RAS section (shown in red). In contrast to Figure 3-3, a relatively good correlation is depicted in Figure-3-4 between a surveyed cross section and HEC-RAS cross section. GHD-surveyed cross sections were utilized and replaced prior HEC-RAS cross sections. Surveys were only to the top of bank, resulting in changes to the DTM sections in the creek channels, though the overbanks were not changed.

3.3.5 Additional Creek Field Surveys

Some of the modeled creeks reaches included in the prior HEC-2 and HEC-RAS models do not extend sufficiently upstream or downstream to include all the storm drain outlets currently existing within the Town. For example, the East Windsor Creek upstream extent in the prior HEC-RAS model is currently at Lakewood Drive. East Windsor Creek Tributary #3 was also not previously included in previous master plan modeling efforts, and there is significant storm drainage infrastructure tying into this system. Faught Creek, upstream of Highway 101, also has an open channel component that has not previously been modeled.

The need for additional creek surveys was discussed with the Town in March 2014 in order to fill data gaps. This includes Windsor and East Windsor Creeks near Highway 101, East Windsor Creek near Bell Road, Gumview Creek, and Windsor Creek downstream of the confluence of the Windsor Creek network. Field data was collected by GHD at seven locations on March 21, 2014 and provided to ESA for use in preparation of the model.

The need for additional upstream creek surveys was discussed with the Town in April 2014. ESA then completed the additional surveys on April 24 and 25, 2014, collecting 30 additional cross sections.

At the completion of the Phase 1 SDMP, additional creek surveys were recommended, specifically to include the upstream extent of Starr Creek Tributary #7 near Wild Oak Drive and Windsor River Road. All surveyed cross sections, including those surveyed as part of Phase 2, are shown on Figure 3-1.

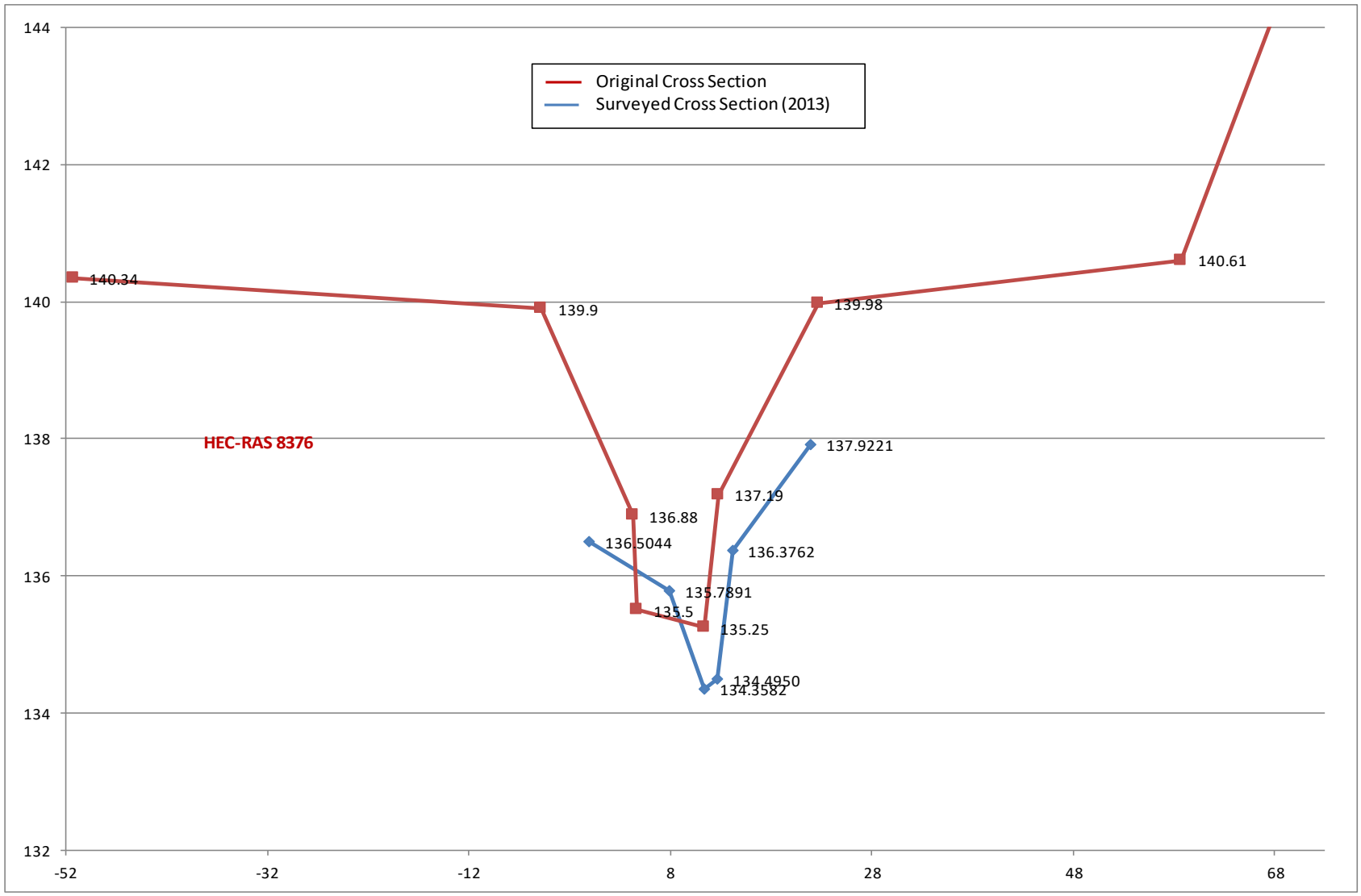


Figure 3-3 East Windsor Creek – Cross Section 8376 (Bad fit between HEC RAS Cross Section [Boyle 1999] and Surveyor Cross Section [GHD 2013])

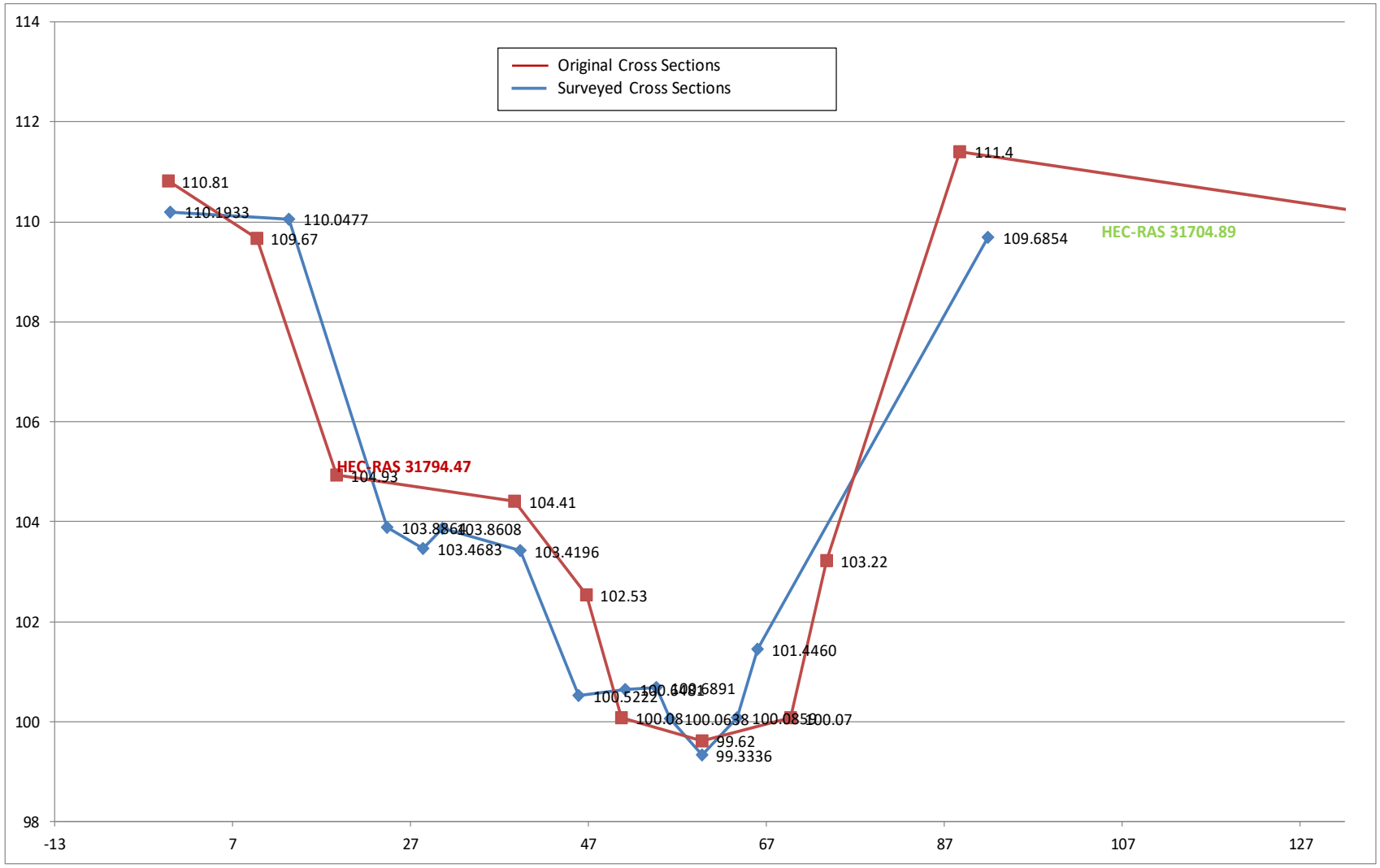


Figure 3-4 East Windsor Creek – Cross Section 31704.89/31794.47 (Good fit between HEC RAS Cross Section [Boyle 1999] and Surveyor Cross Section [GHD 2013])

3.4 Pipeline Field Surveys

Pipeline network features that were identified in the GIS geodatabase review for field verification and additional data collection included outlets, inlets, manholes and gravity mains associated with 24-inch diameter and larger pipes. Other drainage network features included culverts, and open channels that were needed for model continuity. Field surveys were conducted to observe the condition of the various features, confirm existing data, and collect additional data required for the model.

A work plan was prepared prior to commencing the pipeline network field survey to determine field survey objectives, data needs, and field procedures. The Pipe Survey Work Plan was organized into the following sections:

- Data to be Collected;
- Features Surveyed; and
- Collection Methodology

The following sections describe the field and office work for data collection.

3.4.1 Pipeline Data Collection Methodology – GIS based

Two field personnel from GHD were assigned to collect pipeline network data. Each person had an electronic tablet (iPad) for data collection. The Town provided field personnel for each GHD staff, thus forming two teams, each with one GHD and one Town representative.

Field survey work began on June 25, 2013 and was substantially completed in October 2013. Additional follow up field work was completed after October for areas which were difficult to access or had complicated pipeline networks. Both project teams met as a group at the beginning of each week of field work to review the Pipe Survey Work Plan and discuss project safety considerations.

Field surveys typically started at pipe network discharge points and proceeded upstream. Photographs were taken using the iPads at each survey location and were tied to the feature within the GIS geodatabase (e.g., photograph of a culvert inlet). Photographs are accessible via links established in the GIS geodatabase. When a notable condition was encountered that was not accounted for in the GIS data entry fields, field personnel prepared one of the following for documentation of the condition, which were later reconciled into the GIS geodatabase during post processing:

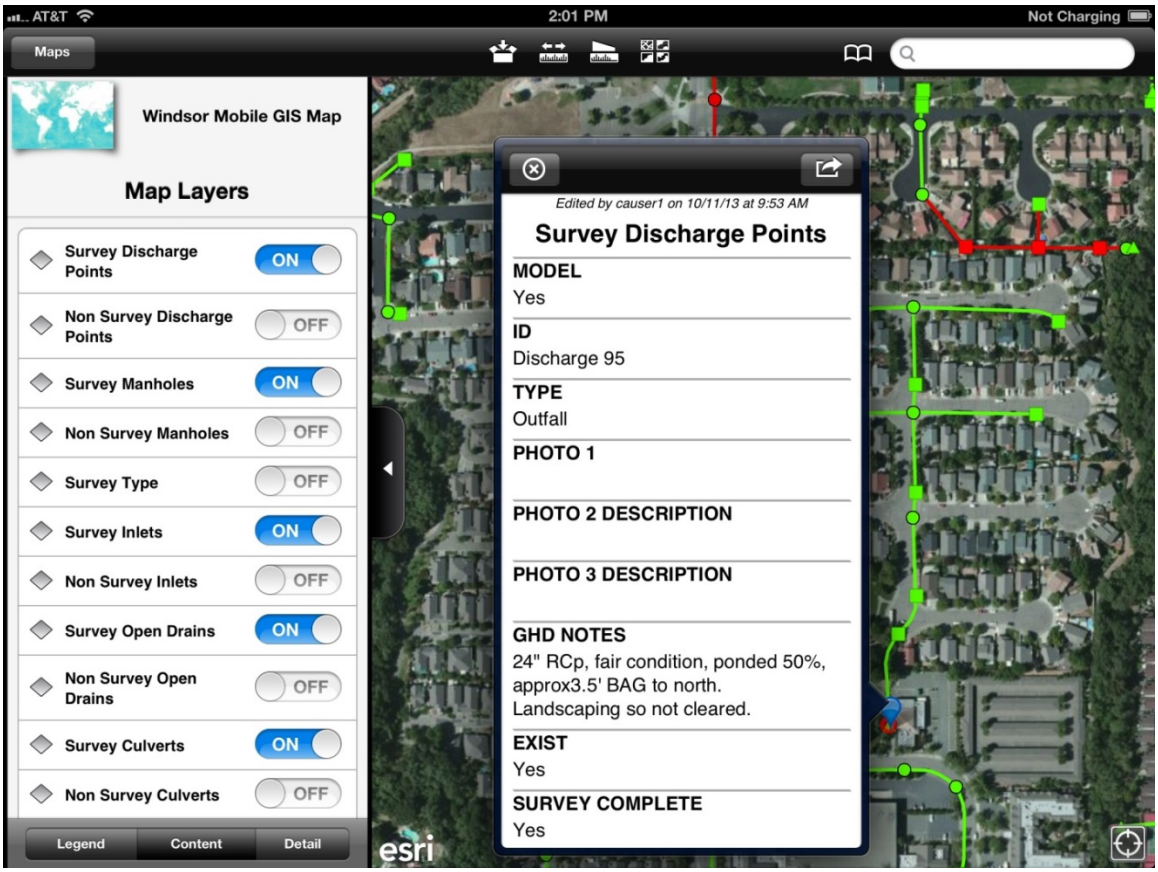
- Hand sketch and a photograph taken of the sketch;
- Photograph only; and/or
- Written notes.

Data collected during the field surveys was continuously uploaded to an ArcServer and monitored by GHD office personnel as the work progressed. GHD office and field personnel coordinated during the work for data inquiries. A screen capture of the iPad typical display is provided below. A typical display included aerial photo, pipeline network, layer options, and a selection table of

fields for data input. Specific data targeted for each feature class is summarized below in Table 3-1.

Table 3-1 Feature Class Data Collection Targets

Feature Class	Data Collection Targets
Discharge Points	Type (outfall, other)
Inlets	Type (grated, curb, combination, culvert, other) Inlet Dimensions Structural Condition (poor, fair, good) Structural Issue Sedimentation
Manholes	MH Diameter Structural Condition (poor, fair, good) Structural Issue Sedimentation
Culverts	Material Diameter / shape (circular, box, irregular)
Open Channels	Channel dimension, description, material
Gravity Mains	Material (confirm if possible) Diameter (confirm if possible) Upstream Dip Downstream Dip



3.4.2 Pipeline Network Features Surveyed

The following storm drainage system pipe network features were surveyed:

- All pipelines 24-inches in diameter and larger and structures on those pipelines;
- Associated outlets, inlets, manholes, culverts, open channels, and gravity mains; and
- Additional pipelines need for connectivity and structures on those pipelines.

A combination of conventional survey and field observations was used during the creek outlet survey to establish the pipe invert elevation, where necessary, for modeling purposes. Due to tree canopy and/or heavy brush, many pipe outfall locations were not accurately mapped in the GIS geodatabase via the aerial imagery and resulting DTM. To address this, field teams conducted preliminary visits to creek outlets as part of the pipeline network feature survey to verify that the outlets could be located either with or without clearing of brush, and by conventional survey or field observations. If accessible, data was collected for outlets during the pipeline network survey. If not immediately accessible, Town crews cleared brush to expose pipe outlets. Also, data for some outlets was collected by conventional survey during data collection for creek cross sections. With these efforts, data was collected for most, but not all, outlets.

Pipeline elevations were established by measuring the depth of storm drainage system structures (i.e., drop inlets, catch basins) from the rim elevation to invert elevations and using interpolation between certain manholes (assuming straight line grades). Rim elevations were obtained from the aerial mapping/DTM developed for the Town.

Record drawings were reviewed throughout the field survey process to verify the location of drainage structures.

Table 3-2 summarizes the number of pipeline network features targeted for surveying, the actual features surveyed, and the features identified to be carried forward into the SDMP model. Figure 1-1 also displays this information graphically.

Table 3-2 Pipeline Field Survey Data Statistics

Feature Class	Targeted for Survey	Surveyed	Identified for Modeling
Outlet Points	166	193	125
Inlets	842	898	685
Manholes	581	636	571
Culverts	36	52	22
Open Channels	72	85	41
Gravity Mains	1,323	1,367	1,265

The SDMP modeled pipeline network is comprised of pipes ranging in diameter from 18 to 72 inches, along with a few non-circular shapes labelled as “other” in Table 3-3 below. Table 3-3 summarizes the distribution of pipe sizes and associated mileage that was surveyed and is included in the model.

Table 3-3 Distribution of Pipeline Sizes in Model Network

Pipeline Diameter	Length (Miles)
18 inches	0.3
24 inches	14.7
30 inches	9.0
36 inches	10.2
42 inches	2.9
48 inches	4.5
54 inches	1.3
60 inches	4.5
66 inches	1.3
72 inches	4.4
Other	0.7
Total	53.8

Pipe material helps define pipe capacity for the modeling. It was often difficult to identify the pipe material during the field survey but, where possible, the field crew confirmed or updated the pipe material in the GIS geodatabase for use in the SDMP model. Table 3-4 summarizes the distribution of pipe material by miles for the overall storm drainage network in the GIS database.

Table 3-4 Distribution of Pipeline Material (Total Storm Drainage Network)

Pipeline Material	Length (miles)
Brick	0.1
CIPP	25.4
CMP	1.37
CP	11.2
DIP	<0.1
HDPE	4.1
PE	1.7
PP	<0.1
RCP	5.9
Other /Unknown	51.3

Notes: *CIPP = cast in place concrete pipe*
CMP =corrugated metal pipe
CP = concrete pipe
DIP = ductile iron pipe
HDPE = high density polyethylene
PE = polyethylene pipe
PP = polypropylene pipe
RCP = reinforced concrete pipe
Other/Unknown = arch culvert, oval, rectangular/box

Inlets and manholes were surveyed for vertical geometry and to record general structural condition, structural issues, and sedimentation. Tables 3-5 and 3-6 summarize the results of the inlet and manhole surveys. Results are also shown on Figures 3-5 and 3-6. Information provided in the following tables can also be queried in the GIS geodatabase. See Section 7.6 in Chapter 7 for a description of the problems noted during field surveys for the high priority structures (i.e., poor rating) noted in the tables. The structural conditions presented are from Phase 1 of the SDMP effort and might have been altered or repaired since completion of Phase 1, or they may be altered or repaired at a future time. Thus, the information presented herein should be considered as baseline conditions for the 2017 SDIP evaluation period, and not used for later planning without reevaluation of these findings.

Table 3-5 Inlet Structure Conditions

Conditions Evaluated	Condition Rating	# of Inlets Surveyed	% of Inlets Surveyed
Structural Condition (See Fig 3-5)	Poor	25	3.6
	Fair	83	11.8
	Good	595	84.6
Structural Issues(1) (See Fig 3-6)	Critters	1	0.1
	Cracked Structures	26	3.7
	Grate Damaged	5	0.7
	Other(2)	57	8.1
	Open Joint	1	0.1
	Pipe Connection Misalignment	2	0.3
	Sheen or Smell	1	0.1
	Trash Accumulation	54	7.7
Sedimentation	Negligible (<1”)	482	73.5
	Moderate (1-6”)	141	21.5
	Significant (>6”)	28	4.3
	Plugged	5	0.8

Notes: (1) “Structural Issues” does not necessarily indicate a poor condition.

(2) Other includes ponded water, overgrown, and/or below grade. Ponded is the most common “other” condition note.

Table 3-6 Manhole Structure Conditions

Conditions Evaluated	Condition Rating	# of Manholes Surveyed	% of Manholes Surveyed
Structural Condition (See Fig 3-5)	Poor	2	0.4
	Fair	31	5.9
	Good	493	93.7
Structural Issues[1] (See Fig 3-6)	Cracked Structures	7	1.3
	Grate Damaged	1	0.2
	I&I Indications	6	1.1
	Other[2]	34	6.5
	Open Joint	2	0.4
	Pipe Connection	1	0.2
	Misalignment	10	1.9
	Trash Accumulation		
Sedimentation	Negligible (<1")	404	78.0
	Moderate (1-6")	93	18.0
	Significant (>6")	21	4.1
	Plugged	0	0.0

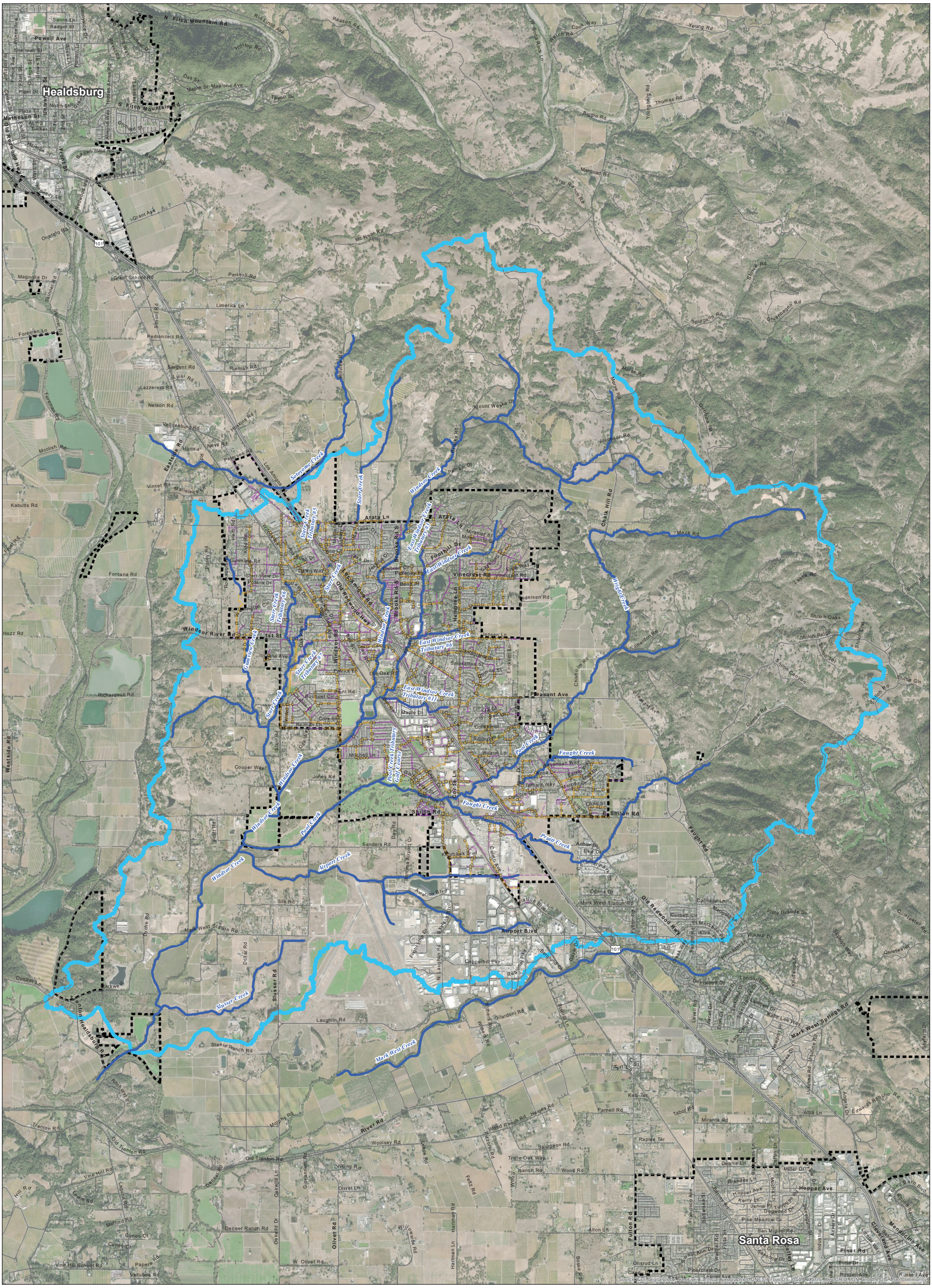
Notes: (1) "Structural Issues" does not necesarily indicate a poor condition.

(2) Other includes ponded water, "Sanitary Sewer" lid, and/or rough bottom. Ponded is the most common "other" condition note.

3.4.3 Post-Data Collection GIS Geodatabase Processing

At the completion of the data collection, additional GIS data processing was performed to confirm data connectivity and correct geometry where needed. There were several locations where data could not be collected, typically due to access issues. As part of the modeling analysis, ESA reviewed data gaps and made reasonable engineering assumptions to fill in the gaps where feasible, or make recommendation for additional data collection. See Section 3.3.3 for details on model assumptions for missing pipe outlet field data.

There were also a number of locations where the GIS geodatabase and field observations were inconsistent. This was resolved through discussions with the Town and additional field investigations. At the completion of the GIS geodatabase post-processing, the GIS geodatabase was delivered to ESA for preparation of the hydrologic and hydraulic model.



Paper Size 22" x 34" (ANSI D)

0 1,000 2,000 3,000 4,000

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drain Master Plan

Watershed

Job Number	11159126
Revision	5
Date	07 Feb 2020

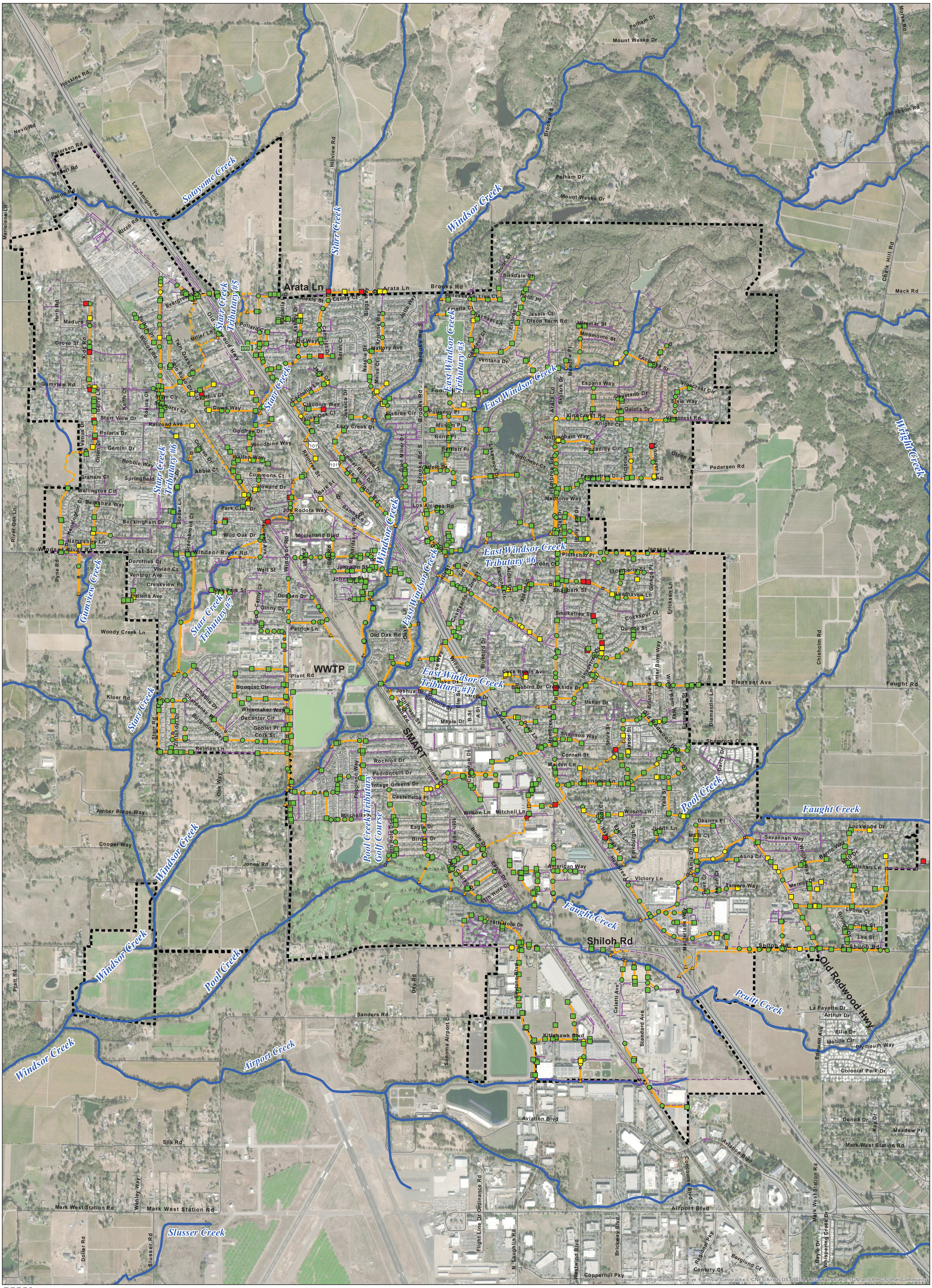
Figure 3-2

2235 Mercury Way Suite 150 Santa Rosa CA 95407 USA **T** 707 523 1010 **F** 707 527 8679 **E** santarosa@ghd.com **W** www.ghd.com

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 3-2 Watershed.mxd
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Data source: PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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Town Limits	Culverts, Modeled	Gravity Mains, Not Modeled
Streets	Culverts, Not Modeled	Open Channels, Modeled
Rivers and Creeks	Gravity Mains, Modeled	Open Channels, Not Modeled
		Discharge Points, Modeled

Inlets, Surveyed
- Condition Not Recorded
- Good
- Fair
- Poor

Manholes, Surveyed
- Condtion Not Recorded
- Good
- Fair
- Poor

Paper Size 22" x 34" (ANSI D)

0 450 900 1,350 1,800

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

GHD ESA TOWN OF WINDSOR

Town of Windsor
Storm Drain Master Plan

Manhole and Inlet Structural Condition

Job Number	11159126
Revision	5
Date	07 Feb 2020

Figure 3-5

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 3-5 Structural Condition.mxd

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Data source: PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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3.5 References

Aerial Imagery

San Francisco, Sacramento, Stockton, Modesto, Windsor, CA 133UA 0.25-Foot Ortho with Upgrades Aerial Imagery Acquisition and Digital Orthophoto Production Task USGS CONTRACT NO: G10PC00057 TASK ORDER NO: G11PD00296, 2011, Woolpert Inc. contract with United States Geologic Survey (USGS)

Digital Terrain Model (DTM)

Digital Terrain Model for Town of Windsor, 2011, Woolpert Inc.

Planning Documents

Windsor Area Master Drainage Plan, June 1989, Sonoma County Water Agency

Windsor Cumulative Drainage Impact Mitigation Program Update Report, September 1999, Boyle Engineering

Town of Windsor General Plan, Town of Windsor Planning Department, Adopted March 13, 1996

Windsor *Water Master Plan Update: Final Report*, 2011, RMC Water and Environment

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Old Redwood Highway Vision Plan – Conceptual Land Use Plan, RBF Consulting

North Old Redwood Highway Area Utility Infrastructure Study, March 2012, Winzler & Kelly (GHD)

Windsor Station Area/Downtown Specific Plan, January 18, 2012

FEMA Flood Insurance Rate Maps (FIRMS)

GIS

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Record Drawings

Storm Drain Record Drawings (various), Town of Windsor, May 14, 2013

Previous Models

HEC-2: *Windsor Area Master Drainage Plan*, June 1989, Sonoma County Water Agency

HEC-RAS: *Windsor Cumulative Drainage Impact Mitigation Program Update Report*, September 1999, Boyle Engineering

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4. POLICY AND REGULATORY ISSUES

Stormwater management policies and regulatory requirements, as well as hydrologic trends related to climate change, will influence the Town's future storm drain capacity requirements. This chapter briefly summarizes regulatory requirements related to Federal National Pollution Discharge Elimination System Municipal Separate Storm Sewer System (NPDES MS4) permitting and the Sonoma County Water Agency Flood Management Design Manual (FMDM). Additionally, this chapter provides a short description of the current understanding of likely impacts of climate change on local hydrology.

It is important to note that this chapter presents information regarding the referenced regulatory requirements, design criteria and climate change predictions as they are in 2019. These regulations, criteria and climate change predictions may change in future years.

4.1 Hydromodification Management

Watershed land use changes can alter the runoff and sediment transport processes that shape stream channels. Hydromodification refers to changes in channel form that are triggered by land use changes. In general, land development increases the volume and rate of runoff while reducing sediment supply, a combination that often leads to channel erosion and degradation of beneficial uses. To protect beneficial uses, California's Regional Water Quality Control Boards began requiring Hydromodification Management Plans (HMPs) as part of NPDES municipal storm water permit renewals in 2001 and many Phase I and Phase II permits now include hydromodification management requirements.

The first HMP was completed by the Santa Clara Valley Urban Pollution Prevention Program and adopted in 2005. This HMP established many of the precedents that were subsequently followed and refined in the San Francisco Bay Area, Southern California and Sacramento. These include the use of runoff flow duration control[5] between a high flow threshold (typically a 10-year event discharge, or Q_{10}) and a low flow threshold associated with the onset of creek erosion (locally variable but between one-tenth and one-half of the 2-year event discharge – i.e. between 0.1 and $0.5Q_2$). Evaluating flow duration control required the use of continuous hydrologic simulations, and the first set of HMPs saw the development and refinement of regional hydrology modeling packages based on the Western Washington Hydrology Model. Some permittees also developed sizing factors and design tools for Low Impact Development (LID) facilities that were based on the results of continuous modeling conducted in HSPF (Hydrological Simulation Program-Fortran) or HEC-HMS (the Hydrologic Engineering Center Hydrologic Modeling System). Most of the HMPs following Santa Clara's can be viewed as direct technical descendants that refined and optimized for local conditions and, in some cases, simplified the key approaches. The Central Coast HMP was a departure from this trend, requiring retention and infiltration of specified percentile rainfall depths rather than flow duration control.

[5] Flow duration control is the use of storm water facilities such as bioswales and detention basins to retain water and slowly 'meter' it out so that when the pre- and post-project flow duration curves for a watershed are compared, the curves match one another between prescribed upper and lower flow limits.

The Santa Rosa Region co-permittees adopted a similar approach in the *2017 Storm Water Low Impact Development Technical Design Manual* (LID Manual), which requires retention of the 85th percentile 24-hour storm event. As described below, the Town of Windsor adopted and is implementing the requirements of the LID Manual. A link to the 2017 LID Manual is provided in Appendix A.

4.2 NPDES MS4 Permitting

The purpose of the NPDES MS4 program is to address water quality in the surface waters of the state as impacted by storm water discharge from municipal storm drainage systems. The Phase I NPDES MS4 program is implemented in California by the Regional Water Quality Control Boards, which issue permits to municipalities that operate storm drainage systems. The MS4 permits establish requirements for storm water discharges that enter into the MS4 and thereby discharge to receiving waters. In addition to specific discharge prohibitions, MS4 permits also require municipalities to establish LID standards for new and redevelopment projects.

The goal of the LID requirement is to reduce hydromodification impacts of development by requiring site design approaches that preserve pre-development hydrologic functions. These requirements, if fully and successfully implemented, may reduce the storm water flow for small storm events from new development and increasing urbanization. These requirements are not anticipated to have a significant impact on the sizing needs for future storm drain capacity capital improvement projects.

4.2.1 Santa Rosa Region Phase I MS4 Permit

Because of Windsor's population (less than 100,000 people) the Town is designated as a Phase II community under the NPDES MS4 program. However, as of October 1, 2013, the Town opted to comply with the requirements of the Santa Rosa Region's Phase I MS4 permit (Phase I permit) overseen by the North Coast Regional Water Quality Control Board (Regional Board). In June 2014, The Town submitted a Notice of Intent to be a co-permmittee on the RWQCB Phase I MS4 Stormwater Permit Order No. R-2009-0050 with the City of Santa Rosa, County of Sonoma, Sonoma County Water Agency along with most of the other smaller (Phase II) municipalities in Sonoma County.

The renewed Phase I permit (Order No. R1-2015-0030) was adopted on October 8, 2015 and became effective January 6, 2016. The Town of Windsor became a co-permittee on the Phase I permit effective January 2016. A link to the Phase I permit is provided in Appendix A.

4.2.2 Previous LID Requirements

Proposed developments in the Town of Windsor had previously been subject to the requirements of the 2005 Santa Rosa Area SUSMP[6] (2005 SUSMP) adopted by the Town of Windsor Council in 2010. The 2005 SUSMP was developed to provide guidance for the design of new and redevelopment projects to minimize the introduction of pollutants into the storm drainage system,

[6] 2005 *Guidelines for the Standard Urban Storm Water Mitigation Plan* (SUSMP) Storm Water Best Management Practices for New Development and Redevelopment for the Santa Rosa Area and Unincorporated Areas around Petaluma and Sonoma.

to prevent increases in storm water runoff from the two-year, 24-hour storm event, and to conserve natural areas. Site design for projects which triggered the SUSMP was required to include source control and treatment control features.

In coming into compliance with the Phase I Permit, the Town of Windsor Council adopted the 2011 LID Manual which went into effect as of December 31, 2014. The 2011 LID Manual was an update to the 2005 SUSMP, and was more prescriptive than the 2005 SUSMP. The design storm was defined in the LID Manual as the 85th percentile 24-hour storm. In the Santa Rosa area this was determined to be 0.92 inches.

The design goal under the 2011 LID Manual is for the infiltration or reuse of 100% of a site's post-development runoff from the 85th percentile 24-hour storm event (0.92 inches in 24 hours). The document mandated that if this design goal is not feasible for a particular site, the site should be designed to infiltrate or reuse the volume of runoff which is equivalent to the difference in runoff for the site post-development versus pre-development for the 85th percentile 24-hour storm. This was a significant change from the 2005 SUSMP, which required matching pre-project runoff for the two year event.

Another significant change to the requirements was that offsite storm water runoff which drains onto a development site must be included in the site design. The runoff which drains onto a development site may be diverted away from the development site or may be included in the runoff volume in the LID feature sizing.

4.2.3 Current LID Requirements

Since 2011, the manual has been updated to reflect the revisions to the Phase I permit. In May 2017, the most recent revision of the LID Manual, superceding both the 2005 SUSMP Guidelines and the 2011 version of the LID Manual, went into effect. The design storm has been averaged region-wide for consistency; thus, the effective design storm increased from 0.92 inches to 1.0 inches for all communities complying the with Santa Rosa area Phase I permit.

Table 4-1 below presents the triggers for LID Manual Compliance as outlined in the 2017 LID Manual.

Table 4-1 Project Triggers for 2017 LID Manual

Project Triggers
All development projects that create or replace **10,000 square feet** or more of impervious surface
Street, road, highway, or freeway projects that create or replace **10,000 square feet** or more of impervious surface (exemption for public roads less than 48 feet wide was removed in 2018)
All development projects that create or replace **one acre** or more of impervious surface will have to comply with hydromodification requirements

4.3 Offset

4.3.1 Program (Expected in 2019-2020)

An offset program is being developed to provide mitigation options for site developers when the LID goals for a particular development site are not technically feasible. The offset program will provide a mechanism by which developers can either directly implement an offset project to meet full LID requirements or pay in lieu fees to fund local or regional mitigation measures. The goal of the program will be to develop local or regional detention and recharge projects that will assist developers achieve full compliance with hydromodification requirements on a regional basis.

Currently, an offset policy is under development for the Phase I co-permittees. This policy will detail the fee structure and specific mechanisms for the use of offset projects to fulfil LID Manual requirements. The draft offset policy was under legal review and will be submitted to the Regional Water Board in January 2020 for their review and approval.

4.4 Total Maximum Daily Loads (TMDLs)

A TMDL is a quantified maximum allowable discharge of a specific pollutant to a particular water body and is meant to include all point and non-point sources in a watershed. The purpose of a TMDL is the development of a calculated maximum discharge of a pollutant which still allows the receiving water body to meet water quality standards. TMDLs are generally developed for impaired water bodies, as identified on the federal Clean Water Act's Section 303(d) List of Impaired Water Bodies. The 303(d) List identifies impaired water bodies and the pollutants causing their impairment.

Section 303(d)-listed water bodies which are relevant to the Town of Windsor are the Russian River, the Laguna de Santa Rosa, and Mark West Creek. As tributaries, all streams going through the Town (with the exception of Sotoyome Creek), flow into Mark West Creek, which flows into the Russian River and all are within the Laguna de Santa Rosa. Various pollutants have been identified as impairing various stretches of these three water bodies. In general, when a water body is listed as impaired, tributaries to that water body are treated as impaired also. If data for a particular tributary indicates that the tributary is not contributing to the pollutant loading of the primary impaired water body, the tributary is removed from the requirements of the 303(d) listing.

The entire Russian River Watershed is listed as impaired by sedimentation, siltation, and temperature, including all tributaries. Currently, the "mainstem" of the Laguna de Santa Rosa, as well as Mark West Creek, are also listed as impaired by mercury, nitrogen, phosphorous, and dissolved oxygen. Sections of the Russian River and the Laguna de Santa Rosa are also listed as impaired by high fecal indicator bacteria.

Studies and data collection are ongoing by the North Coast Regional Board. It is anticipated that as more comprehensive data on water quality in the Russian River watershed is obtained, the impairment listings may expand to additional geographic reaches.

The North Coast Regional Water Quality Control Board is preparing new Total Maximum Daily Loads (TMDLs) for nutrients (nitrogen and phosphorus), dissolved oxygen, temperature, and sediment applicable to the Laguna de Santa Rosa, including its tributaries such as Mark West Creek. Additional details are provided in Section 4.4.1 below.

The Water Board also began the process of developing a TMDL for pathogens for the Russian River in 2015. After a number of public review periods for draft Action Plans in 2015, 2017, and 2019, the Water Board held a public hearing on August 14, 2019 in which the Proposed Action Plan for the Russian River Pathogen TMDL was presented for adoption.

There is currently no schedule for completion of a TMDL for mercury for the Laguna de Santa Rosa.

Those pollutants found to have impaired the Russian River and the Laguna de Santa Rosa must be addressed by the Town of Windsor as part of its storm water management plan, regardless of completion of TMDLs. Many of these pollutants, including sediment and temperature will be addressed (and are being addressed) with LID standards, creek set back requirements, and construction site management requirements.

4.4.1 Nitrogen TMDL and Load Allocations

In March 1995, the North Coast Regional Board approved a TMDL for the Laguna watershed thereby assigning numeric, seasonal targeted reductions and net load goals for both Total Nitrogen and Ammonia in urban storm water for four areas within the Laguna watershed. A Waste Reduction Strategy for the Laguna (Strategy) was also approved to implement the TMDL. The TMDL and Strategy were subsequently approved by USEPA in May 1995.

The Strategy identified several municipalities including the Town of Windsor as contributing urban storm water runoff to the Laguna, and recommended nutrient load reductions from urban areas. A watershed based approach was implemented, and the watershed was divided into four attainment areas with specific net load goals developed for both Total Nitrogen and Ammonia in urban runoff. These attainment goals are summarized in the 2009 Santa Rosa Region's Phase I MS4 permit's Fact Sheet.

These net load goals were included for reference only, and are not currently enforceable. However, these goals are expected to be replaced with updated waste load allocations from the updated Laguna TMDLs currently under development by North Coast Regional Board staff. The updated TMDLs for nutrients (nitrogen and phosphorus), dissolved oxygen, temperature, and sediment applicable to the Laguna and its tributaries such as Mark West Creek is enveloped in what is called the Water Quality Trading Framework for the Laguna de Santa Rosa Watershed (see below).

4.4.2 Water Quality Credit Trading Market

The TMDLs adopted by the Regional Board establish constituent limits and source reduction targets and will apply to the Town of Windsor's storm water discharges to the Laguna watershed that are subject to the Town's storm water Phase I MS4 permit. Therefore, Windsor may be able to take advantage of a new water quality credit trading program that is being developed to facilitate compliance with the TMDLs.

The Sonoma Resource Conservation District (RCD), in conjunction with the Gold Ridge RCD, developed the Water Quality Credit Trading Program for the Laguna de Santa Rosa watershed, the first such program in California., The Regional Water Board adopted Resolution No. R1-2018-0025 approving this framework during a public hearing on July 11, 2018. The effort has been

funded by the USDA and involves a Project Advisory Committee tasked with providing feedback on elements of the program framework, credit calculation methodology, regulatory consistency, and statewide application of the program. Both the North Coast Regional Water Board and Windsor have participated in developing the program as members of the Project Advisory Committee. The Water Quality Credit Trading Program provides the framework by which water discharges, and their associated nutrient and sediment loading, may be offset through water quality credits from erosion control, livestock management, and other habitat improvement projects that decrease nutrient and sediment laden runoff into the Laguna de Santa Rosa and its watershed. The current framework is set-up for phosphorus offsets and is not currently applicable to other nutrients, although it may be expanded to cover other nutrients in the future. It is feasible that the phosphorus removal credit trading framework may be applied to stormwater discharges in the next version of the permit adopted by the North Coast Regional Water Board (adoption scheduled for January 2021).

4.5 Sonoma Water Flood Management Design Manual (FMDM)

The Sonoma County Water Agency (Sonoma Water, formerly SCWA) “Flood Management Design Manual” (FMDM), formerly known as the “Flood Control Design Criteria” (FCDC), establishes design criteria for flood control and storm water facilities in portions of Sonoma County that are subject to Sonoma Water drainage review, including the Town of Windsor. The FMDM will replace the current FCDC which was last revised in 1983 and has been a reference tool used throughout the County since 1966. The FMDM outlines analysis methods, design criteria and submittal requirements for the design of facilities such as constructed waterways, culverts and storm drains. Sonoma Water is currently revising the FMDM to reflect current methods and practices The FMDM contains updated precipitation estimates using National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall data and includes recommended detention standards generally requiring that there be no net increase in the post-project peak flows for both the 25-year and 100-year flood events. Proposed hydrology methods also include synthetic unit hydrograph based approaches for larger drainages in addition to the existing rational method approaches. Sonoma WaterA public draft of the updated FMDM was released in August 2019 and is anticipated to be implemented in January 2020. A link to the draft FMDM requirements is provided in Appendix A.

4.6 Climate Change

The impact of climate change on hydrologic variables has been evaluated extensively in the United States to assess the potential for shifts in water availability and extreme rainfall-runoff patterns under uncertain future climate conditions. General agreement has been found among studies suggesting shifts in precipitation from snow to rain (Knowles, et. al. 2007), reductions in average snowpack conditions, and earlier water delivery regimes in snowmelt fed watersheds (Cayan, et. al. 2008). These trends are largely driven by increase in average temperature conditions observed in the 20th century and which nearly all climate simulations show continuing through the 21st century. Less agreement is found within climate models for trends in total precipitation and associated hydroclimate variables such as streamflow, groundwater flow, and soil moisture. As part of a statewide climate assessment for California, Cayan et al (2012) evaluated precipitation changes from six General Circulation Models (GCMs), under two global emissions scenarios (A2 and B1 from the IPCC Special Report on Emissions Scenarios). This

assessment found that the preponderance of models assessed show drying trends in annual average rainfall by the end of the century throughout California. However, precipitation patterns are projected to continue to exhibit interannual (from year to year) and interdecadal (from decade to decade) variability suggesting continued vulnerability to drought and extreme rainfall events in the state.

Regional analyses have been conducted using downscaled global climate model data to drive hydrologic models and derive projections in several hydroclimate variables. Cayan et al (2012) used data derived from the Variable Infiltration Capacity (VIC) model—a macroscale, physically based hydrologic model—to estimate fluctuations in snowpack in California. The findings of this study estimate a 60% loss in Sierra snowpack by the end of the century. Flint and Flint produced high resolution downscaled datasets to drive the USGS developed Basin Characterization Model (BCM) to estimate evapotranspiration, recharge, runoff, soil moisture, and other hydroclimate variables in Northern California watersheds, with a focused look at the Russian River watershed (Flint and Flint, 2012). This study found that the region will experience longer drier conditions in summer with increased potential for precipitation intensity variability. Trends in average precipitation, as with numerous other studies, differ depending on the climate model. Regardless of precipitation trends, soil moisture content is projected to decrease due to increasing temperatures. The regional variability in soil moisture reveals that some areas will be more resilient to future climate conditions than others.

In summary, there is considerable variability associated with downscaled climate projections particularly as it relates to precipitation, associated runoff, storm drainage system performance, and flood management. Russian River watersheds will likely experience longer drier conditions in summer and increased potential for precipitation variability (Flint and Flint, 2012). As such, the Town of Windsor may begin to consider increased intensity variability in rainfall and associated runoff in terms of adopting plans and policies that are intended to adapt to and mitigate this future potential variability, and for purposes of storm drain master planning and SDIP / CIP program development. Several resources are available to assist the Town with adaptation planning under uncertainty, including the “Climate Change Handbook for Regional Water Planning” (USEPA, 2011) and “Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments” (Snover et. al, 2007). A link to the “Climate Change Handbook for Regional Water Planning” is provided in Appendix A.

These resources are focused on providing frameworks for incorporating assessment of climate change impacts into watershed or regional planning processes, assessing risks associated with these impacts both in the near-term and longer-term, evaluating and selecting strategies to mitigate risk, and monitoring and updating strategies as data and analyses are refined. Adapting to climate change impacts will be an ongoing process for the Town of Windsor, as it will be for the entire North Coast Region. As an additional resource, the North Coast Integrated Regional Water Management (IRWM) Plan developed a Climate Change Vulnerability Assessment specific to the North Coast Region of California that will be integrated into future North Coast IRWM Plan updates, providing further guidance for local planning agencies to assess climate change effects, impacts, vulnerabilities, and strategies for local and regional sectors and systems.

In July 2013, AECOM prepared for FEMA a study to characterize climate change effects on the National Flood Insurance Program (NFIP). This report analyzed both riverine and coastal flood risk in 20-year intervals through 2100, and associated impacts to the financial strength of the

NFIP program. The study used probabilistic methods to determine the effects of climate change on flood hazards and estimated median projected percent changes in the 1% annual flood discharge[7] (100-year event) for the entire continental United States. The report projects an increase in the 1% annual flood discharge by between 30 and 50% in coastal northern California. However, this report states clearly that results reflect national averages only and are not to be interpreted locally (AECOM, 2013).

Other studies have focused on resolving needed changes to design criteria for storm drainage infrastructure to account for climate change affects (Mailhot and Duchesne, 2010). Given flood frequency analyses and associated design discharges are based on a statistical analysis of past events, flood managers must consider anticipated changes to the intensity and frequency of rainfall events to revise design criteria that take into consideration potential changes in flood frequency. One simplified procedure to develop design criterion integrates information about climate projections, expected lifetime of the infrastructure or system, and the acceptable level of performance or risk.

As an example, Mailhot and Duchesne (2010) present a scenario for a specific study site in which a 100-year return period (or level of protection) results in an effective 52-year return period (or level of protection) at the end of a 100-year expected lifetime for an infrastructure or system. This reflects a nearly twofold increase in the probability of exceeding the infrastructure's capacity over its expected lifetime. In order to maintain a desired level of protection or capacity throughout the expected lifetime of an infrastructure or system, an increased current level of protection must be incorporated into the design. To maintain 100-year level of flood protection over a 100-year timeframe, a design criterion of 190-year return period is proposed by the authors. Over a 60-year timeframe, a design criterion of 145-year return period is proposed by the authors. The Town of Windsor could conduct a similar investigation if desired.

The following examples should be considered by the Town when planning future projects relative to climate change. These examples provide some accommodation from the intensification of storm events and greater flooding than what results in 2019 from a particular storm event.

Example 1: Oversize drainage pipelines and open channels to provide additional freeboard (i.e., vertical distance between the maximum water surface and top of pipeline or channel).

Example 2: Provide additional area around pipeline, open channel, and storm water pond improvements to allow for future system expansion. Expansion may involve widening of a channel, installation of a parallel pipeline, for development of a flood plain.

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City of Santa Rosa and County of Sonoma Storm Water Low Impact Development Technical Design Manual, August 2011.

Snover, A.K., Whitely Binder, J. Lopez, E. Willmott, J. Kay, D. Howell, and J. Simmonds. 2007. Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments: In association with and published by ICLEI – Local Governments for Sustainability, Oakland, CA

5. HYDROLOGY

Modeled hydrology conditions were developed for the SDMP to evaluate the performance of the existing storm drainage system and develop recommended SDIPs. Modeled hydrology includes baseline and future conditions for the 10-, 25-, and 100-year return period storm events. Baseline hydrology was developed using existing land use conditions, and future hydrology was developed using buildout land use conditions consistent with Town planning documents, including the Town's 2040 General Plan Future Land Use Map (Windsor, 2018) and Windsor *Water Master Plan Update: Final Report* (RMC Water and Environment, 2011). A copy of the Town's 2040 General Plan Map is provided for reference at the end of this chapter.

This section includes: a description of the hydrology design criteria and assumptions, as set forth in Sonoma Water's FMDM, and used in development of the hydrology model; a description of the hydrology modeling platform; a description of the model development process; and a discussion of the hydrology model results.

5.1 Hydrology Design Criteria and Assumptions

5.1.1 Flood Management Design Manual (FMDM)

Sonoma Water's FMDM establishes design criteria and methodology for hydrology and hydraulic design within Sonoma County. The manual was last revised in August 2019 and is in draft form for public comment at the time of this writing with an anticipated adoption date of February 2020. However, known updates to the FMDM were utilized in the development of this SDMP.

5.1.2 FMDM Design Criteria

The 2019 Draft FMDM establishes design criteria and methodology for hydrology and allows for the use of the Rational Method or the Synthetic Unit Hydrograph Method as the preferred approaches to model design rainfall events. The Rational Method may be used to estimate peak flow for drainage areas less than 200 acres (0.31 square miles) if storage effects are negligible (i.e. no detention). The FMDM,requires a synthetic unit hydrograph (i.e., Snyder unit hydrograph) method to estimate flow peaks and hydrographs for drainage areas greater than 200 acres (0.31 square miles) or where detention is a factor in the basin. The synthetic unit hydrograph method transforms a design rainfall event into a design runoff hydrograph. Unlike the Rational Method, which only provides peak discharge rates (independent of time), the synthetic unit hydrograph methodology calculates an estimated time-varying flow rate (i.e., hydrograph) for the duration of the design storm event. Key parameters including peak flow and runoff volume can be obtained from this approach. Therefore, because of the anticipated changes to the FMDM design criteria and advantages of the synthetic unit hydrograph method, this approach was selected for the SDMP hydrology model.

The FMDM also provides design storm criteria for major, secondary, and minor waterways that were used to develop the SDMP hydrology model. Table 2-1 in Chapter 2 provides waterway designations for the creeks and tributaries within the Town's storm drainage system. The criteria are as follows:

1. Major Waterways – for watersheds of four square miles or more, the design storm is a 100-year event (i.e., Windsor Creek).
2. Secondary Waterways – for watersheds of one to four square miles, the design storm is a 25-year event (i.e., Starr Creek).
3. Minor Waterways – for watersheds less than one square mile, the design storm is a 10-year event (i.e., tributaries).

Design hydrology for the 10-, 25-, and 100-year return period events was developed as part of the hydrology model development for the Town of Windsor SDMP.

5.2 Hydrology Model Description and Background

5.2.1 MIKE URBAN

The MIKE URBAN software program (v. 2019 by DHI Software) was selected as the platform for the SDMP hydrology model. MIKE URBAN is a GIS-integrated modeling platform that simulates rainfall-runoff and hydrograph routing processes, including overland routing, and storm drain hydraulic routing through storm drainage systems. The integrated platform allows for the coupling of watershed subbasins (i.e., sub-drainages) with the storm drainage system, allowing for the transfer of subbasin runoff hydrographs into the storm drain pipe and open channel network for subsequent routing and discharge to the Town's creeks. MIKE URBAN was selected because of its ability to simulate standard hydrological methods as set forth in the FMDM update; its compatibility with other MIKE software programs; and its ability to dynamically couple the Town's storm drainage network with creeks and overland flow paths, including the Town's roadway network. This coupling allows better simulation of complex hydraulic interactions between the Town's creeks, storm drain pipes, open channels, floodplains, and roads.

MIKE URBAN is discussed in more detail in Chapter 6.

5.3 Hydrology Model Development

5.3.1 Watershed Delineation and Subbasins

The hydrology model domain includes the entirety of the Windsor Creek watershed, as shown on Figure 3-1 in Chapter 3. The Windsor Creek watershed and its major tributaries were delineated into sub-drainages, referred to in this report as subbasins. A subbasin represents a hydrological unit whose physical parameters are used to characterize design hydrology and estimate peak discharges and runoff hydrographs for use in hydraulic modeling and evaluating storm drainage system performance and flood risk. In other words, a subbasin is a defined area that collects and concentrates rainfall and discharges to a certain point (a creek, a storm drain inlet, or an open storm drain channel). The subbasin delineation process took into account major creek tributaries within the Windsor Creek watershed and also the Town's storm drainage system network.

The watershed and subbasins of Windsor Creek were delineated using the ArcHydro toolset in ArcGIS version 10.1 (Phase 1) and 10.5 (Phase 2). The watershed was delineated in its entirety from the confluence of Windsor Creek and Mark West Creek to the headwaters of Windsor

Creek, including drainages above the dams that exist within the upper watershed in Foothill Regional County Park. Two topographic datasets were used to guide the subbasin delineation:

- The Town of Windsor's DTM (Woolpert Inc. 2011)[8] within Town limits
- USGS National Elevation Dataset outside of Town limits

Subbasins were delineated to concentrate (outlet) at key locations in the watershed and storm drainage system including confluences between two streams, storm drainage system upper extents and key junctions, and key points for the hydraulic model including the upstream ends of the creeks included within the hydraulic model. These key locations were used to guide the subbasin delineation process, and used to define points that represent where subbasins outlet or eventually drain. Tributaries are important to be represented by subbasins so that a tributary's flow input can be input into the mainstream creeks. The upper extents of storm drain systems and creeks are important to also provide flow inputs.

Once the subbasins were delineated in GIS, some subbasins were manually adjusted to account for drainage routing in the storm drain collection system. The topographic data does not account for subsurface drainage patterns of the collection system, and in some areas the surface gradient slopes in a different direction than the slope of the storm drains. Therefore, the Town's storm drain network GIS was used to guide the manual subbasin adjustments.

During Phase 2 of the SDMP, rural basins were further dilineated into subbasins with areas in the range of 100 to 200 acres, where feasible, per feedback from Sonoma Water received during Phase 1 and consistent with the updated FMDM. Using the Sonoma Vegetation Mapping Lidar and Aerial, GHD divided 6 rural basins into smaller subbasins. Topographic features such as minor ridgelines, drainages, roadways, etc. were used to further refine the rural basins. Table 5-1 summarizes the delineated rural subbasins.

Table 5-1 Summary of Delineated Rural Subbasin

Rural Catchment ID	Total Area (acres)	Number of Subbasins	Subbasin Area Range (acres)	Original 25-year Peak Flow (cfs)	New Combined 25-year Peak Flow (cfs)	Percent Change
299	2246	21	60 - 161	45.5	46.9	3%
306	2095	16	41 - 198	31.4	31.1	-1%
308	2217	17	61 - 231	37.1	42.4	14%
313	2019	5	297 - 524	44.0	46.0	5%
390	1501	10	25 - 228	27.6	31.8	15%
489	350	2	148 - 201	8.9	8.8	-2%

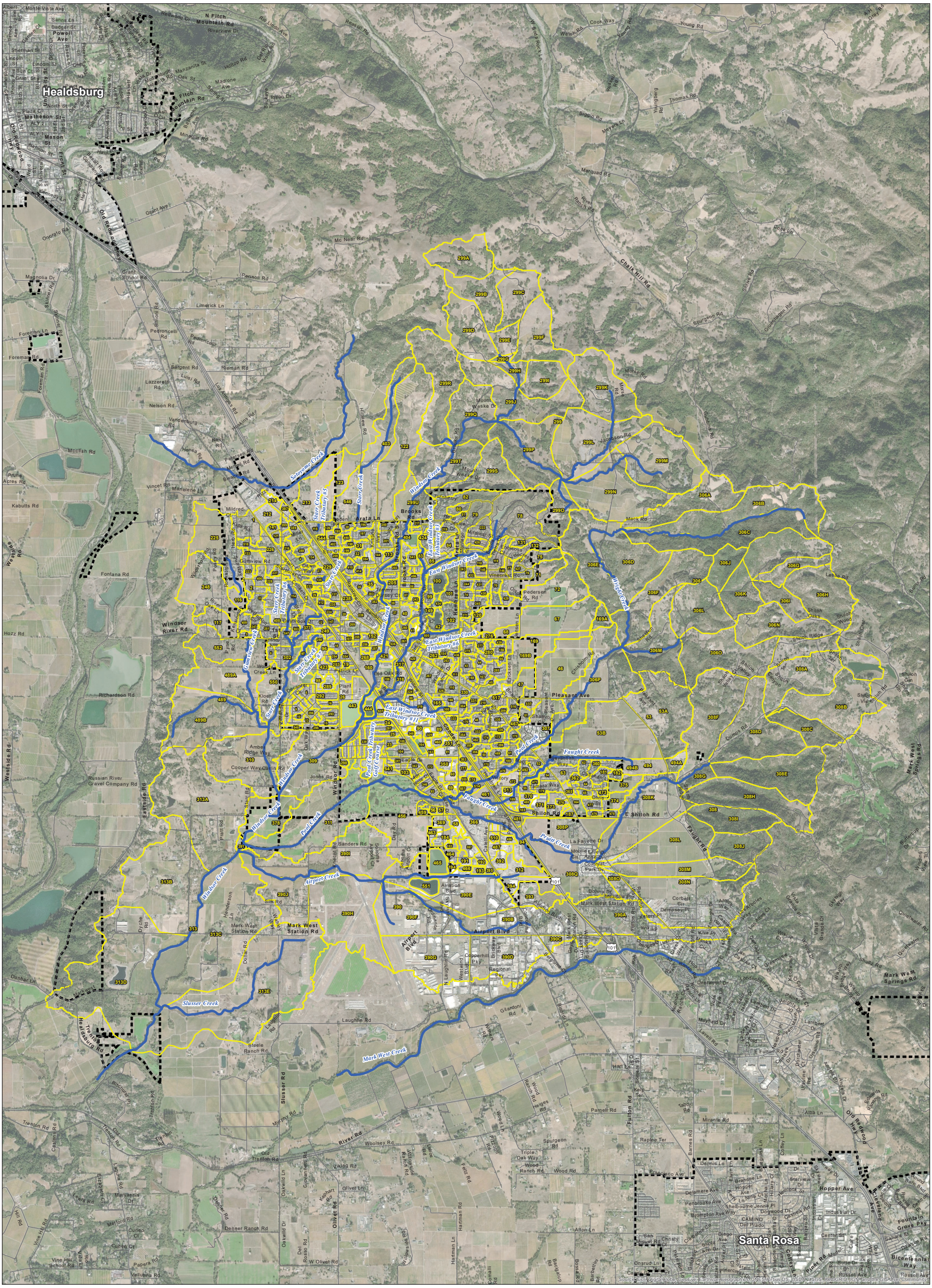
Of note, Basin 313 is located southwest of the Town and downstream of the drainages that impact the Town's infrastructure. In addition, Basin 313 is relatively flat with minor topographic features. As such, dividing Basin 313 into 100-200 acre sub-basins proved difficult and would not result in much added benefit to the project. The resulting subbasins within Basin 313 are larger than the other rural basins located upstream of the Town. Ultimately, a total of 626 subbasins

[8] The Town's DTM specifications are summarized in Section 3.2.

were delineated to represent the Windsor Creek watershed in the MIKE URBAN model. Table summarizes the subbasin delineation effort and model impacts.

The resulting subbasin delineation of the Windsor Creek watershed is shown on Figure 5-1 Subbasins were categorized with a unique identifier to indicate whether they drain directly to a waterway, a storm water drainage inlet or network, or are disconnected hydraulically from the watershed (e.g., wastewater ponds). Subbasin parameters, including subbasin area and unique identifiers, are included in Appendix B (5B). Subbasins ending with a letter indicate subbasins from Phase 1 that were further dileanted. The original subbasin ID number from Phase 1 were maintained while letters were added to the subbasin ID for the further delineated subbasins in Phase 2. The resulting subbasin delineations are included in the GIS database for future use.

Computed hydrographs from these subbasins were used as inputs to the hydraulic model components, which are discussed in more detail in Chapter 6.



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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

Subbasins

Job Number	11159126
Revision	5
Date	07 Feb 2020

Figure 5-1

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N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 5-1 Subbasins.mxd
© 2012. While every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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5.3.2 Hydrology Model Components

As described above, the hydrology model for the SDMP was developed using MIKE URBAN. The MIKE URBAN model is comprised of four primary components, described below:

1. **Rainfall** – Characterization of the quantity of rain falling on the watershed and how that rainfall is distributed in time and space.
2. **Loss rates and baseflow** – For a given amount of rainfall, a portion of that rainfall will infiltrate or be intercepted in the watershed and will not immediately contribute to peak channel discharge. The amount and rate of loss is influenced by the soil type and land cover in the watershed. This component has a significant influence on how peak discharges are computed for a given design or validation event. Baseflow conditions capture longer-term watershed processes, including the amount of instream flow prior to a rainfall event and the hydrograph recession rate.
3. **Transformation** – The transformation model component characterizes the timing and shape of a discharge hydrograph for a given amount of rainfall. The hydrograph shape is dependent upon the physical characteristics of the watershed.
4. **Routing** – This component represents the physical configuration of how flows are routed through the system including channel flow, diversions, and reservoir impoundments.

The following sections describe the existing input data, technical assumptions, and development of these core hydrologic model components.

Design Rainfall

Following the guidelines of the pending FMDM update for hydrology, the “balanced frequency-based storm” was used to develop the design rainfall hyetograph. This method differs from conventional SCS methodologies for developing rainfall hyetographs both in the location of peak intensity and the manner in which it builds a nested hyetograph using rainfall depths of the shorter duration storm events. The method is designed to make sure that the rainfall total is distributed in a way that preserves the recurrence interval for every sub-basin in the watershed.

The Hydraulic Engineering Center’s Hydrologic Modeling System (HEC-HMS) contains several methods for distributing rainfall depths over a time series to create a design rainfall hyetograph, and was utilized to develop design rainfall hyetographs. Parameters required to define a design rainfall hyetograph in HEC-HMS include:

1. **Probability** – The annual probability associated with the design rainfall event frequency (e.g., 10 percent for the 10-year design storm).
2. **Intensity Duration** – The intensity duration (i.e., time step) for the rainfall hyetograph. The intensity duration should be no longer than one-fifth of the time of concentration[9] of the watershed.

[9] The time of concentration (t_c) is defined as the time required for runoff to travel from the most distant point in the watershed to the computation point where the flow is being estimated. It represents the time required for all areas within the watershed to contribute to runoff at the watershed outlet.

3. **Storm Duration** – The design event duration. Design event duration should be equal to or slightly exceed the watershed lag time[10]. For example, a one-hour design storm would be appropriate for a watershed with a lag time of 45 minutes.
4. **Intensity Position** – Select the default of 50 percent (highest rainfall intensity in the middle of the storm).
5. **Storm Area** – The size of the watershed.
6. **Storm Depth** – The rainfall depth for each intensity duration shown on the input table in HEC-HMS. NOAA Atlas 14 rainfall depth data was used consistent with the pending FMDM update (see Table 5-2).

Design rainfall was computed for each subbasin in the Windsor Creek watershed via a two-step process, generating rainfall hyetographs and rainfall scalers.

First, 24-hour rainfall hyetographs were generated using HEC-HMS and the balanced frequency based storm approach as set forth in the updated draft FMDM. Rainfall hyetographs were developed using geospatial datasets of rainfall frequency data for California from NOAA Atlas 14 (NOAA, 2011). This approach yields a 24-hour rainfall hyetograph that contains the design rainfall depths for the 24-hour (implied), 12-hour, 6-hour, 3-hour, 2-hour, 1-hour, 15-minute, and 5-minute durations specific to the Town of Windsor Public Works Department building location. This location was selected because it represents a central location within the Town. Rainfall depths were calculated for each of these durations for each design storm event (10-, 25-, and 100-yr) and input into the HEC-HMS model to develop 5-minute time step, 24-hour duration hyetographs for the 10-, 25-, and 100-year recurrence interval design storm events. Figure 5-2, 5-3, and 5-4 present the 100-year, 25-year, and 10-year, 24-hour rainfall hyetographs developed for the SDMP.

Table 5-2 below summarizes the rainfall depths for varying durations extracted from NOAA Atlas 14 at the Public Works Department and input to HEC-HMS to develop the 10-, 25-, and 100-year design rainfall hyetographs.

[10] The lag time (t_L) is defined as the length of time between the midpoint of rainfall mass and peak flow of the resulting hydrograph.

Table 5-2 NOAA Atlas 14 Design Rainfall Depths

Duration	10-year Design Storm Rainfall Depth		25-year Design Storm Rainfall Depth		100-year Design Storm Rainfall Depth	
	(mm)	(in)	(mm)	(in)	(mm)	(in)
5 min	7.4	0.29	8.7	0.34	10.6	0.42
15 min	12.9	0.51	15.1	0.60	18.5	0.73
1 hr	25.3	1.00	29.7	1.17	36.3	1.43
2 hr	37.3	1.47	43.2	1.70	52.1	2.05
3 hr	47.0	1.85	54.4	2.14	65.0	2.56
6 hr	70.9	2.79	81.5	3.21	96.5	3.80
12 hr	104.6	4.12	120.7	4.75	143.0	5.63
24 hr	150.9	5.94	175.3	6.90	208.5	8.21

Second, design rainfall for each of the subbasins within the watershed was applied through the use of scalars. Rainfall scalars were calculated by determining the area-weighted 24-hour design rainfall total for each subbasin using the NOAA Atlas 14 geospatial data sets for each design recurrence interval. Total rainfall depths for each subbasin were generated by intersecting and area-weighting the NOAA Atlas 14 geospatial data sets with each subbasin area, given most subbasins overlap with several grid cells within the NOAA Atlas 14 data set. Dividing these depths by the rainfall depth at the Public Works building provided a scalar that could then be applied to scale the Public Works building hyetograph to distribute rainfall over all subbasins within the Windsor Creek watershed (i.e., the model domain), allowing for a single hyetograph to be scaled appropriately within the entire model domain. This approach was applied to develop the 10-, 25-, and 100-year hyetographs, and recurrence interval-specific scalars for the hydrology model.

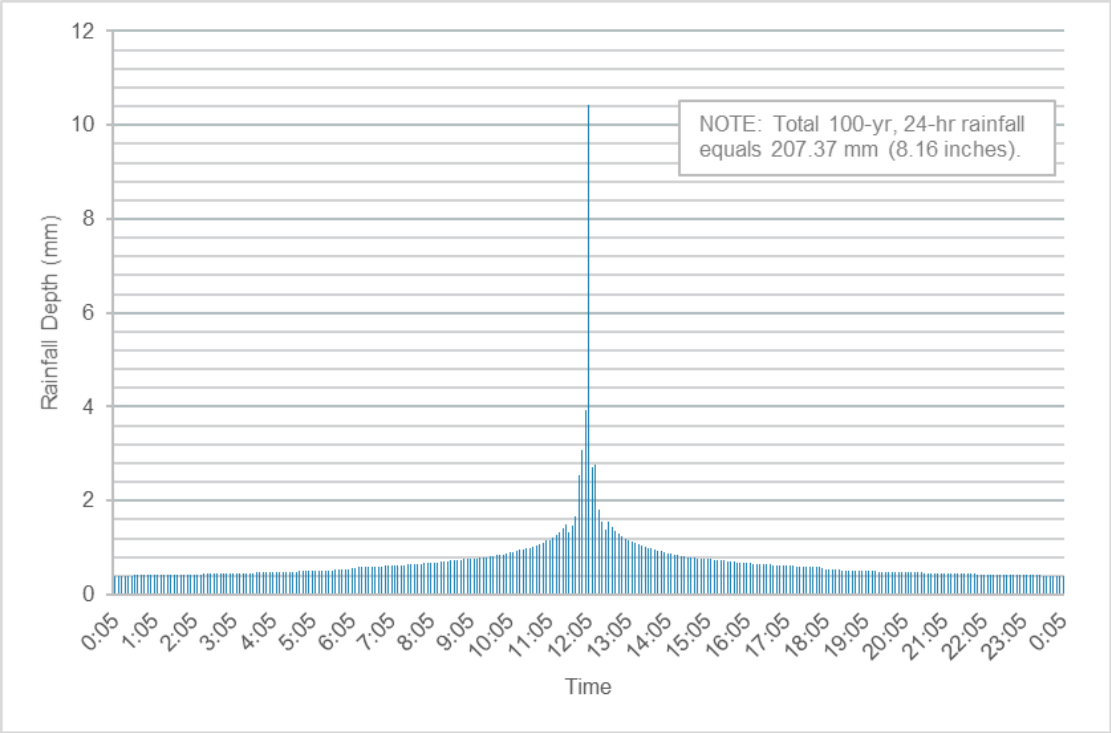


Figure 5-2 100-year, 24-hour Rainfall Hyetograph

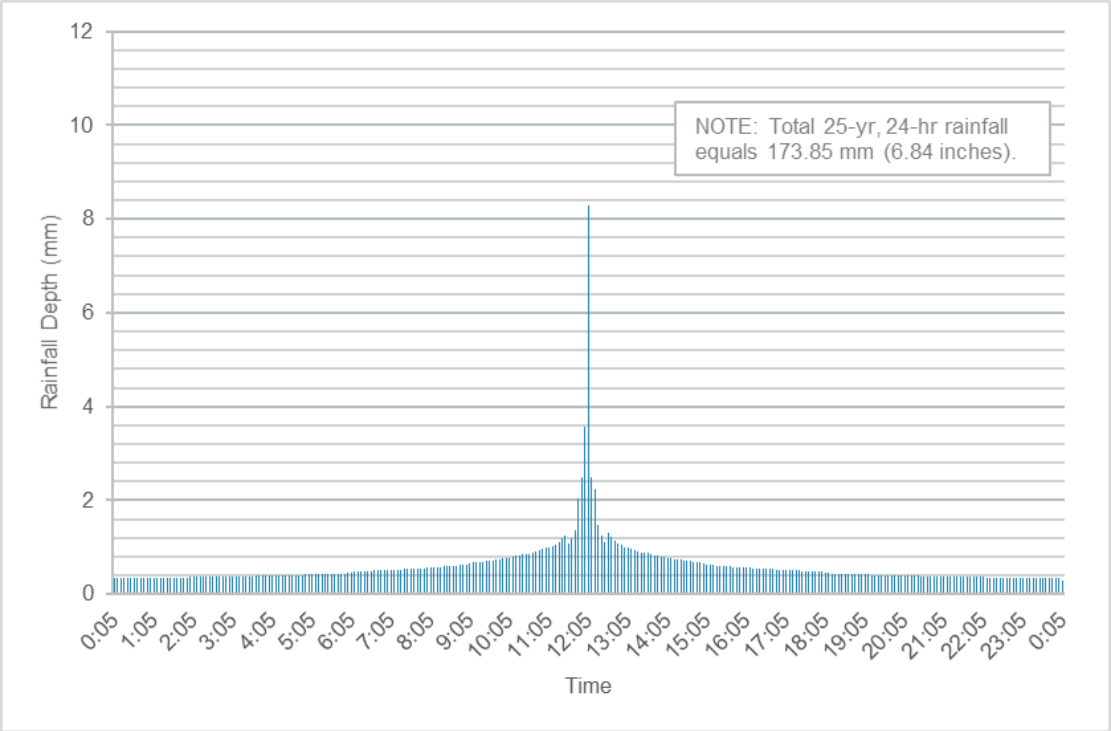


Figure 5-3 25-year, 24-hour Rainfall Hyetograph

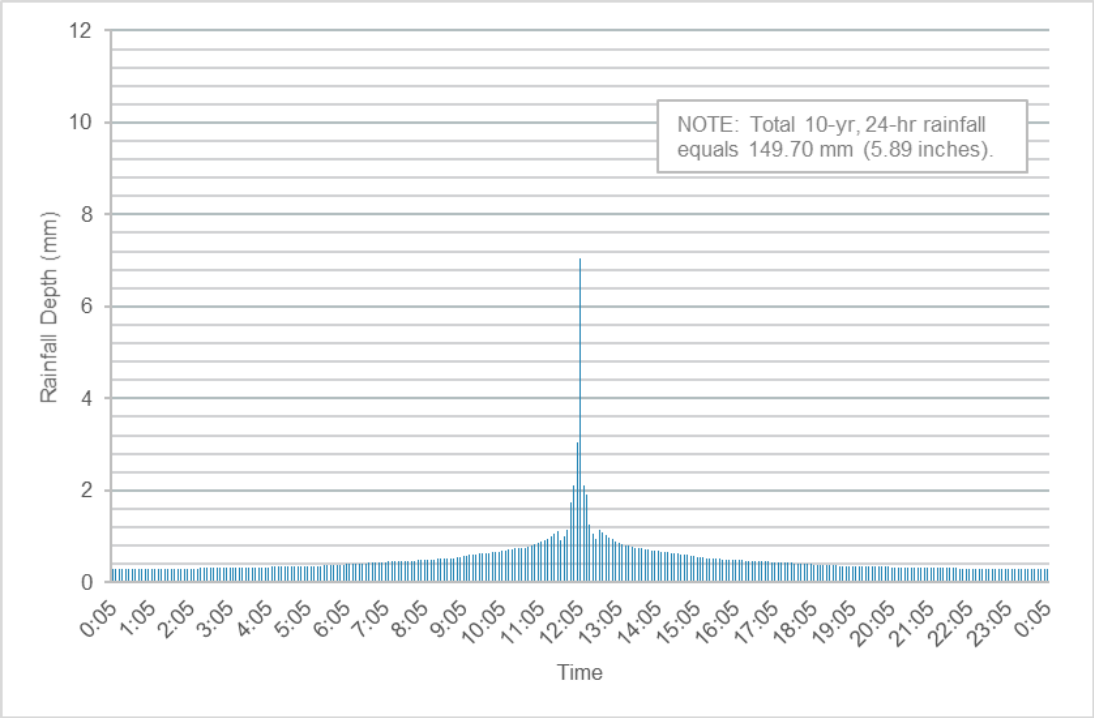


Figure 5-4 10-year, 24-hour Rainfall Hyetograph

The design rainfall recurrence intervals (i.e. 10-, 25-, and 100-yr) were selected to be consistent with FMDM criteria for assessing major, minor, and secondary waterways within the Town.

5.3.3 Loss Rate Methods

The Soil Conservation Service (SCS) Curve Number (CN) approach as outlined in the National Resource Conservation Service's (NRCS) Technical Release No. 55 (TR-55) (NRCS, 1986) was used to characterize loss conditions in the watershed. This method assigns a CN to each basin which is used to calculate the initial losses during a storm event and the continuing losses over the duration of the event. The CN is a function of the land cover and soil conditions within each basin, and dictates the amount of runoff generated by a given amount of rainfall (higher CN results in less infiltration and more runoff). High resolution geospatial datasets were used to calculate a composite CN for each subbasin based on an area-averaged CN value.

Soil type, for use in development of basin CNs, was characterized using the NRCS Soil Survey Geographic (SSURGO) data for the Santa Rosa Creek watershed (NRCS, 2011). The CN method characterizes soil type by Hydrologic Soil Group (HSG), which represents the infiltration capacity of the soil. Soils are classified into HSGs based on four factors: intake and transmission of water under the conditions of maximum yearly wetness; soil not frozen; bare soil surface; and maximum swelling of expansive clays. HSG groups A, B, C, and D are organized in order of increasing runoff potential and decreasing infiltration rates. Any gaps in identified HSG within the watershed were assigned to the adjacent HSG that most surrounded the gap. These gaps were limited and primarily existed in the peripheral subbasins outside of the Town limits.

Land cover and usage also play an important role in influencing runoff transformation from rainfall. Two datasets were used to inform land use in the Windsor Creek watershed. Land cover

for areas inside Town limits were characterized using land use GIS data provided by the Town that was also used to develop the Town's 2011 Water Master Plan Update (WMP). Existing land use data (Figure 5-5) was used to develop CN values for baseline conditions, and future land use data from the 2040 General Plan (2040 GP) Land Use Map (Figure 5-6) was used to develop future conditions CN values. Land cover type for areas outside of the Town limits were characterized using the National Land Cover Dataset (NLCD) generated for 2011 conditions by the Multi-Resolution Land Characteristics Consortium (MRLC) (MRLC, 2015). These three datasets (WMP, 2040 GP, and NLCD) are described below.

For the urban areas within the Town limits, land cover was characterized according to land use GIS data from the WMP for baseline condition model and from the 2040 GP for the future scenario model. For the existing condition model, residential parcels from the WMP dataset were used to replace the NLCD dataset for residential land use designations. Therefore, NLCD land cover data was used for commercial and industrial properties. For the future condition scenario, 2040 GP residential, commercial and industrial land use parcels were extracted and used in place of the WMP and NLCD data for the CN calculation. The WMP land use data also did not include roads, and the NLCD data was not at a high enough resolution to capture paved/non-paved detail for determination of impervious percentages. Therefore, land use for a paved road was independently defined to properly characterize the higher runoff potential in urban areas.As part of the update to the FMDM, ESA PWA conducted a GIS analysis of percent impervious area based on aerial imagery for the SCS residential lot-size categories. The GIS analysis (which focused on residential areas within Sonoma County) found that the percent impervious area in the County differed from the values presented in the SCS tables. A comparison between the SCS values and the values estimated by ESA PWA (for the FMDM update) for percent impervious areas for different residential lot sizes is summarized in Table 5-3. Ultimately, the impervious fractions used for the SDMP were based on the ESA analysis for the FMDM update for residential parcels because they were more specific to this region and were based on TR-55 values for commercial and industrial parcels (which the ESA PWA analysis did not include).

Table 5-3 Percent Impervious Area for Residential, Commercial and IndustrialLots: Comparison of SCS TR-55 and FMDM Update Values

Land Use for Residential Districts by Average Lot Size	Average Percent Imperviousness	
	SCS TR-55	FMDM Update
1/8 or less (townhomes)	65%	70%
1/4 acre	38%	49%
1/3 acre	30%	41%
1/2 acre	25%	32%
1 acre	20%	24%
2 acres	12%	11%
Commercial	86%	NA[1]
Industrial	81%	NA[1]

Notes: (1) Commercial and industrial land uses were not included in the ESA PWA analysis of the percent imperviousness area

The fraction of impervious surfaces is related to land use. Similar to land use, imperviousness was determined from two sources. The CN for residential areas was calculated following the TR-55 methodology, which applies a CN of 98 to the impervious fraction of the parcel and a CN for open ground in fair condition (open, fair) for the pervious fraction of the parcel. Modified CN values were developed for residential conditions based on this assumption and the analysis results reported in Table 5-3.

Table 5-4 Curve Numbers for Town parcels

WMP Land Use	CNs by Hydrologic Soil Group				
	TR-55 category	HSG: A	HSG: B	HSG: C	HSG: D
	open, fair	49	69	79	84
	impervious	98	98	98	98
	Impervious Fraction (1)	Impervious-weighted CNs			
Residential High Density	0.70	83	89	92	94
Residential Medium Density	0.70	83	89	92	94
Residential Medium Low Density	0.49	73	83	88	91
Residential Low Density	0.32	65	78	85	88
Residential Very Low Density	0.11	54	72	81	85
Commercial	0.86	91	94	95	96
Industrial	0.81	89	92	94	95

Notes: (1) Impervious fractions based on equivalent lot sizes from ESA analysis for FMDM update for residential parcels and based onTR-55 for commercial and industrial parcels

The 2011 NLCD data (used to categorize non-residential land use cover inside and outside of Town limits) is a 30-meter resolution grid-based geospatial dataset and contains 20 land cover categories. The MRLC also provides a dataset of percent impervious cover at the same resolution of the 2011 NLCD. The percent impervious cover data was used to weight CN values for:

- All non-residential parcels inside and outside of Town limits (for the baseline model), and
- All parcels not identified as either residential, commerical, or industrial parcels inside and outside of Town limits (for the future model).

The same TR-55 methodology described above (applying a CN of 98 to the impervious fraction of the parcel and a CN for open ground in fair condition (open, fair) for the pervious fraction of the parcel) was applied to the 2011 NLCD data.

Equivalent NRCS classes were established for each NLCD land class, and Table 5-5 was generated for calculating curve numbers.

Table 5-5 Curve Numbers for NLCD 2011 Land Uses (prior to impervious weighting)

NLCD Land Class [1]	Equivalent NRCS Class [2]	Hydrologic Soil Group (HSG)			
		A	B	C	D
Barren Land	Fallow - Bare Soil	77	86	91	94
Cultivated Crops	Row Crops – Straight, good condition	67	78	85	89
Deciduous Forest	Woods - Good	30	55	70	77
Developed, High Intensity	Urban – Commercial	89	92	94	95
Developed, Open Space	Open Space, Good	39	61	74	80
Emergent Herbaceous Wetlands	Wetland [3]	90			
Evergreen Forest	Woods - Good	30	55	70	77
Hay/Pasture	Pasture, Grassland, Good	39	61	74	80
Herbaceous	Herbaceous, Good	62	62	74	85
Mixed Forest	Woods - Good	30	55	70	77
Open Water	Water [4]	100			
Shrub/Scrub	Desert Shrub, Fair	55	72	81	86
Woody Wetlands	Wetland [3]	90			

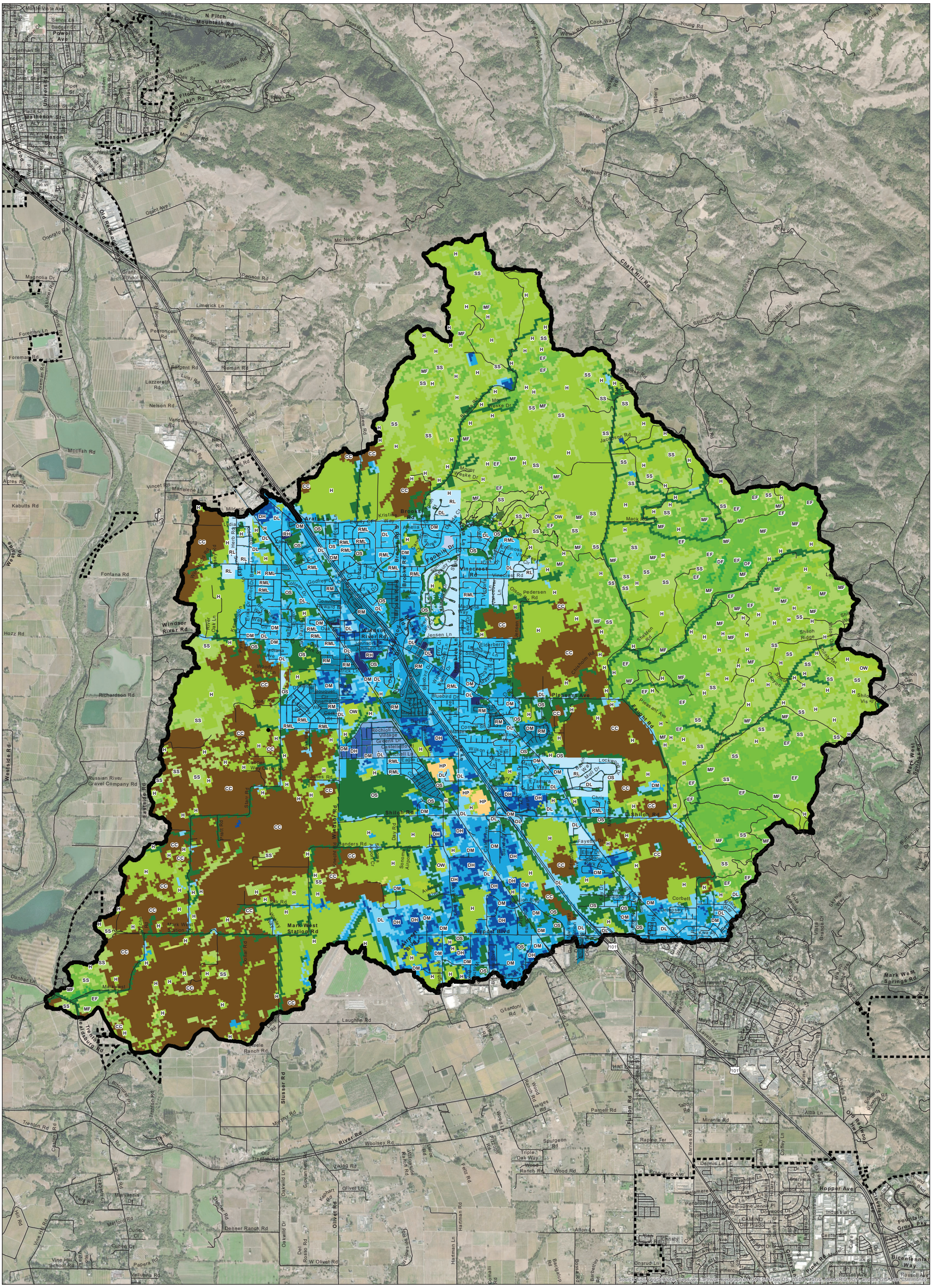
Notes: *(1) NRCS, 2015*
(2) NRCS, 1986
(3) NRCS does not have a wetland class
(4) NRCS does not have a class for water

The HSG, land use and imperviousness GIS layers were intersected with all subbasins resulting in basin “components” that have a unique HSGs, land uses, imperviousness values, and areas associated with each. These were then exported and tabulated in Excel to develop curve numbers for each subbasin component. Finally, the areas and impervious-weighted CNs calculated for each basin component were area-weighted to generate composite CNs for each basin. Roads were assumed to have a CN of 98.

The CN also depends on the rainfall conditions prior to the analyzed storm event or what is referred to as the “antecedent moisture conditions” (AMC). There are three AMC categories (CNI, CNII, and CNIII) representing dry, average, and wet preceding rainfall conditions. The TR-55 baseline curve numbers are for CNII conditions. Average AMC conditions were also assumed for development of composite CNs.

The computed CNII values for the subbasins in the Windsor Creek watershed are also summarized in Appendix B (5A).

Figures characterizing the 2011 WMP Update land use, 2040 General Plan future land use, and soils data by subbasin are included as figures 5-5, 5-6, and 5-7. Complementary figure detailing existing and future composite CNs by subbasin, are included as Figures 5-8 and 5-9.



Paper Size 22" x 34" (ANSI D)

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Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

Existing Land Use

Job Number	11159126
Revision	5
Date	07 Feb 2020

Figure 5-5

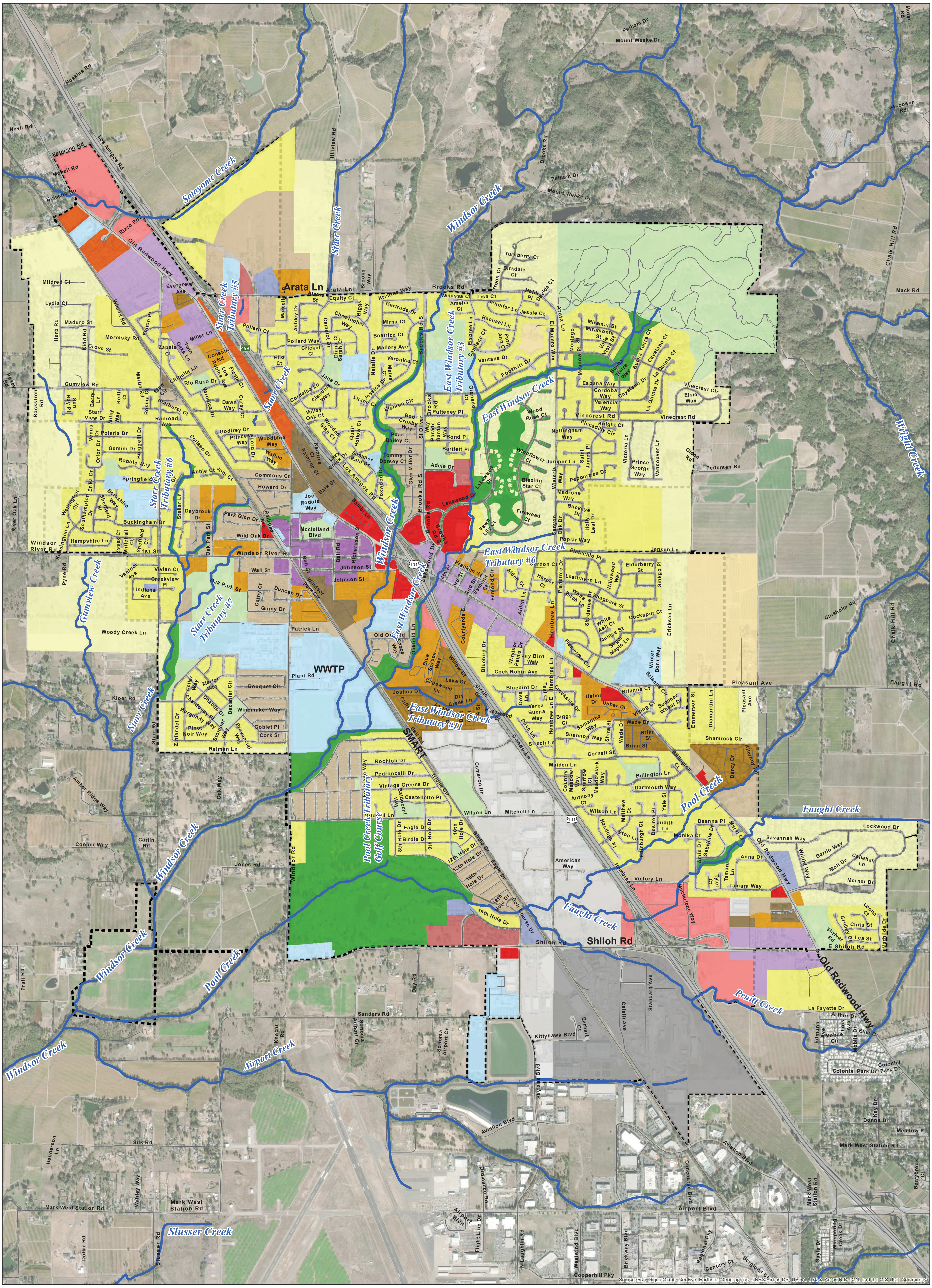
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Town Limits
Streets
Rivers and Creeks

General Plan Land Use

- Rural Residential
- Estate Residential
- Very Low Density Residential
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Mobile Home Park
- Retail Commercial
- Service Commercial
- Gateway Commercial
- General Business
- Neighborhood Center Mixed Use
- Boulevard Mixed Use
- Town Center Mixed Use
- Light Industrial
- Heavy Industrial
- Parks and Recreation
- Open Space
- Public/Quasi-Public

Paper Size 22" x 34" (ANSI D)

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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Town of Windsor
Storm Drainage Master Plan

2040 General Plan Land Use

Job Number	11159126
Revision	1
Date	07 Feb 2020

Figure 5-6

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Town Limits
Watershed Boundary

Soil Hydrologic Group

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

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Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

Job Number	11159126
Revision	5
Date	07 Feb 2020

Soil Hydrologic Groups

Figure 5-7

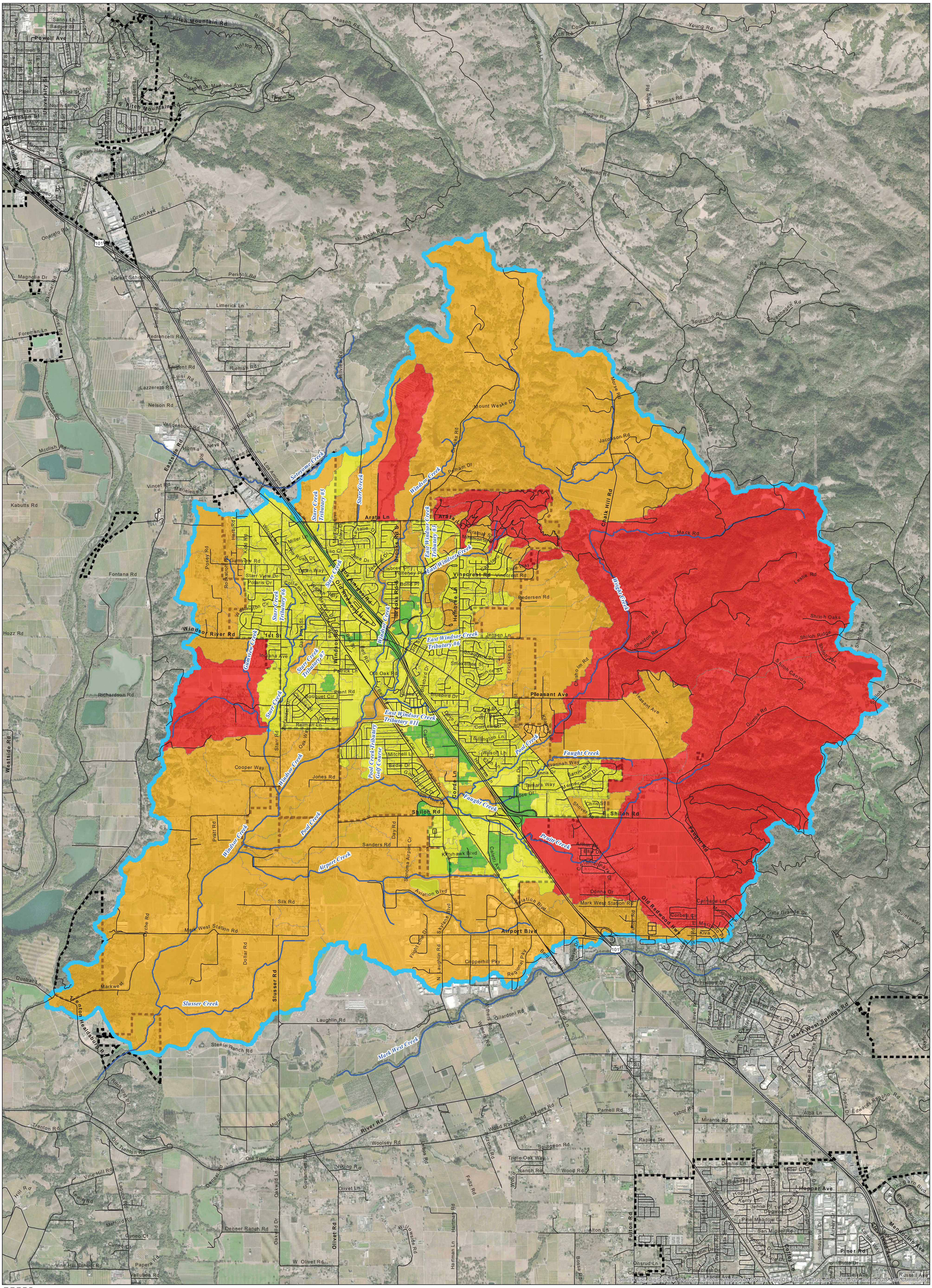
N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 5-7 Soils.mxd

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Town Limits
Streets
Rivers and Creeks
Watershed Boundary

Composite CN

65 - 75	85 - 95
75 - 85	> 95

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GHD

ESA

TOWN OF WINDSOR

Town of Windsor
Storm Drain Master Plan

Current
Composite Curve Number Map

Job Number 11159126
Revision 5
Date 07 Feb 2020

Figure 5-8

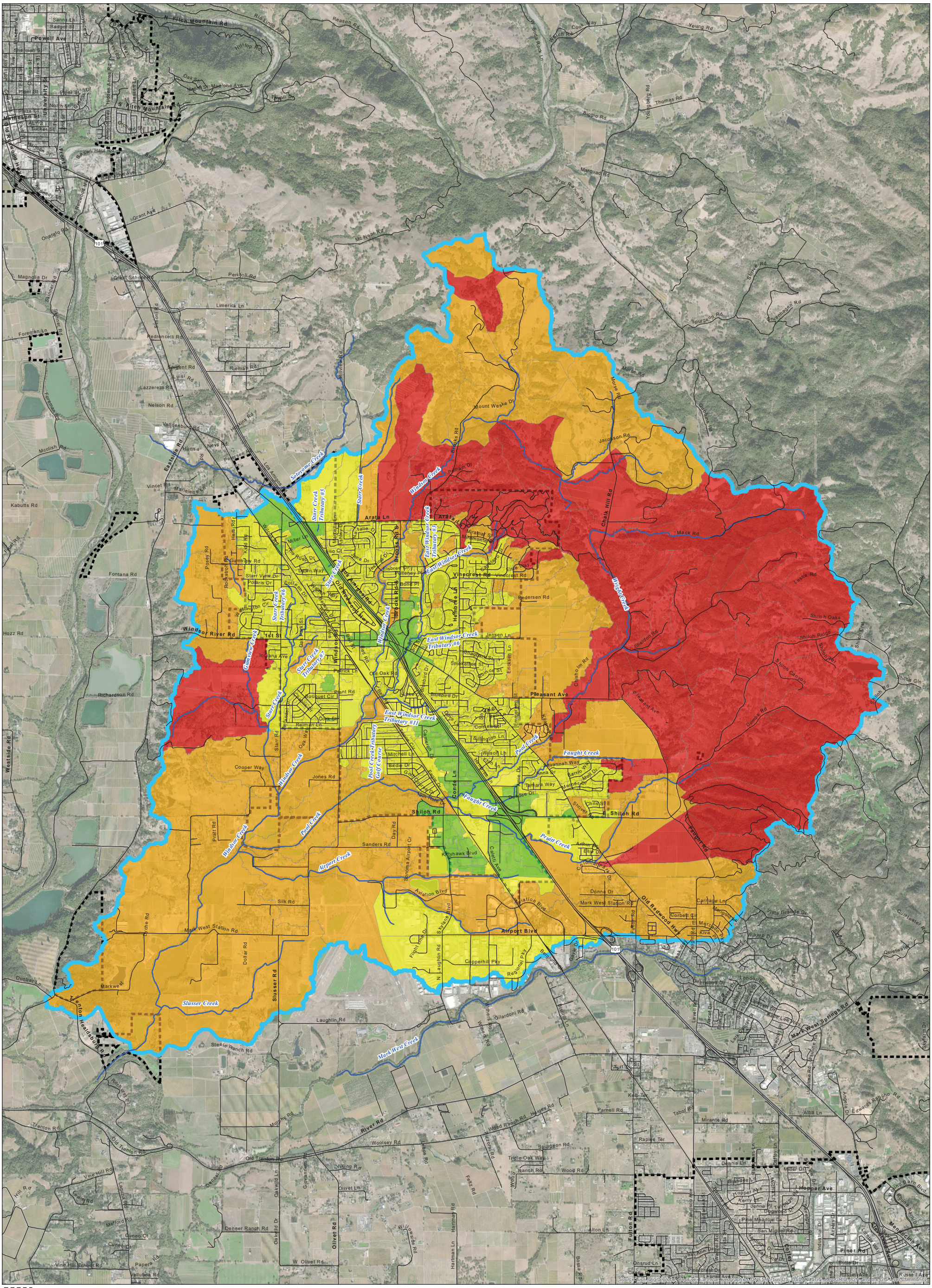
N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 5-8 Composite CN.mxd

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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drain Master Plan

Future Composite Curve Number Values

Job Number 11159126
Revision 1
Date 07 Feb 2020

Figure 5-9

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 5-9 Future Composite CN.mxd
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5.3.4 Transformation

The fraction of rainfall that is not realized as loss is referred to as “excess rainfall” and is converted to streamflow. The transformation method converts a unit of excess rainfall to a flow rate. The FMDM update recommends the use of the Snyder unit hydrograph method for this transformation. The Snyder unit hydrograph method is parameterized by two inputs: lag time and peaking coefficient.

The peak coefficient was set to 0.75 for all basins as recommended by the FMDM update. The lag time is defined as the length of time between the midpoint of rainfall mass and peak flow of the resulting hydrograph. The lag time can be calculated from the following equation:

$$t_L = 1.56 \times \left(\frac{L \times L_c}{\sqrt{S_o}} \right)^{0.38}$$

(Equation 1)

where:

- t_L is lag time (hours)
- L is the length of the longest watercourse (miles)
- L_c is the length from the outlet to the watershed centroid (miles)
- S_o is the average watershed slope (feet/mile)

Longest watercourses and centroids were created for each subbasin using ArcHydro tools. Some watercourses were altered or created manually by assessing the terrain surface due to the nature of hand-delineated subbasins covering the urban drainage network. Average slopes were determined for each subbasin by creating a slope raster from the terrain, converting it to polygons, and intersecting and area-weighting, similar to the CN generation process.

5.3.5 Routing

Once surface runoff from a subbasin reaches an open channel it is routed downstream according to the routing method and parameters. Because open channels were modeled under a separate modeling platform (MIKE 11), routing parameters were not included within the MIKE URBAN hydrology model. All hydraulic routing takes place within MIKE 11, which is described in further detail in Chapter 6.

5.3.6 Base Flow

The baseflow characterizes the amount of stream flow prior to and following a peak flow event and represents slower processes of water draining from the watershed. Baseflow was assumed to be negligible for the design events under consideration within the hydrology model, and was therefore assumed to be zero for each subbasin. This is a valid assumption given the magnitude of the flood events being analyzed relative to the small magnitude of base flow within the Town’s creeks.

5.4 Hydrology Results

As described in Section 5.3, MIKE URBAN was used to develop 10-, 25-, and 100-year hydrology for both baseline (current) and future conditions within the Windsor Creek watershed to inform development of this Storm Drainage Master Plan. The resulting runoff hydrograph peak flows for each subbasin for each return period storm and for both baseline and future conditions are summarized in Appendix B (5B).

5.5 References

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6. HYDRAULICS

The hydraulic analysis developed for the Town's SDMP was performed using both baseline (current) and future conditions hydrology for the 10-, 25-, and 100-year return period storm events. Baseline and future conditions hydraulics were evaluated to inform development of the Town's SDMP and SDIP project recommendations.

There are several hydraulic components that were evaluated as part of this effort. These can be defined as the following:

- Creek and open channel hydraulics
- Storm drain system hydraulics
- Overland street and floodplain hydraulics

The MIKE suite of software programs were selected for their inter-compatibility and ability to dynamically couple the Town's storm drainage network with both creeks and overland flows, including the Town's road surfaces. This coupling better facilitates simulation of complex hydraulic interactions between the Town's storm drain pipes, open channels, creeks, floodplains, and roadway networks.

Storm drainage system hydraulics were evaluated in MIKE URBAN (MU). Creek and open channel hydraulics were evaluated using MIKE 11. Overland street and floodplain hydraulics were evaluated using MIKE 21 FM. Sonoma Water FMDM update was followed to establish design criteria for evaluating hydraulics within the Town.

The following sections further describe the design criteria and assumptions used in guiding development of the hydraulic models, the modeling platforms and the model development and validation process, and finally, model results for the 10-, 25-, and 100-year return period events. Recommended SDIP projects are discussed in Chapter 7.

Due to the large number of figures in this chapter, figures are placed at the end of the chapter.

6.1 Hydraulics Design Criteria and Assumptions

The Sonoma Water FMDM establishes design criteria and methodology for hydraulic design and hydrology within Sonoma County. The manual (previously the FCDC) was last revised in August 1983: however, a major revision to the FMDM (also referred to as FMDM update) is anticipated to be adopted in February 2020.

The pending FMDM update does not include significant modifications to hydraulic design criteria related to storm drains, creeks, and flood control channels. However, the FMDM update does include the following hydraulic design criteria:

- For watersheds greater than four square miles (i.e., major waterways), the design storm is a 100-year event.
- For watersheds of one to four square miles (i.e., secondary waterways), the design storm is a 25-year event.

- For watersheds less than one square mile (i.e., minor waterways), the design storm is a 10-year event.
- Secondary or minor waterways discharging into major or secondary downstream waterways shall be designed to operate against a 25-year or 10-year flow, respectively, in the major or secondary downstream waterway, provided that the ground elevation along the secondary or minor system shall be above the 100-year water surface elevation in the major or secondary downstream waterway.
- Secondary or minor waterways in closed conduits shall have surface routes to carry the incremental 100-year flows with no inundation of structures, or be sized for the full 100-year flows.
- Closed conduits shall be designed with maximum surcharging to within one foot of top of rim or grade for purposes of determining hydraulic capacity.
- Minimum pipe diameter is 12-inches with a minimum velocity of 2.5 feet per second (fps) when flowing full.
- Detention basins will generally be sized for 100-year, 24-hour storm events assuming no increase in runoff from existing conditions.[11].

6.2 Hydraulic Models Description and Background

Storm-driven hydraulics in the Town were modeled with MIKE software (v. 2017 by DHI), in which three separate computational models were coupled to evaluate the open creek channels (MIKE 11), floodplains/adjacent lands (MIKE 21 FM), and storm drainage infrastructure (MU), in the Town. Each model component is described in the following sub sections.

MIKE FLOOD (MF) is the model platform that allows for coupling of the three model elements (MU, MIKE 11, and MIKE 21 FM).

6.2.1 MIKE 11 – Open Channel Hydraulics

MIKE 11 (M11) is an implicit finite difference model used for modeling networks of one-dimensional channels with respect to both hydrodynamics and water quality transport. It is an unsteady flow model based on the St. Venant equations and thus capable of modeling one-dimensional channel flows that vary over time and space. The basic hydrodynamic (HD) model within M11 contains the creek network alignments and cross sections defining the Town's open channels and was utilized for simulating channel hydraulics for all creeks and major tributaries within the Town. The HD model allows for calculation of water levels, velocities and shear stresses (not used in this SDMP model), and discharge throughout the model domain over the simulation period.

M11 has the ability to be dynamically coupled with MU to dynamically simulate interactions between the one-dimensional channels and the Town's storm drain network, and can also be coupled with MIKE 21 (M21) to dynamically simulate interactions between the one-dimensional

[11] This design criteria is not currently included in the existing 1983 FCDC but is included in the FMDM update.

channels and a two-dimensional floodplain or DTM surface. For this storm drainage master plan, M11 was coupled to both MU and M21, which is described further in the following section.

M11 model development is further described in Section 6.3.1.

6.2.2 MIKE 21 – Floodplain and Overland Hydraulics

MIKE 21 FM is a two-dimensional, unsteady hydrodynamic model capable of simulating complex floodplain and street flooding through the use of a flexible mesh model grid. The M11 model described above simulates only the active channel portion of creeks and open channels within the Town (defined as top of bank to top of bank), while the M21 model routes flows two-dimensionally on a DTM surface. M21 is dynamically coupled with both M11 and MU, and thus is able to dynamically exchange flows with either model component. M21 receives flows from either the M11 model when flows exceed the active channel carrying capacity and out of bank flows occur, or when flows from the MU model exceed the storm drainage system capacity. This exchange also works in reverse, so out of bank flows are able to reenter the M11 model when water levels recede sufficiently within creeks and open channels, and flows are also able to reenter the MU model when hydraulic grade lines within the storm drainage system recede.

M21 model development is further described in Section 6.3.2.

6.2.3 MIKE URBAN – Storm Drain Hydraulics

MIKE URBAN is a hydrodynamic model capable of routing runoff from subbasins through closed conduit and open channel reaches referred to in the model as links. Each link connects upstream and downstream nodes, which consist of curb inlets, manholes and outlets or discharge points. Curb inlets and manholes are collectively referred to as nodes within the MU model. These MU storm drain nodes and outlets provide the active coupling between MU storm drain hydraulics and the MIKE 11 channel hydraulics as well as MIKE 21 floodplain/overland hydraulics to be discussed in the following sections.

For example, a storm drain pipe discharging to a creek via an outlet provides a dynamic coupling by which flow can be exchanged from the pipe system to the creek, and vice versa, with creek water levels providing a dynamic boundary condition, or backwater, that impacts storm drainage system hydraulics. This represents the dynamic coupling between MU and MIKE 11.

The manhole nodes within the storm drain network are also dynamically coupled to the Town's surface hydraulic model defined by a DTM, allowing for flow to be exchange from the storm drainage system to the DTM surface, and vice versa, for overland flood routing. Therefore, flow from surcharged manholes is transferred directly onto the DTM surface for two-dimensional routing. When hydraulic grade lines within the storm drainage system recede, flow is able to enter back into the storm drainage system from the DTM surface as well.

MU model development is further described in Section 6.3.3.

6.2.4 MIKE FLOOD and Coupling with MIKE URBAN

MIKE FLOOD represents the model developed by dynamically coupling the M11 one-dimensional channel hydraulics models, the MU model simulating the catchment hydrology and storm

drainage system hydraulics, and the M21 model simulating two-dimensional floodplain and overland hydraulics. For the purposes of storm drainage master planning, the dynamic coupling of these various models provides valuable insight into complex and dynamic interactions between the Town's storm drain network and creeks, and the ability to route overland flooding two-dimensionally within the floodplain and road network. The ability to accurately simulate these dynamics ultimately allows for increased understanding of system performance, areas susceptible to flooding, and the ability to simulate flood reduction benefits from SDIP alternatives.

The MF model represents a significant advancement in hydraulic modeling within the Town of Windsor compared to modeling tools used for the 1999 Boyle Report.

6.3 Hydraulic Model Development

The following sections describe the model development process for each of the respective hydraulic models, providing background and detail on the model domains, model input and data sources, and boundary conditions used within the hydraulic models.

6.3.1 MIKE 11

Model Domain

The M11 model includes the major creeks that flow through the Town as well as significant tributary channels and ditches. The model domain covers the following channel extents (described moving downstream):

Windsor Creek, from 500 feet upstream of Arata Lane to its confluence with Mark West Creek (WINDSOR CREEK).

Airport Creek, from 20 feet upstream of the track of the Northwestern Pacific Railroad to its confluence with Windsor Creek (AIRPORT CREEK).

Pool Creek, from approximately 1,000 feet upstream of Old Redwood Highway to its confluence with Windsor Creek (POOL CREEK); Pool Creek tributary ditch, a short open ditch that feeds in at station 7,200 feet in Windsor Golf Course (POOLGOLFTRB).

Pruitt Creek, from approximately 500 feet upstream of Highway 101 to its confluence with Pool Creek (PRUITT CREEK).

Faught Creek, the open channel portion from 20 feet downstream of Old Redwood Highway to its transition to double culverts 150 feet downstream of Amie Drive (FAUGHT_US); the underground portion of Faught Creek from the start of the double culverts 150 feet downstream of Amie Drive, extending beneath the Shiloh Center and Walmart parking lots, to 44 feet downstream of the Highway 101 culverts (FAUGHT_WALMART); and the open channel portion from 44 feet downstream of Highway 101 to its confluence with Pool Creek (FAUGHT CREEK).

Starr Creek, from approximately 500 feet upstream of the track of the Northwestern Pacific Railroad to its confluence with Windsor Creek (STARR CREEK); Starr Creek Tributary No. 6, from approximately 300 feet upstream of Colleen Drive to its confluence with Starr Creek (STARR TRB 6); and Starr Creek Tributary No. 7 through a residential stretch from approximately 320 feet upstream from Windsor River Road to 20 feet downstream of Windsor River Road (STARRTRB_Upper) continuing along and flanking Keiser Community park, from 20 feet downstream of Windsor River Road to its confluence with Starr Creek near river station 6,300 feet (STARR TRB 7).

Gumview Creek, from 45 feet downstream of Windsor River Road to its confluence with Starr Creek (GUMVIEW CREEK).

East Windsor Creek, from 130 feet upstream of Foothill Drive to its confluence with Windsor Creek (E WINDSOR CREEK and EW_US); East Windsor Creek Tributary No. 11, from 500 feet upstream of Highway 101 to its confluence with East Windsor Creek (EW TRB 11); East Windsor Tributary No. 6 from 30 feet downstream of Hembree Lane to its confluence with East Windsor Creek next to the US Post Office near river station 5,200 feet (EW TRB 6); and East Windsor Creek Tributary No. 3 from its upstream terminus 100 feet from Elsbree Lane at Candace Court to its confluence with East Windsor Creek, 300 feet downstream of Foothill Drive (EW TRB 3).

Model Input and Data Sources

Geometric data required for the M11 model includes creek centerlines, cross sections and associated reach lengths, and bridge or culvert crossing information. Existing HEC-RAS and HEC-2 model data from the 1999 Boyle Report was provided by the Town as a start to the M11 network. Given that these models were not georeferenced, the models were approximately georeferenced by GHD/ESA, based on the location of existing bridge and culvert road crossings and newly digitized creek centerlines corresponding to the DTM provided by the Town. Additional structures and cross sections were field surveyed to extend the coverage of East Windsor Creek to include significant open channels in the Town not already a part of the model network, and to improve the resolution of reaches with fewer cross sections. Open channels represented in the MU network that directly connected to the M11 network were removed from the MU network and added to the M11 network. Additional HEC-RAS data from the Sonoma-Marin Area Rail Transit (SMART) project (GHD, 2010) was added to update the Northwest Pacific Railroad (NWPRR) crossing on Windsor Creek.

Hydraulic Roughness

Hydraulic roughness for the MIKE 11 model was estimated using a combination of site photos and reconnaissance, comparison to literature values for similar channel conditions, and the roughness values from the prior HEC-2 and HEC-RAS models developed for Windsor's creeks (SCWA, 1989 and Boyle, 1999). The range of assumed Manning's roughness values for each of the creeks are summarized in Table 6-1.

Table 6-1 Manning's Roughness Values Used in MIKE 11 Model

M11 Creek ID	Range of Manning's Roughness Values
AIRPORT CREEK	0.017 - 0.080
E WINDSOR CREEK	0.022 - 0.080
EW TRB 11	0.035 - 0.045
EW TRB 3	0.055
EW_US	0.035 - 0.050
EW TRB 6	0.045
FAUGHT CREEK	0.040 - 0.050
FAUGHT_WALMART	0.015
FAUGHT_US	0.050
GUMVIEW CREEK	0.040 - 0.070
POOL CREEK	0.017 - 0.100
POOLGOLFTRB	0.040
PRUITT CREEK	0.025 - 0.060
STARR TRB 6	0.050
STARR CREEK	0.017 - 0.085
STARR TRB 7	0.045
STARRTRB_Upper	0.045
WINDSOR CREEK	0.015 - 0.080

Boundary Conditions

Boundary conditions were set in the M11 model at the downstream end of Windsor Creek at its confluence with Mark West Creek. The Windsor Creek watershed is nearly 70 square miles, and its downstream reach near the confluence with Mark West Creek is dominated by Russian River backwater conditions. Given the relatively small size of the Windsor Creek watershed in comparison to the Russian River watershed, a 10-year Russian River tailwater elevation was selected as the downstream boundary condition to the M11 model for all return period storm events analyzed. This was selected and deemed appropriate to assess the Town's creek and storm drain systems given the small nature of Windsor Creek relative to the Russian River. FEMA guidance recommends coincident return period backwater only be used when the ratio of the drainage areas lies between 0.6 and 1.4 Additional coincident probability analysis could be conducted in the future to provide further insight into appropriate Russian River backwater conditions to be used under the various return period storm events analyzed.

Flood information was accessed through FEMA's online map service center which provides the Digital Flood Insurance Rate Map (DFIRM) and Flood Insurance Study (FIS) for Sonoma County. The 10-year flood elevation at the confluence of Windsor Creek and Mark West Creek is 70 feet NAVD 88, confirmed both in the DFIRM and FIS for Mark West Creek.

6.3.2 MIKE 21

Model Domain

The M21 model domain covers the extents of the Town of Windsor's DTM (see Figure 6-3) and storm drainage system, including all storm drainage infrastructure discharging into the creeks and open channels listed in the M11 model extents.

Model Input and Data Sources

A DTM provided by the Town was used to develop the M21 model surface. The original DTM point data was aggregated to varying resolution throughout the model domain to create a flexible mesh surface constructed of triangular elements that define the M21 model domain. Three classifications of resolution were defined in developing the flexible mesh:

- Areas within 50 meters of any creek or open channel were assigned a maximum element area of 40 square meters.
- Areas within 50 to 100 meters of any creek or open channel, or within 50 meters of a storm drain network, were assigned a maximum element area of 80 square meters.
- All remaining areas within the model domain were assigned a maximum element area of 200 square meters.

These were selected to provide a greater degree of resolution in areas adjacent to creeks and in the direct vicinity of storm drainage systems to accurately represent floodplain and street flooding. The resulting flexible mesh contained 310,580 elements.

Hydraulic Roughness

A uniform hydraulic roughness value of 0.03 was used throughout the M21 model domain. This represents an average value for floodplains with pasture comprised of short grass, and was also considered representative of the Town's road network.

Boundary Conditions

The M21 model downstream limit is located at the Town limit immediately west of Windsor Road, and utilized a downstream boundary condition of 85.4 feet. This value is approximately equal to the FIS published profile for Windsor and Pool Creeks just downstream of Windsor Road, and is just slightly above the road deck elevation of Windsor Road at Pool Creek (consistent with observations). Therefore, the model assumes slight backwatering of the M21 surface only at the Windsor Road crossing of Pool Creek.

6.3.3 MIKE URBAN

Model Domain

Model coverage for the MU storm drainage network extends throughout the Town of Windsor limits and includes all major storm drainage infrastructure greater than or equal to 24-inches in diameter, with some smaller pipelines included for model connectivity. Smaller pipelines were not addressed within this modeling effort, but could be added as model refinements in the future.

There are several locations within the Town's storm drainage network, where piped systems flow to open channels and then back to piped systems. These open channels located in between piped portions of the system were included within MU. Figure 6-3 shows the digitized storm drain network utilized in the MU model.

Model Input and Data Sources

Existing storm drainage system data was supplied by the Town of Windsor in the form of a geodatabase. The database was validated in the field and missing data was filled in during the data collection/field survey phase of the project, further described in Chapter 3 of this SDMP.

The MU model consists of nodes and links. Nodes represent storm drain manholes, drainage inlets, and catch basins within the Town. Node information such as diameter, bottom invert elevations, and ground elevation were input into the MU model. Links (closed conduits and open ditches) represent the major conveyance components in the Town. Link data such as upstream and downstream invert elevations, diameters, material, and length were input into the MU model. The geodatabase containing all the information needed for MU model development was supplied following the field data collection phase of the project. Given the field data collection effort was not able to field verify every single storm drainage system component within the Town, some minor adjustments and assumptions were made to the geodatabase during MU model development to fill any remaining data gaps. See Chapter 3 for additional discussion on data collection and field surveys.

The Town of Windsor storm drainage network includes a total of 112 storm drain outlets that discharge to creeks throughout the Town. These MU storm drain outlets provide the active coupling between MU storm drain hydraulics and the MIKE 11 creek channel hydraulics to be discussed in the following section. The number of outlets discharging to each creek within the Town is summarized in Table 6-2. The table also includes the M11 Creek ID and a description of the creek or tributary.

Appendix C (6A) includes further information related to these storm drain outlets, providing unique identifiers used in the MU model, the creek receiving the discharge, and the creek stationing associated with the discharge. The unique identifiers associated with each creek outlet and its associated storm drain network are also included in Figure 6-3. GIS includes labels for all inlets, manholes, and discharge points that cannot be shown in Figure 6-3.

Table 6-2 MIKE URBAN Storm Drain System Outlets

M11 Creek ID	M11 Creek Description	# of Storm Drain System Outlets
AIRPORT CREEK	Airport Creek	7
E WINDSOR CREEK	East Windsor Creek	15
EW TRB 11	East Windsor Tributary 11 (confluence with East Windsor Creek is located immediately upstream of railroad)	6
EW TRB 3	East Windsor Tributary 3 (confluence with East Windsor Creek located just southeast of Hiram Lewis Park)	2
EW_US	East Windsor Creek Upstream (reach upstream of East Windsor Tributary 3)	6
EW TRB 6	East Windsor Tributary 6 (confluence with East Windsor Creek is located just east of Lakewood Drive)	4
FAUGHT CREEK	Faught Creek	0
FAUGHT_WALMART	Faught Creek where it goes underground beneath Shiloh Center	3
FAUGHT_US	Faught Creek Upstream (reach upstream of underground portion of creek east of Shiloh Center (Home Depot, Walmart) and Highway 101)	6
GUMVIEW CREEK	Gumview Creek	2
POOL CREEK	Pool Creek	10
POOLGOLFTRB	Pool Creek Golf Course Tributary (a small reach of open ditch located in golf course)	1
PRUITT CREEK	Pruitt Creek	5
STARR TRB 6	Starr Creek Tributary 6 (confluence with Starr Creek just south of Windsor River Road)	4
STARR CREEK	Starr Creek	14
STARR TRB 7	Starr Creek Tributary 7 (confluence with Starr Creek located near Keiser Community Park and Windsor High School)	2
STARRTRB_Upper	Starr Creek Tributary 7 (reach upstream of Keiser Community Park through residential stretch north of Windsor River Road)	1
WINDSOR CREEK	Windsor Creek	23

6.4 Hydraulic Model Validation

The Town purchased and installed two stream gauges and two rainfall gauges that were intended to record stream levels and rainfall during storm events. The gauges were initially installed in Pool Creek and Windsor Creek. Not enough rainfall occurred during the Phase 1 timeline to generate an ample data set. Maintenance and upkeep of the stream gauges proved difficult. While the gauges did record a few storm events between Phase 1 and Phase 2, the data was not comprehensive enough, and the recorded storms did not span the range of flows needed, to perform a complete calibration of the MIKE model.

During Phase 2, GHD gathered all available information from the gauges and assessed what could be used to attempt to hone the model to real-world and recorded creek levels.

Below is summary of the available calibration data:

- 2014 storm event (<1-yr storm event) with full recorded storm hydrographs and rainfall data at both locations
- Two January 2017 storm events
    - Time recorded single field observation of water surface elevations at both locations made by ESA
    - Recorded stream velocity measurements at both locations
    - No recorded hydrographs at either gage location

A relatively small storm event in 2014 was determined to contain the only complete set of data needed to attempt a model calibration. The initial calibration attempt demonstrated the limitations of the 2014 storm event. While the model predicted the Windsor Creek hydrographs reasonably well, significant adjustments to the model parameters were needed to match the recorded discharge hydrographs at Pool Creek. The adjustments needed fell outside the range acceptable given the limited storm data set and recognizing that the default model parameters were chosen based on both industry standards with field observation. Recognizing the data set limitations (singular relatively small storm event) for complete calibration, GHD and the Town decided to use field observations for two later and larger storm events in January of 2017 to validate the existing model setup.

For the hydraulic validation of the model, the rating curves for the gage location cross sections in the model were compared to the observed events during the January 8th and 10th 2017 storm events. The field observations consisted of velocity and stage measurements and were completed by personnel from ESA. See Figure 6-1 for the graphical comparison between the model rating curve and the observed water surface elevation. The field observed water surface elevations for the two January 2017 storm events generally match up with the rating curves representing the gage location cross sections in the model. The approximate match demonstrates the existing model's channel roughness appropriateness for Pool Creek and East Windsor Creek locations.

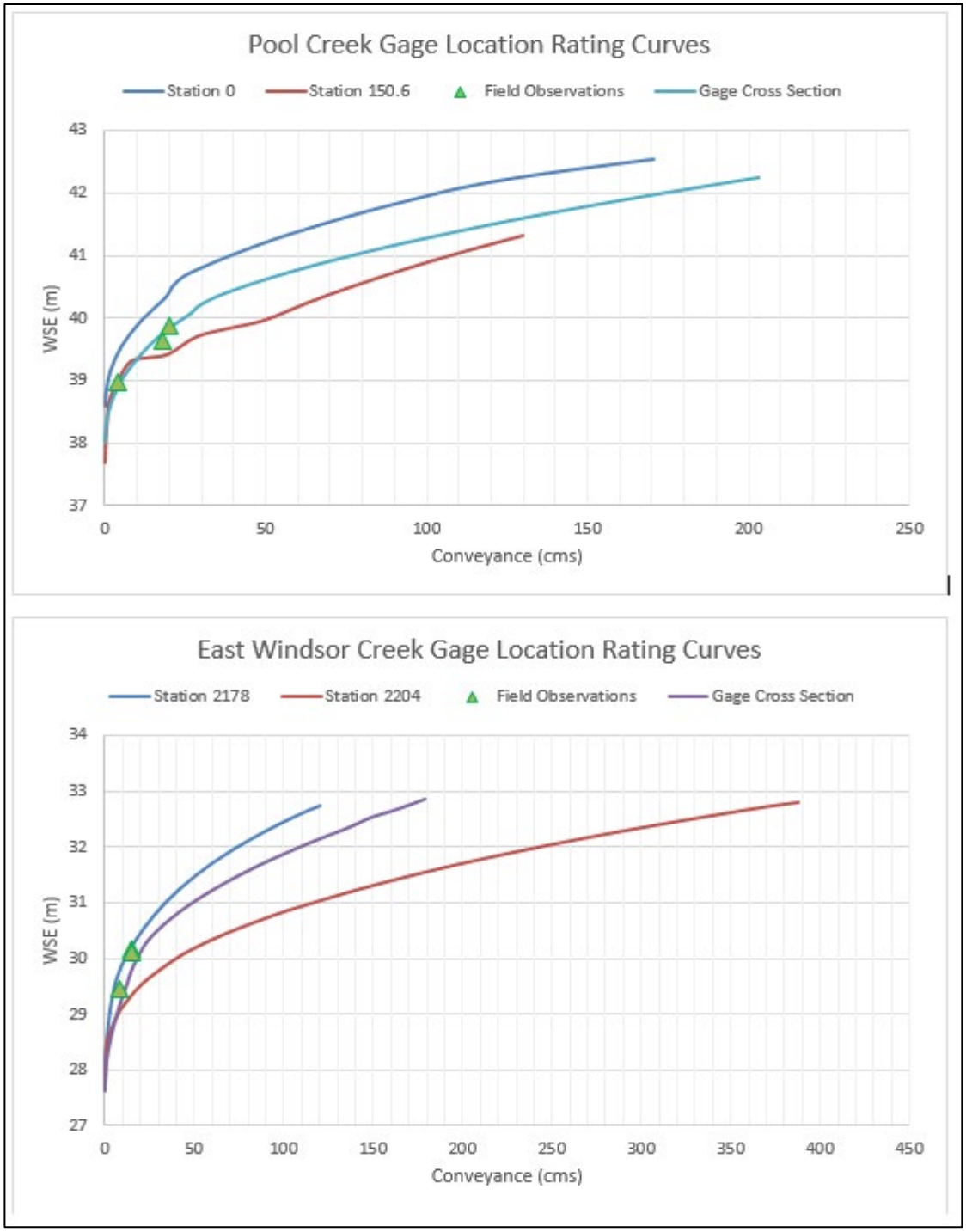
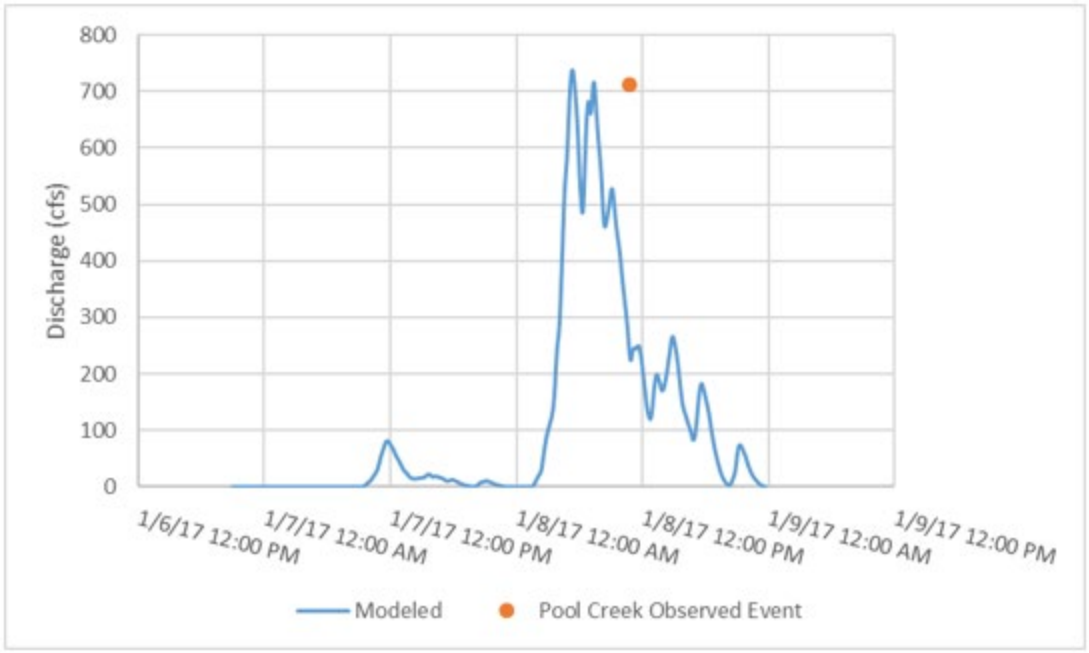


Figure 6-1 Field Observations vs. Modeled Rating Curves Near Creek Gauge Locations

With the hydraulic validation complete, the January storm event field observations at Pool Creek and East Windsor Creek was used to evaluate the existing model runoff parameters. Figure 6-2 compares the model output hydrograph at the Pool Creek and East Windsor Creek gage locations with the observed January 8th storm event.



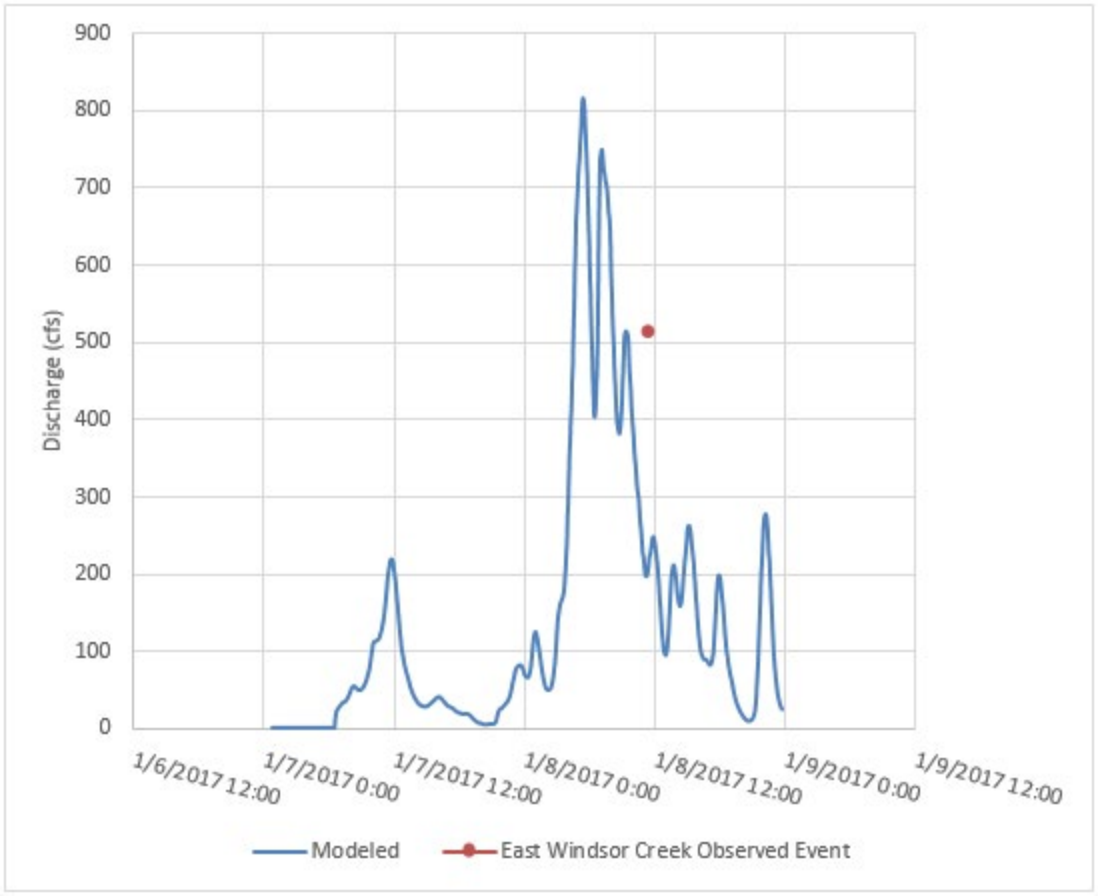


Figure 6-2 Model Validation with Pool Creek and East Windsor Creek Observed Events

As shown above, although the timing is offset, the observed Pool creek discharge (estimated by ESA to be reasonably close to the peak water level based on observation) correlates somewhat well with the peak modelled flowrates during the validation storm event.

IN addition, the East Windsor Creek model peak flow results show a similar relationshiop to the observed event. Observations from ESA at the time of the field observations indicate that the field observations were made after the peak of the storm had passed. GHD determined that additional gage data would be needed to justify adjusting model parameters to create a better fit. The Town has future plans to install at least one more robust stream gauge that can be used to gather enough data for future calibrations. This future gauge can be installed with real-time monitoring to make preventative maintenance tracking and data gathering much easier.

6.5 Hydraulic Model Results

Model results for baseline and future conditions modeling are discussed below. Model results for both the baseline and future SDIPs are described in further detail in Chapter 7. The following model scenarios were developed and are describe as follows:

- Baseline condition scenario is reflective of current development conditions with no SDIPs in place (Figures 6-4, 6-5, and 6-6)
- Baseline conditions with SDIPs scenario is reflective of current development conditions with baseline SDIPs implemented and in place (Figures SDIP-1, SDIP-5 , SDIP-6, SDIP- 8, SDIP-9, SDIP-11, SDIP-12, SDIP-13, and SDIP-14)
- Future conditions with existing (baseline) SDIPs is reflective of buildout conditions (as reflected by the General Plan 2040, Future Land Use Map) with baseline (existing) SDIPs implemented and in place (Figures 7-4, 7-5, and 7-6)
- Future conditions with SDIPs is reflective of buildout conditions (as reflected by the General Plan 2040, Future Land Use Map) with both baseline and future SDIPs implemented and in place (Figures F-SDIP-1, F-SDIP-3, F-SDIP-4, F-SDIP-5, F-SDIP-6, F-SDIP-7, F-SDIP-8, and F-SDIP-9)

6.5.1 Baseline Conditions

Baseline conditions are reflective of current development conditions with no SDIPs in place. The baseline conditions for storm drainage system and creek hydraulics were evaluated for the 10-, 25-, and 100-year return period storms. Model results were used to identify potential hydraulic deficiencies within the Town's storm drainage system and to identify high priority areas where flooding is derived from either the storm drainage system spilling onto the roadway network or creeks overtopping their banks. Baseline model results are summarized in a general way for the two-dimensional (2-D) overland flooding results (MF) and in more detail for the storm drainage system (MU) and creeks (M11).

Baseline conditions model results were used to inform SDIP project selection. Baseline SDIP projects are described further in Chapter 7. The baseline SDIP development process and project selection were primarily driven by 2-D model results of overland flooding for the 100-year baseline conditions model and Town Staff's experience with known areas of flooding. The Town's focus was primarily aimed at identifying projects which would reduce flooding potential to

the roadway network and residential areas within the Town. However, MU and M11 model results are also important and provide valuable information to help better understand the dynamic hydraulic interactions occurring within the Town's storm drain and creek systems.

6.5.2 MIKE FLOOD (MF) Baseline Results

The coupled MF model was used to evaluate baseline conditions flooding within the Town of Windsor. Baseline conditions overland flooding results are shown in Figures 6-2, 6-3, and 6-4 for the 10-, 25-, and 100-year return period storms, respectively.

10-yr Return Period Storm Event

As can be seen in Figure 6-4, the Town's storm drainage system and creeks result in minimal street and overland flooding during the 10-year event, indicating the storm drainage system is functionally conveying 10-year flows in most locations throughout the Town. Flooding is mostly limited to roadways, with the exception of the following:

- Flooding overtops Arata Lane in several areas.
- Flooding resulting from overtopping of Pool Creek in the vicinity of the golf course.
- Flooding of Windsor Creek and East Windsor Creek in the vicinity of the railroad tracks.
- Flooding of Pruitt Creek upstream of Highway 101 into an undeveloped field and onto Highway 101 northbound off ramp at Shiloh Road.
- Flooding of Starr Creek near the Windsor High School ball field.

These flooded areas are generally limited to undeveloped floodplains and do not result in flooding of infrastructure or structures.

25-yr Return Period Storm Event

There are some distinguishing items to note during the 25-year storm shown in Figure 6-5. These include:

- Flooding areas that appear during the 10-year event are generally exacerbated during the 25-year event.
- Flows from the flooded field southeast of the intersection of Shiloh Road and Highway 101 begin to break out and overtop the highway road elevations resulting in overland flooding to the west. This impacts areas west of Highway 101 including areas surrounding Caletti Ave and Shiloh Road intersection.
- The detention pond at Hiram Lewis Park begins to activate during the 25-year event.
- Some additional flooding begins to appear throughout the storm drainage system in areas not flooded during the 10-year event, but these are generally confined to the roadway network.
- Flooding from the creeks in and around the Town's WWTP is exacerbated relative to the 10-year event.

100-yr Return Period Storm Event

The 100-year flooding shown in Figure 6-6 was largely used to inform selection of the SDIP projects developed to address baseline flooding and summarized in Chapter 7. Generally, flooding is exacerbated relative to the higher frequency return periods, particularly at the WWTP and the Highway 101 flooding in the vicinity of Shiloh Road. Pleasant Oak Park and areas west of Old Redwood Highway are also flooded during the 100-year event. The most significant flooding dynamic occurring during the 100-year event is the overtopping of the detention pond at Hiram Lewis Park, on the southern end, leading to overland flooding of Windsor Middle School and residential areas to the south of the Park.

6.5.3 MIKE URBAN (MU) Baseline Results

Flooding resulting from the storm drainage system is largely evident within the 2-D overland flooding results shown in Figures 6-2, 6-3, and 6-4. In addition to these flood results, MU provides further insight into storm drainage system performance by including the ability to calculate statistics of the hydraulic conditions within the storm drainage system under the various return period storms analyzed. Initial model output includes node water levels and pipe flowrates for all time steps in which output was written during the model simulation. The time series output is used to develop statistics layers for nodes and pipes within the system.

The result layers shown in Table 6-3 below were developed for the 10-, 25-, and 100-year return period storms.

Table 6-3 Summary of MU Model Results Statistics

Model Component	Result Layers	Description
Nodes	Max Node Level	The maximum hydraulic grade line (HGL) of the node during the 24-hour design storm.
	Max Node Flood	The maximum difference of the HGL and ground level during the 24-hour design storm.
	Max Node Discharge	The maximum discharge rate from the node to the 2-D surface during the 24-hour design storm.
Pipes	Max Link Discharge	The maximum flowrate experienced in the link during the 24-hour design storm.
	Max Link Q / $Q_{MANNING}$	The maximum ratio of link discharge to a computed Manning formula (pipe full flowrate for given diameter and slope) for the link.
	Max Link Filling	The maximum ratio of water depth and conduit height (similar to traditional depth over diameter, d/D, values) for the link.

Figures 6-5, 6-6, and 6-7 include an overview from two result layers including the $Q/Q_{MANNING}$ and *Max Node Discharge* results for the 10-, 25-, and 100-year return period events. While the $Q/Q_{MANNING}$ result highlights pipes that are exceeding hydraulic capacity flowing in a full pipe condition, the additional *Max Node Discharge* result highlights those surcharged pipes that are actually resulting in flows being discharged to the surface as a result of the system HGL exceeding the ground elevation.

The *Max Link Filling* result layer provides further information to assess storm drainage system hydraulics, and can be viewed together with the *Max Link Q / $Q_{MANNING}$* results to identify pipes that are surcharging as a result of backwater or as a result of flows exceeding hydraulic capacity of the pipe. The $Q_{MANNING}$ result layer represents the hydraulic capacity of the pipe flowing full in the absence of a backwater condition. Therefore, if pipes are surcharged, but the *Max Link Q / $Q_{MANNING}$* ratio is less than 1, then this indicates a backwater condition that is preventing the pipe from functioning at its optimal hydraulic performance. Conversely, if the pipes are shown as surcharged, and the *Max Link Q / $Q_{MANNING}$* result layer is greater than 1, then this indicates the pipe may be undersized to convey design flows.

The MU results, when viewed in conjunction with the MF overland flooding results presented above, provide insight into which storm drainage system overflows are problematic and result in flooding of structures as opposed to surface flooding that is confined to roadways or open areas and do not result in flood damages. For example, flooding from a MU node onto the MF surface may not be seen as problematic in and of itself if flooding is contained within roadways. The MF flooding results provide insight into whether the resulting surface flooding results in flooding of structures. Generally, the MU model results mirror the MF model results, in that increased flooding and storm drainage system surcharging result from higher return period (i.e., less frequent) storms.

In addition to the results layers, a Development Review Look-Up Table and accompanying figure are included in Appendix C (6E). The table and figure include 100-year baseline MU results (maximum discharge and hydraulic grade line) for select nodes which have inputs to the MU model. This appendix was developed for use during development review.

6.5.4 MIKE 11 (M11) Baseline Results

Flooding resulting from the creeks is also largely evident within the 2-D overland flooding results as shown in Figures 6-2, 6-3, and 6-4. However, M11 model results for maximum water surface elevations (WSEs) and profiles for the 10-, 25-, and 100-year return period events are helpful in evaluating portions of the creeks where water surface profiles exceed bank elevations and also to establish baseline WSEs for planning and design. Given the large number of baseline WSE profiles associated with all the creeks and tributaries within the Town, these figures are included as Appendix C (6B). Tabular results data are also provided in Appendix C (6D).

6.5.5 Future Conditions

The future conditions modeling assumed all baseline SDIP projects were in place and future land use was defined by the 2040 General Plan Future Land Use Map (see Figure 5-6 presented in Chapter 5). Future conditions for storm drainage system and creek hydraulics were also evaluated for the 10-, 25-, and 100-year return period storms. Model results were used to identify new areas of hydraulic deficiencies within the Town's storm drainage system resulting from increased drainage from future build-out conditions. Future conditions model results are summarized generally in Chapter 7 for the 2-D overland flooding results (MF), and in more detail for the storm drainage system (MU) and creeks (M11).

Future conditions model results were also used to inform future SDIP project selection. Future SDIP projects are described in Chapter 7. Similar to baseline SDIP development, future SDIP

project selection was largely driven by 2-D model results of overland flooding for the 100-year future conditions model. Future SDIP projects also include lower priority projects that were identified as part of the baseline SDIP process but were not ultimately selected to be included within the ten baseline SDIP projects. Of note, SDIP 2 and SDIP 4 from Phase 1 were moved from existing to future during Phase 2 in part to incorporate detention as a preferred approach over capacity projects, where feasible. MU and M11 model results are also important and provide valuable information to help better understand future hydraulic interactions occurring within the Town's storm drain and creek systems after the baseline SDIP projects are implemented and Town build-out has occurred according to the 2040 General Plan Future Land Use Map.

6.6 Storm Drainage Improvement Plan

Model results for baseline and future conditions modeling were used to identify hydraulic deficiencies within the Town's storm drainage system and to identify high priority areas where flooding derived from either the storm drainage system spilling onto the roadway network or creeks overtopping their banks. Baseline conditions model results were ultimately used to inform baseline SDIP project selection. The baseline SDIP development process and project selection were largely driven by hydraulic model results for the 100-year baseline conditions model, and the model was also used to test the effectiveness of the selected current SDIP projects. Future SDIP projects built upon the baseline SDIP projects being implemented and addressing future deficiencies and needs arising from future development within the Town.

Baseline and future SDIP projects are described in Chapter 7.

6.7 References

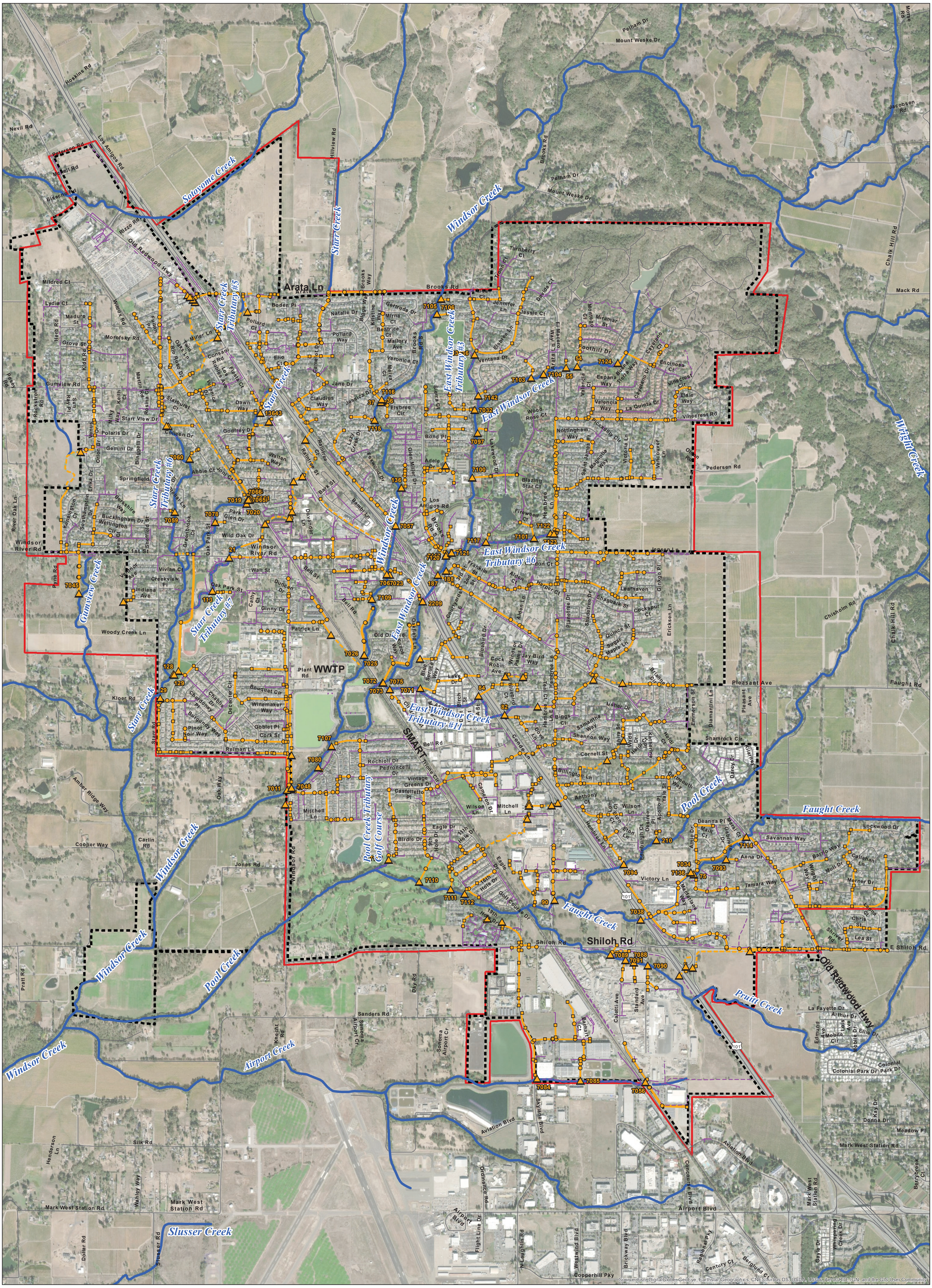
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- Town Limits
- M21 Model and DTM Extents
- Streets
- Rivers and Creeks
- Culverts, Modeled
- Culverts, Not Modeled
- Gravity Mains, Modeled
- Gravity Mains, Not Modeled
- Open Channels, Modeled
- Open Channels, Not Modeled
- Inlets, Modeled
- Manholes, Modeled
- 7085 Discharge Points & ID, Modeled

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Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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Town of Windsor
Storm Drainage Master Plan

Existing Storm Drain System and Creeks

Job Number	11159126
Revision	5
Date	12 Feb 2020

Figure 6-3

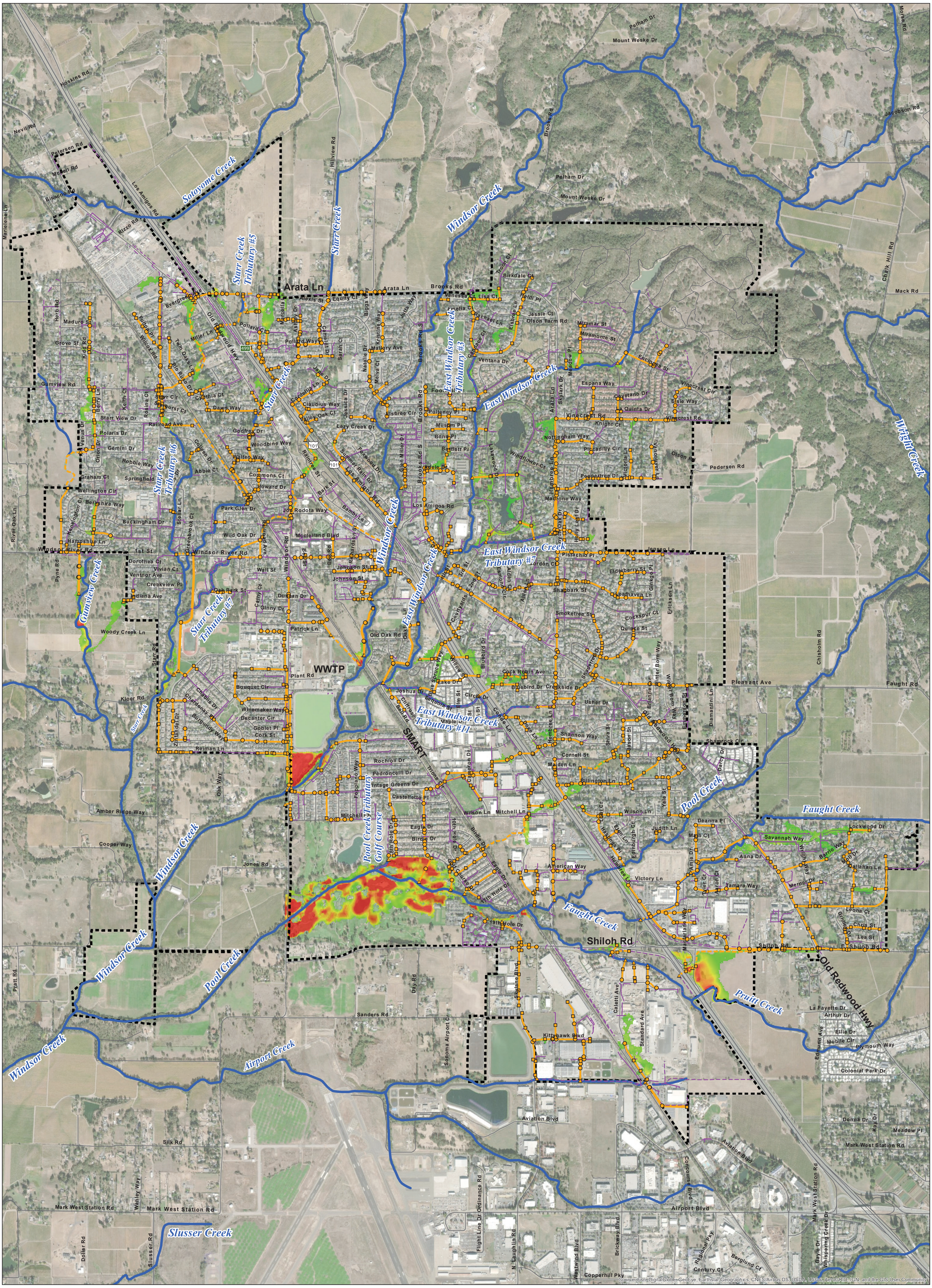
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Town Limits	Culverts, Modeled	Gravity Mains, Not Modeled	Inlets, Modeled	**10 Year Flood Depth (ft)**
Streets	Culverts, Not Modeled	Open Channels, Modeled	Manholes, Modeled	> 2
Rivers and Creeks	Gravity Mains, Modeled	Open Channels, Not Modeled	Discharge Points, Modeled	> 0

Paper Size 22" x 34" (ANSI D)

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Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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ESA

TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

10-Year Storm
Baseline Flood Map

Job Number	11159126
Revision	5
Date	14 Feb 2020

Figure 6-4

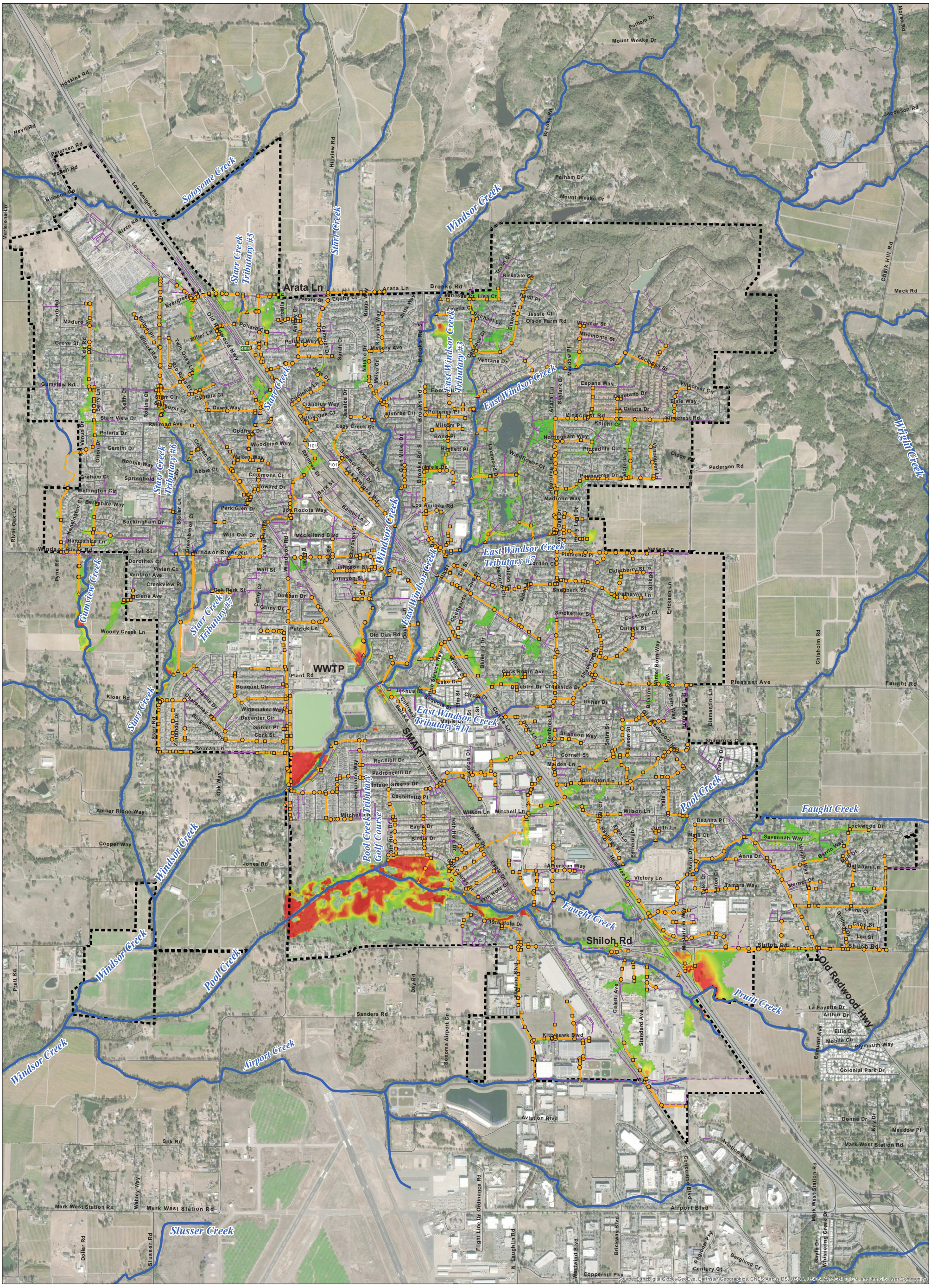
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Town Limits
Streets
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Modeled
Manholes, Modeled
Discharge Points, Modeled

25 Year Flood Depth (ft)

> 2

> 0

Paper Size 22" x 34" (ANSI D)

0 450 900 1,350 1,800

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

25-Year Storm Baseline Flood Map

Job Number 11159126
Revision 5
Date 12 Feb 2020

Figure 6-5

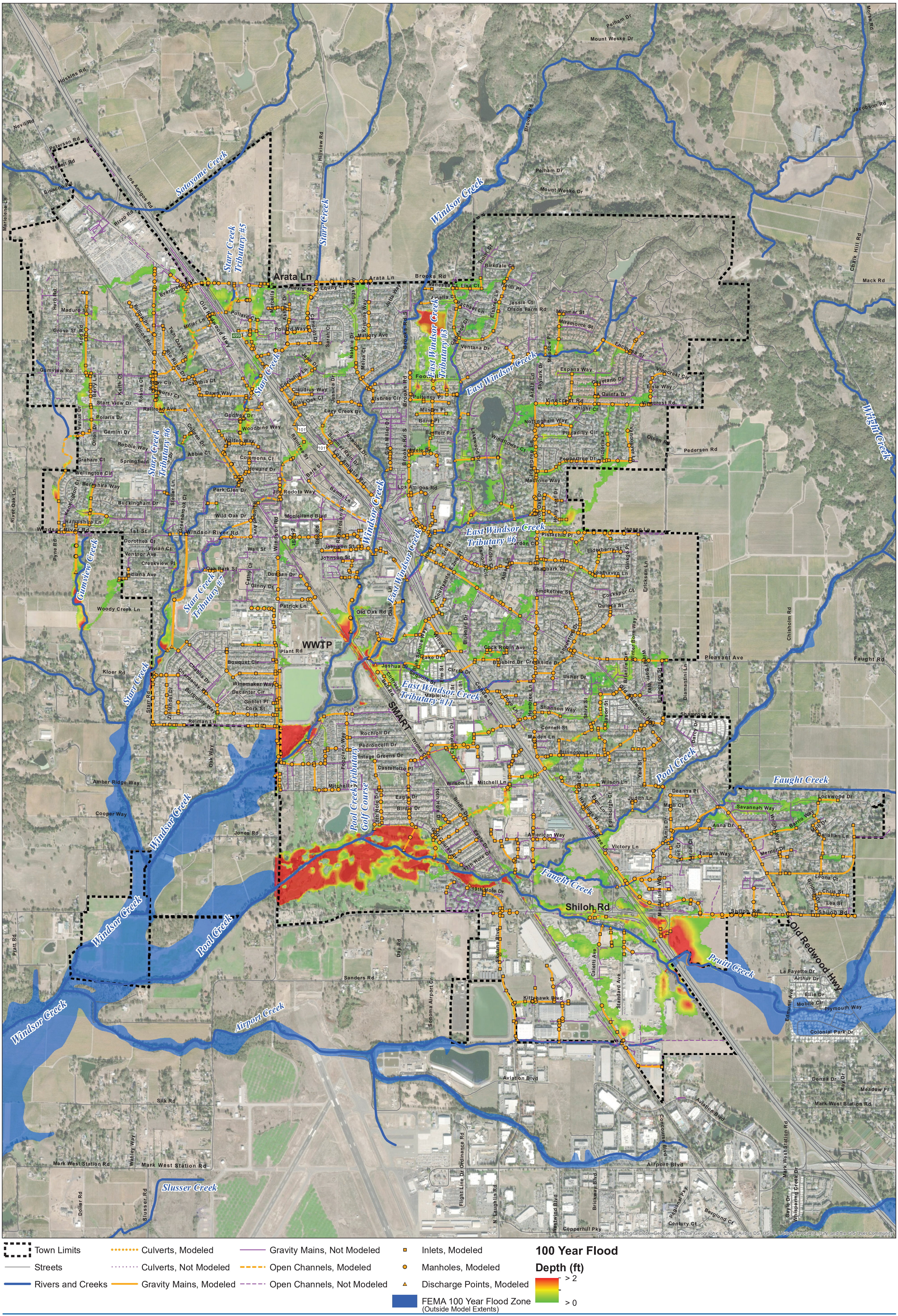
N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 6-5 25-Year Baseline Flood.mxd

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Town of Windsor
Storm Drainage Master Plan

100-Year Storm Baseline Flood Map

Job Number	11159126
Revision	5
Date	12 Feb 2020

Figure 6-6

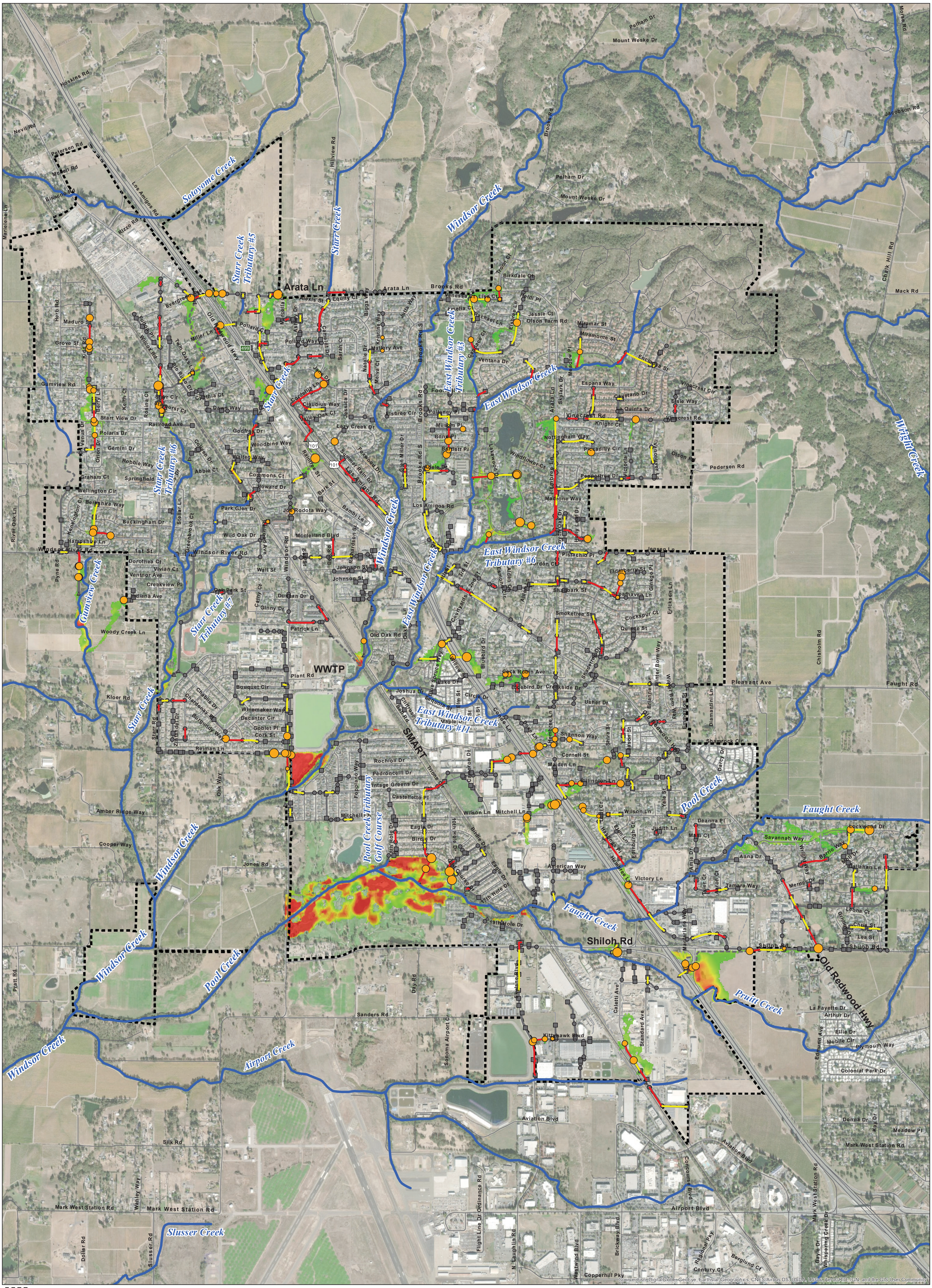
N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 6-6 100-Year Baseline Flood.mxd

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Data source: FEMA, Flood Zone, December 2019; PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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Town Limits | Streets | Rivers and Creeks | Culverts, Modeled | Culverts, Not Modeled | Gravity Mains, Modeled | Gravity Mains, Not Modeled | Open Channels, Modeled | Open Channels, Not Modeled | Inlets, Modeled | Manholes, Modeled | Discharge Points, Modeled

10 Year Flood Depth (ft)
> 2
> 0

Discharge to Surface (cfs)
- > 0 to 1.0
- > 1.0 to 5.0
- > 5.0 to 20
- > 20

Capacity Deficiency (q/Qmanning)
- > 1.0 to 1.5
- > 1.5

Paper Size 22" x 34" (ANSI D)
0 450 900 1,350 1,800
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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Town of Windsor
Storm Drainage Master Plan

10-Year Storm Baseline Storm Drain System Results

Job Number | 11159126
Revision | 5
Date | 12 Feb 2020

Figure 6-7

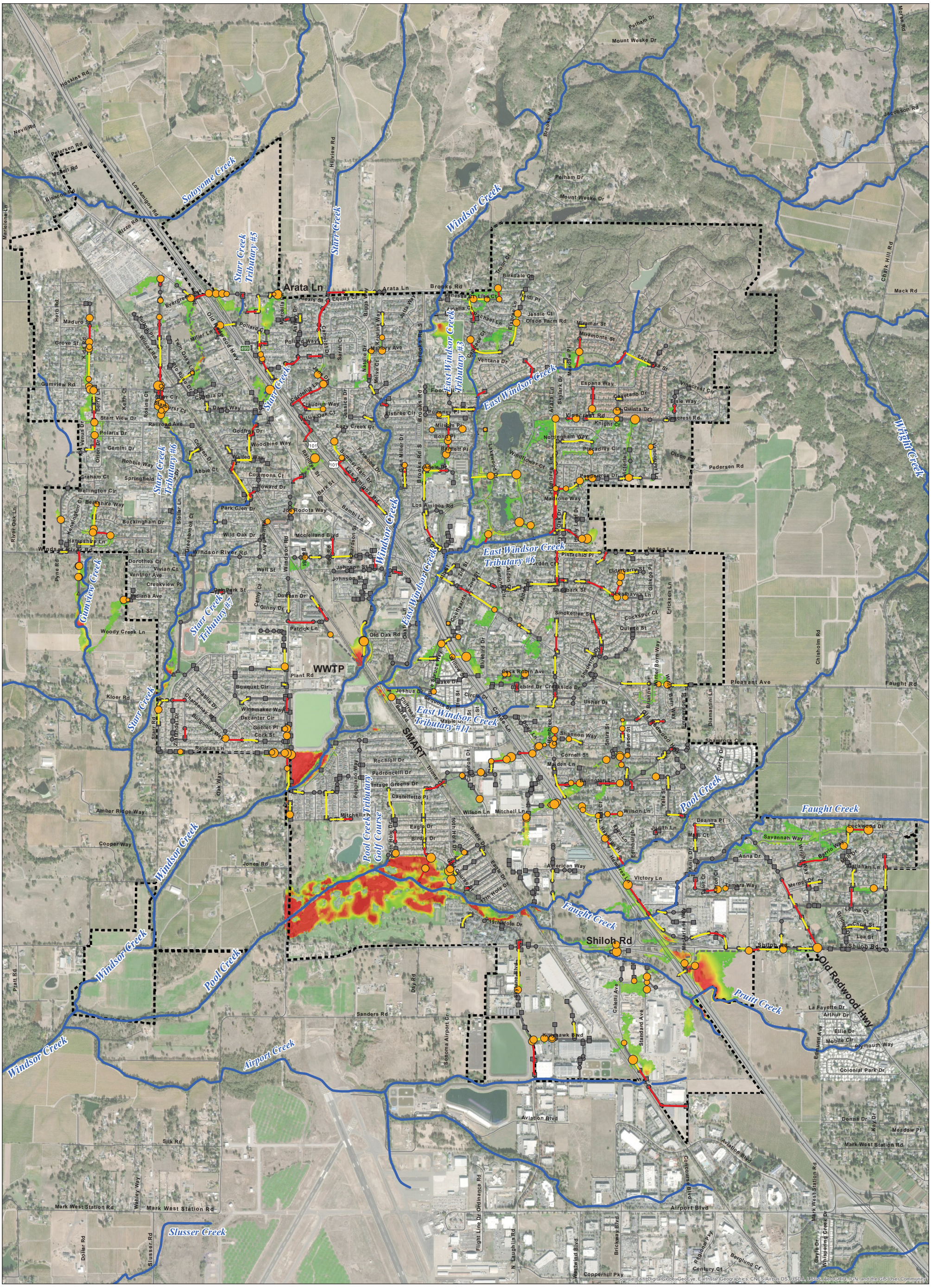
N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 6-7 10-Year Baseline Storm Drain System Results.mxd

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Town Limits
Streets
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Modeled
Manholes, Modeled
Discharge Points, Modeled

25 Year Flood Depth (ft)
> 2
> 0

Discharge to Surface (cfs)
> 0 to 1.0
> 1.0 to 5.0
> 5.0 to 20
> 20

Capacity Deficiency (q/Qmanning)
> 1.0 to 1.5
> 1.5

Paper Size 22" x 34" (ANSI D)
0 450 900 1,350 1,800
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

25-Year Storm Baseline Storm Drain System Results

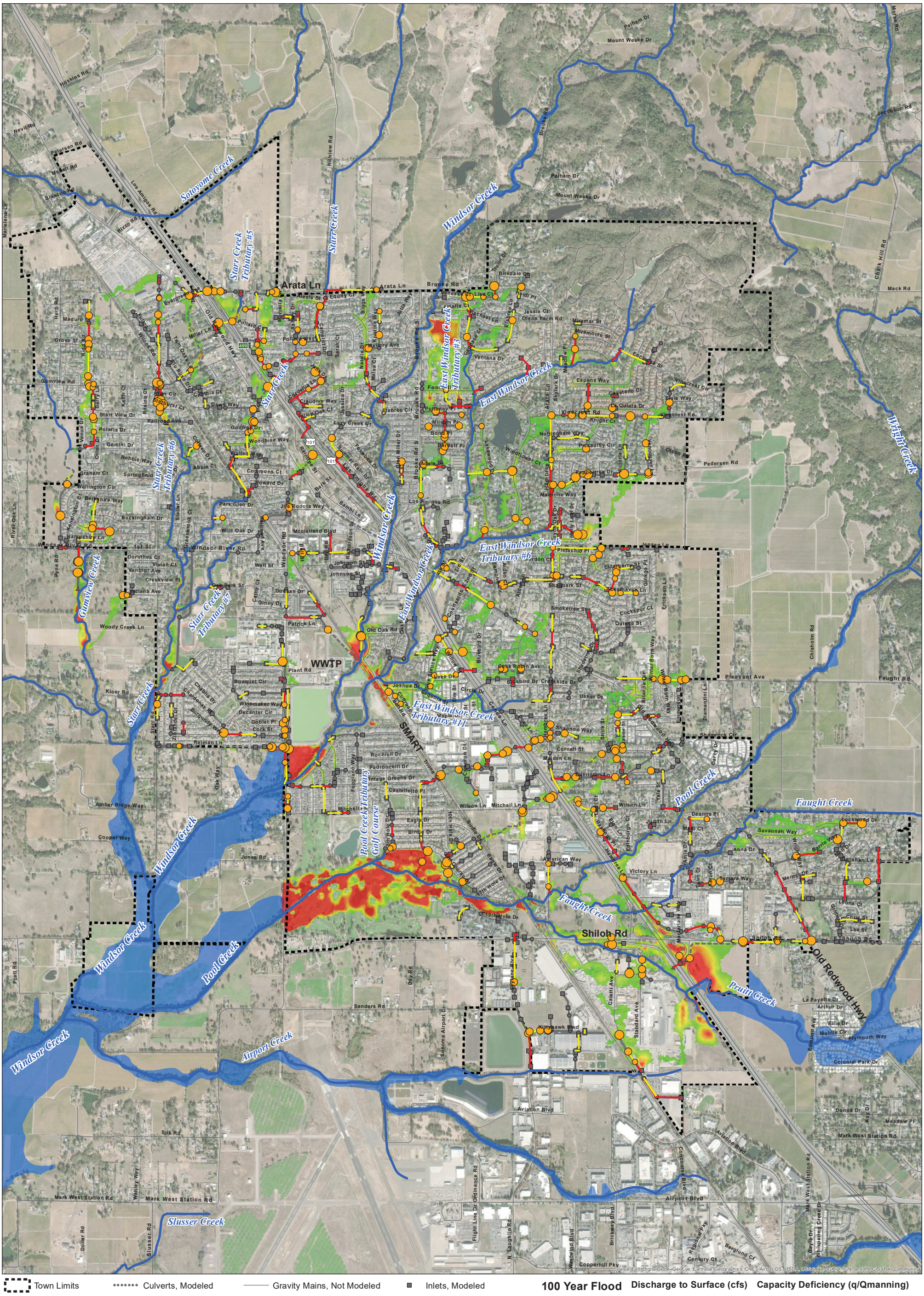
Job Number 11159126
Revision 5
Date 12 Feb 2020

Figure 6-8

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 6-8 25-Year Baseline Storm Drain System Results.mxd
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Data source: PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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Paper Size 22" x 34" (ANSI D)

0 450 900 1,350 1,800

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

100-Year Storm Baseline Storm Drain System Results

Job Number 11159126
Revision 5
Date 12 Feb 2020

Figure 6-9

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 6-9 100-Year Baseline Storm Drain System Results.mxd

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Data source: FEMA, Flood Zone, December 2019; PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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7. STORM DRAINAGE IMPROVEMENT PROGRAM

This chapter presents recommended Storm Drainage Improvement Projects (SDIPs) for baseline (existing) and future conditions . SDIPs were developed from the hydrology and hydraulic modeling results and known drainage problems. Also presented in this chapter are opinions of probable costs for each SDIP.. Emphasis was placed on solutions that would not move the issue downstream, i.e. opportunities for retention basins in lieu of, or in addition to, increased conveyance capacity, where possible.

Due to the large number of figures in this chapter, they are placed at the end of the chapter.

7.1 Opinions of Probable Project Costs

Opinions of probable project costs for the SDIP projects are Class 4 (study or feasibility level) estimates of probable costs as defined by the Association for the Advancement of Cost Engineering, International (AACE). Study or feasibility level estimates of probable cost are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval, and typically engineering is 1% to 15% complete. Some examples of estimating methods would include equipment factors, gross unit costs/ratios, and other parametric and modeling techniques. The typical expected accuracy ranges for this class estimate are -15% to -30% on the low side and +20% to +50% on the high side.

The opinions of probable project costs include a 25 percent contingency on top of the probable construction cost. It is important to note that contingency is not directly related to the stated accuracy range for a Class 4 estimate. Determination of construction cost contingency is intended to cover unforeseen aspects of construction that are not evaluated during master planning-level analysis. Non-construction “soft” costs are also included for each SDIP project. The amount included for soft costs is anticipated to vary by project and should be reviewed by the Town when programming costs for future fiscal year SDIP budgeting.

Construction costs are indexed to the Engineering News Record Construction Cost Index (ENR CCI) for the San Francisco area. The opinions of probable project cost were developed at various times to support the Town of Windsor during the Capital Improvement Program (CIP) process and for the Storm Drainage Fee Study which was performed concurrent to the master planning effort prior to completion of the SDMP. As such, the index varies by project depending on when the opinion of probable project cost was developed. An evaluation of market trends should be considered for future fiscal year programming of project costs.

Detailed summaries of the planning-level opinions of probable project cost are provided in Appendix D. The following general assumptions were made for all SDIP projects presented in this chapter. Project-specific assumptions are noted in the SDIP project descriptions.

- Estimates are based on SDMP modeling results, evaluation of available existing planning documents, and review of standard estimating data. Estimates reflect typical current costs and are subject to escalation;
- The Town Standard Trench Detail and standard trench shoring, project dewatering, and general geotechnical considerations for soil conditions were assumed;

- Pipe materials are based on Town standards;
- Estimates account for contractor's bonds, insurance, overhead, and profit;
- Project costs include "soft costs" as a separate line item, which generally include design engineering, regulatory permitting, environmental work, field engineering, construction management, or Town administrative costs. Soft costs are noted for each project cost as 25 percent for "Design" and 12 percent for "CM". Design includes design, survey and geotechnical, environmental review, and permits. CM includes inspection, construction management (CM), and engineering services during construction (ESDC);
- Easement/land acquisition, if required, is not included in soft costs;
- Wetland mitigation, if required, is not included in project costs. The scope and associated cost for this type of mitigation should be determined during the next phase of planning for individual projects;
- Incorporation of concurrent projects is not included in the opinion of probable cost, unless specified. Concurrent projects may include road rehabilitation or improvements for other utilities; and
- Hazardous materials handling and abatement and easement or right-of-way acquisition is not included in the total project cost. The project contingency may account for some or all of these costs. The Town should complete a project pre-design in advance of final budgeting for larger or more complex projects where hazardous materials, easements, rights-of-way, or other similar project aspects are known or suspected to exist.

Estimates of probable construction costs are made on the basis of professional judgment and experience. Actual costs may vary due to availability of labor, equipment or materials, or market conditions at that time.

7.2 Design Life for Storm Drainage Improvement Projects

New pipelines and structures are assumed to have a 50-year design life, with minimal repair and rehabilitation required due to natural degradation of the materials. Depending on the location of new system components (i.e., in roadways, driveways, easements), degradation of material may occur due to excessive vehicle loading or from impacts of subsequent construction. In general, Town operation and maintenance (O&M) costs for new pipe network system components are anticipated to be lower compared to the costs associated with the existing system component.

The design life may be affected by changes in storm drainage system hydraulics, including: intensification of storm events due to climate change; increased or decreased upstream flows resulting from changes in land use and new development or redevelopment; application of LID practices on a large scale; and/or revisions caused by updated hydraulic analysis to account for revised FMDM or Town design criteria, enhanced topographic data (i.e., LiDAR), or revision to modeled boundary conditions / expansion of the model. Compliance with MS4 requirements is not anticipated to affect the design life of SDIPs; however, water quality should be considered during design of each SDIP in accordance with permit requirements.

New and/or modified open channels and creeks are also assumed to have a 50-year design life. Degradation of natural channels and waterways may occur due to scour and embankment

erosion caused by peak flow events or structural modifications (i.e., modification or addition of a pipe outfall). Long term best management practices (BMPs) should be used in the construction for all natural channels and waterways to reduce the potential for scour and erosion, and to minimize Town and/or Sonoma Water maintenance needs. In general, Town and Sonoma Water O&M costs for new and/or modified open channel and creek network system components are anticipated to be lower compared to the costs associated with the existing system component.

Given the assumption that the O&M costs are lower for new and modified storm drainage system components, SDIP budgeting does not include costs for O&M.

7.3 Existing Conditions Storm Drainage Improvement Projects

The existing conditions hydrology and hydraulic model was reviewed under 10-, 25-, and 100-year flood conditions. 17 areas of significant flooding were identified where several structures (i.e., residences, commercial and industrial buildings) would be impacted under either flood condition. After consultation with the Town, three additional sites were added where flooding has been previously or typically observed by Town staff during Phase 1. During Phase 2, five additional project sites were added to incorporate detention basin projects, where practical. The detention projects address the flooding issues identified in Phase 1, but are not always in the vicinity of the inundated area because upstream detention basins will have downstream impacts. Overall, 25 sites were identified as potential project areas based on existing conditions. See Figure 7-1 for the location of these potential project areas and the number of buildings affected under each modeled flood condition.

After identification of the 25 potential project areas, GHD and the Town discussed other variables to help prioritize SDIP projects, such as impacts to roadways, critical Town infrastructure (e.g., WWTP), and areas that cause a nuisance or problem from annual flooding. As a result of this evaluation, the Town selected 9 SDIP projects for evaluation under existing conditions. These 9 existing conditions SDIP projects are discussed in detail in this section, are summarized in Table 7-1, and are illustrated on Figure 7-2.

For consistency between Phase 1 and Phase 2, the SDIP IDs were kept consistent with those in Phase 1 so that there are no duplicate or missing SDIPs between the two phases and reports. These projects are not presented in a prioritized order. For example, during preparation of this Report, the Town identified SDIP 8, SDIP 11, and SDIP 12 as high priority projects. As noted in the table, several projects were identified during Phase 1 of this Report but have been removed for reasons which include: identification of alternative projects achieving the same goal, review of updated model results which do not support the urgency or need for the project, and reflection on recent Town experience during storm events which does not support a priority need for the project.

Table 7-1 Existing Conditions (Baseline) SDIP Projects

SDIP ID	SDIP Name
SDIP 1	Conveyance Improvements along Biggs Way/Natalie Drive
SDIP 2	Windsor Creek and East Windsor Creek Confluence **MOVED TO FUTURE DURING PHASE 2e**
SDIP 3	Hampshire Lane and Wellington Circle **REMOVED DURING PHASE 2**
SDIP 4	Franklin Street and Leafhaven Lane **MOVED TO FUTURE DURING PHASE 2**
SDIP 5	Gumview Drive, Berry Lane, and Starr View Drive
SDIP 6	Hiram Lewis Park Detention Basin
SDIP 7	Elsbree Lane **REMOVED DURING PHASE 2**
SDIP 8	Old Redwood Highway at Dawn Way - Conveyance Improvements
SDIP 8 – Phase 2	Old Redwood Highway at Dawn Way (Phase 2) **REMOVED DURING PHASE 2**
SDIP 9	Old Redwood Highway and Pleasant Avenue
SDIP 10	Brooks Road **REMOVED DURING PHASE 2**
SDIP 11	Shiloh Road at Caletti Avenue
SDIP 12	Hall Park Detention Basin
SDIP 13	Starr Creek Tributary #5 – South of Arata Lane
SDIP 14	East Windsor Creek Flood Control Project

Final prioritization will be determined by the Town during the CIP selection and budgeting process. Prioritization of the 9 existing conditions SDIP projects should be based on the following objectives to alleviate flooding within the Town:

1. Alleviate flooding at locations demonstrated in the model results and/or through Town observations that have the largest impact to structures and the public, including potential for property damage or unsafe flooding conditions in roadways.
2. Alleviate flooding at critical facilities (i.e., Town WWTP) and other locations for public assembly (i.e., schools).
3. Alleviate nuisance flooding, especially in locations with annual flooding and/or those which require frequent maintenance by Town staff.

7.3.1 SDIP 1 Arata Lane & North Windsor Improvements

Problem Description:

The Town identified the SDIP 1 project area as a priority due to observation of flooding across Arata Lane during large storm events. The portion of the Starr Creek and Windsor Creek watersheds located north of the Town boundary drain to Arata Lane. Roadside open channels (i.e., ditches) and storm drains collect this runoff and convey flow to the south and west. During large storm events the existing system is overwhelmed, at which point water sheets across Arata Lane and overland to the south causing flooding of streets. Modeling also shows flooding of residences, and at Brooks Elementary School. See Figure 7-2 and Figure SDIP 1 for the SDIP 1 project area.

Proposed Improvements:

SDIP 1 is described below.

- Improve existing catch basins and inlets along the north side of Arata Lane to improve catchment of surface runoff into the pipe system;
- Install 1,300 LF of 60-inch storm drain pipeline in pavement from Arata Lane, south along Biggs Way/Natalie Drive to the intersection with Mallory Ave; and
- Replace 660 LF of existing 30-, 36- and 42-inch storm drain pipeline on Natalie Drive in pavement, from Malory Avenue south to Windsor Creek, with a 72-inch storm drain pipeline including an improved outfall to Windsor Creek.

The scope and timing for completion of this should be evaluated by the Town.

Flood Reduction:

See Figure SDIP 1 for a visual illustration of the reduction in flooding with implementation of SDIP 1. Flooding is reduced on portions of Natalie Drive and Janes Drive, specifically, in the vicinity of Brooks Elementary School. The SDIP does not completely eliminate sheet flow across Arata Lane nor does it completely alleviate flooding in Biggs Way and Natalie Drive. It is possible that additional inlets along Arata Lane, Biggs Way and Natalie Drive, which are not part of the larger model network, could capture some of the sheet flow and direct it into the pipe network. During the more detailed design phase of this SDIP, the model should be re-run with these additional improvements to verify the effects.

Environmental Constraints:

Based on preliminary review, SDIP 1 may be exempt from CEQA under Public Resources Code Section 21080.21 (Exclude Pipelines of Less than One Mile), and under CEQA Guidelines Section 15301 (Existing Facilities) and 15302 (Replacement or Reconstruction). To confirm SDIP 1 is exempt, additional site evaluation may be required to confirm the potential for impacts to biological resources associated with the outfall to Windsor Creek. In addition, environmental permitting approvals may be required depending on the extent of disturbance for an improved outfall to Windsor Creek. Such approvals likely include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement

- U.S. Army Corps of Engineers – 404 Permit
- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost*:

Construction:	$ 3,210,000
Contingency:	$ 810,000
Design:	$ 1,005,000
CM:	$ 483,000
TOTAL:	$ 5,510,000

* Easement/land acquisition is not included

7.3.2 SDIP 2 Windsor Creek and East Windsor Creek Confluence Improvements

SDIP 2 from Phase 1 has been moved to a future SDIP (FSDIP 6) in Phase 2. This project was moved to the future scenario in order to model a new proposed detention basin at Windsor Creek Elementary School (SDIP 15) independently from SDIP 2. As mentioned in the Phase 1 recommendations, the Town and Sonoma Water prefer stormwater retention compared to conveyance improvments where possible. See FSDIP 6 (Section 7.4.9) for the project description of former SDIP 2.

7.3.3 SDIP 3 Hampshire Lane and Wellington Circle Improvements

This project was removed during Phase 2 due to observations by Town staff that the area is not impacted as significantly as other potential project locations. This project was therefore deprioritized. A description of former SDIP 3 can be found in the 2017 Phase 1 report.

7.3.4 SDIP 4 Franklin Street and Leafhaven Lane Improvements

This project was moved to future SDIP in Phase 2. Please see F-SDIP 7 (Section 7.4.10) for the project description.

7.3.5 SDIP 5 Gumview Drive, Berry Lane and Starr View Drive Improvements

Problem Description:

An undersized storm drain system flows south on Kidd Road beginning at the northern extent of Kidd Road to Gumview Drive, where it jogs east and then south down Tolleson Lane, runs through private property crossing Starr View Drive, then turns west in a series of jogs through private property, and discharges to an open channel and open field west of Orion Drive. This storm drainage system is overwhelmed during larger modeled storm events causing flooding of streets and residences in the area.

Proposed Improvements:

- Install 140 LF of 54-inch storm drain pipeline, running east/west in pavement on Gumview Drive and connect it to the existing storm drain pipeline segment in Gumview Drive;
- Continue a 54-inch storm drain bypass pipeline south for 460 LF on Berry Lane;
- Continue a 54-inch storm drain bypass pipeline approximately 200 LF south through private residences to Starr View Drive;
- Install a 54-inch storm drain pipeline from the connection in Starr View Drive west in pavement on Starr View Drive for 490 LF to the open field (this will include a cross connect to the existing storm drain that is crossing Starr View Drive); and
- Install a 54-inch storm drain pipeline 600 feet south in the open field to the current discharge location at the open channel adjacent to Orion Drive.

Note that SDIP 5 will require obtaining drainage easements for certain properties including 600 feet of storm drain pipeline outside of the Town boundary.

Flood Reduction:

See Figure SDIP 5 for a visual illustration of the reduction in flooding with implementation of SDIP 5. The proposed drainage improvement project will reduce flooding on Maduro Street and east of Maduro Street; along Kidd Road, Gumview Road and Tolleson Lane; and in the vicinity of Starr View Drive and Orion Drive.

Note that the flow in the upper reach of Gumview Creek, which crosses in and out of the Town boundary (and thus the model domain) in the vicinity of SDIP 5 is not developed in the model. Although the FEMA mapping does not show significant flooding in Town in this reach, Town staff have been made aware of intermittent nuisance flooding in this portion of Gumview Creek during higher frequency (lower intensity) storm events. The nature and cause of these issues are unknown and Town Staff have not witnessed the flooding; however, this portion of Gumview Creek should be included in the full design of SDIP 5 to determine if additional infrastructure could alleviate nuisance flooding of the creek in this area as well.

Environmental Constraints:

Based on a preliminary review, SDIP 5 may be exempt from CEQA under Public Resources Code Section 21080.21 (Exclude Pipelines of Less than One Mile), and under CEQA Guidelines Section 15301 (Existing Facilities), 15302 (Replacement or Reconstruction), and Section 15303 (New Construction or Coversion of Small Structures). To confirm SDIP 5 is exempt, additional site evaluation may be required to evaluate the potential for impacts to biological habitat or wetlands where work would occur near the open channel and Gumview Creek. In addition, environmental permitting approvals may be required for a connection of the bypass pipeline to the open channel near Gumview Creek. Such approvals likely include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement
- U.S. Army Corps of Engineers – 404 Permit

- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost*:

Construction:	$ 2,300,000
Contingency:	$ 580,000
Design:	$ 720,000
CM:	$ 346,000
TOTAL:	$ 3,950,000

* Easement/land acquisition is not included.

7.3.6 SDIP 6 Hiram Lewis Park Detention Basin Improvements

Problem Description:

The existing Hiram Lewis Park detention basin diverts flows from Windsor Creek utilizing the existing ball fields as storage. The detention basin berm is less defined toward the south. Larger modeled storm events overwhelm this detention basin with flows overtopping and sheeting south through Windsor Middle School and Foothill Drive causing flooding of the surrounding streets, the school and residences.

Proposed Improvements:

- Re-grade the southern perimeter of the detention basin installing a 2.2-foot high berm to allow for additional storage, which will contain flows up to the 100-year flood.

Flood Reduction:

See Figure SDIP 6 for a visual illustration of the reduction in flooding with implementation of SDIP 6. The proposed project reduces flooding on Elsbree Lane, within the Windsor Middle School facilities and along Foothill Drive.

Environmental Constraints:

Based on a preliminary review, SDIP 6 may be exempt from CEQA under CEQA Guidelines Section 15301 (Existing Facilities) and Section 15304 (Minor Alterations to Land). To confirm SDIP 6 is exempt, additional site evaluation may be required to confirm the potential for impacts to biological resources. This project is not located within the jurisdiction of an environmental permitting agency (i.e., open channel or creek), and therefore no environmental permits are anticipated to be required.

Project Cost*:

Construction:	$ 510,000
Contingency:	$ 128,000
Design:	$ 160,000
CM:	$ 77,000
TOTAL:	$ 880,000

* Easement/land acquisition is not included.

7.3.7 SDIP 7 Elsbree Lane Improvements

Problem Description:

A storm drain on Lisa Court extends west to Elsbree Lane and south on Elsbree Lane where it discharges to an open channel that in turn discharges to East Windsor Creek. A storm drain also extends south on the east loop of Elsbree Lane from Birkdale Court connecting to the same open channel. Both storm drainage systems are inadequate to contain larger modeled storm events and surcharge, causing flooding of the surrounding streets and residences.

This project was removed as part of Phase 2 due to observations by Town staff that the area is not impacted as significantly as other potential project locations andSDIP 7's low priority relevant to other SDIP projects. A description of former SDIP 7 can be found in the 2017 Phase 1 report.

7.3.8 SDIP 8 Old Redwood Highway at Dawn Way Improvements

Problem Description:

Significant flooding across Old Redwood Highway near the intersection with Dawn Way occurs during large but common storm events. Overland flows from Starr Creek on the east side of Highway 101 are conveyed to a 4-foot x 5-foot box culvert crossing beneath Highway 101. These flows discharge to an open channel in undeveloped lots and behind private residences along the west side of Highway 101 (and east side of Old Redwood Highway). Stormwater is then directed to a roadside ditch on the east side of Old Redwood Highway where the flow turns 90 degrees to the south towards a 60-inch CMP culvert under a residential driveway. Beyond the culvert, flow continues through the roadside ditch and again turns 90 degrees towards dual 60-inch concrete culverts that cross beneath Old Redwood Highway in the vicinity of the Dawn Way intersection. The two culverts connect to a 14-foot x 4-foot arch culvert that then crosses beneath Dawn Way and daylights into an open channel segment of Starr Creek behind residences where the flow continues south.

Noted problems in this portion of the storm drainage system include hydraulically-limiting 90-degree turns in the flow path on the east side of Old Redwood Highway and heavy sedimentation of the arch culvert at its discharge to the Starr Creek open channel. Other relevant site features include a power pole located within the roadside ditch on the east side of Old Redwood Highway and a guardrail at the top of the same roadside ditch.

This entire system is overwhelmed during larger storm events, from downstream of the 4-foot x 5-foot box culvert under Highway 101 to a backwater condition that originates downstream of Godfrey Avenue within the existing dual 60-inch storm drainage system. Due to frequently observed flooding across Old Redwood Highway from east to west, and into adjacent property, the Town considers this project a priority and has included a CIP in this vicinity in the fiscal year 2019/2020 – 2020/2021 budget.

Proposed Improvements:

- Remove sediment from inside the culverts crossing the Old Redwood Highway / Dawn Way intersection to improve hydraulic efficiency in the existing culverts.

- Install a new inlet and improve the roadside ditch along the east side of Old Redwood Highway at the first 90-degree bend on the north side of the residential driveway; install approximately 140 LF of 66-inch storm drain bypass pipeline between the new inlet and the manhole where the dual 60-inch pipes crossing Old Redwood Highway intersect with the 14-foot x 4-foot arch culvert crossing Dawn Way to provide straighter, more efficient conveyance by removing both 90-degree bends;
- Install wiers at the end of each of the dual 60-inch pipes to provide detention inside the pipes during high flow events with a smaller diameter orifice to allow pipes to drain and reduce sediment deposition with new trash racks at the culvert entrances to reduce debris clogging; and
- replace the existing 60-inch CMP culvert under the residential driveway with a box culvert that provides at least one foot of cover and the maximum cross sectional area that fits within the site constraints; and improve the roadside ditch between the new box culvert and the dual 60-inch culverts.
- Project design should also add pedestrian safety improvements along the top of the open channel on the east side of Old Redwood Highway, restore the intersection paving and crosswalk, and improve the curb ramp at the southwest corner of the intersection if affected by construction activities.

Flood Reduction:

See Figure SDIP 8 for a visual illustration of the reduction in flooding with implementation of SDIP 8. The proposed project reduces flooding along Old Redwood Highway near the intersection with Dawn Way.

The proposed Hall Park Detention Basin (SDIP 12) and North of Arata Lane Drainage Project (SDIP 13) will also contribute to reduced flooding along Old Redwood Highway near the intersection with Dawn Way by attenuating flow upstream and thereby reducing the peak flows in the vicinity of this project.

Environmental Constraints:

Based on preliminary review, SDIP 8 may be exempt from CEQA under Public Resources Code Section 21080.21 (Exclude Pipelines of Less than One Mile), and CEQA Guidelines Section 15301 (Existing Facilities), 15302 (Replacement or Reconstruction), and 15303 (New Construction or Conversion of Small Structures). To confirm SDIP 8 is exempt, additional site evaluation may be required to confirm the potential for impacts to biological resources from the modification to the roadside drainages.

In addition, environmental permitting approvals may be required depending on the extent of disturbance for modifications to the roadside ditch along Old Redwood Highway, the open channel section of Starr Creek south of Dawn Way, and removal of sediment from select culverts. Such approvals likely include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement
- U.S. Army Corps of Engineers – 404 Permit

- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost*:

Construction:	$ 590,000
Contingency:	$ 150,000
Design:	$ 185,000
CM:	$ 89,000
TOTAL:	$ 1,020,000

* Easement/land acquisition is not included.

7.3.9 SDIP 9 Old Redwood Highway and Pleasant Avenue Improvements

Problem Description:

Town Staff have indicated that significant flooding occurs along Old Redwood Highway at the intersection with Pleasant Avenue. Stormwater flows emanating from the foothills spill in a southerly direction onto Old Redwood Highway. Flooding also occurs in an undeveloped private lot across Old Redwood Highway from Pleasant Oak Park and impacts residences to the south of the lot along the west side of Old Redwood Highway.

Proposed Improvements:

- Install 1,330 LF of 30-inch storm drain pipeline parallel to the existing 48-inch storm drain pipeline in pavement on Pleasant Avenue.

Additionally, approximately 30-inch storm drain pipeline on Old Redwood Highway connecting to the existing storm drain at the intersection with Shira Road may help with directing flow in the area to the storm drain network. An alternate routing to the storm drain on Old Redwood Highway would be to route a storm drain on private property down Andrew Way to Shira Street. Additonal improvements should be evaluated during design phase for this project. The existing pipe in Old Redwood Highway and Andrew Way are not modeled due to their size and therefore neither are either of these additionally noted improvements.

Flood Reduction:

See Figure SDIP 9 for a visual illustration of the reduction in flooding with implementation of SDIP 9.

Environmental Constraints:

Based on preliminary review, SDIP 9 is likely to be exempt from CEQA under Public Resources Code Section 21080.21 (Exclude Pipelines of Less than One Mile) and CEQA Guidelines Section 15303 (New Construction or Conversion of Small Structures). This project is not located within the jurisdiction of an environmental permitting agency (i.e., open channel or creek), and therefore no environmental permits are anticipated to be required.

Project Cost*:

Construction:	$ 1,050,000
Contingency:	$ 270,000
Design:	$ 330,000
CM:	$ 159,000
TOTAL:	$ 1,810,000

* Easement/land acquisition is not included. Project costs do not include evaluation or additional drainage improvements on Old Redwood Highway or Andrew Way.

7.3.10 SDIP 10 Brooks Road Improvements

Problem Description:

Town Staff has noted that flooding in this area can be mitigated with frequent preventative maintenance of drainage inlets. This project was removed as part of Phase 2 due to Town's desire to include more detention basin projects and SDIP 10's relatively low priority compared to other SDIPs.

7.3.11 SDIP 11 Shiloh Road at Caletti Avenue Improvements

Problem Description:

Flooding occurs during severe but frequent storms along Shiloh Road west of Highway 101 near the intersection with Caletti Avenue. A roadside ditch parallels the freeway on-ramp on the south side of Shiloh Road with dual (undersized) 18-inch storm drain pipelines crossing Caletti Avenue and discharging to Pruitt Creek through a 24-inch outfall. The roadside ditch overtops and overflows onto Shiloh Road during intense storm events causing disruption to traffic. This flooding condition was observed during the December 11, 2014 storm event. The Town has included a CIP in this vicinity in the fiscal year 2019/2020 – 2020/2021 budget.

Proposed Improvements:

This project includes the following improvements:

- Install a 4.5-foot high earthen berm with a top elevation of Elevation 116.5 feet NAVD 1988 on Caletti Avenue, wrapping around the intersection and proceeding east on the south side of Shiloh Road for a length of approximately 430 LF. This improvement is intended to contain ditch flows within the roadside ditch and towards the existing dual 18-inch storm drain pipelines crossing Caletti Avenue. Note: a retaining wall should also be considered during detailed design to mitigate encroachment into the drainage ditch; and
- Install a concrete valley gutter across the intersection of Caletti Avenue and install a catch basin tying into the existing nearby discharge to Pruitt Creek.

Flood Reduction:

See Figure SDIP 11 for a visual illustration of the reduction in flooding with implementation of SDIP 11. The proposed project primarily reduces flooding on Shiloh Road near the intersection

with Caletti Avenue; however, it does not completely alleviate 100-year storm flooding in the intersection. Increasing the capacity of the twin 18-inch storm drain pipelines crossing Caletti Avenue and the 24-inch outfall to Pruitt Creek might also provide some flood reduction in this area. It is recommended that the model be used to evaluate upsizing of these storm drains during the design phase of this SDIP. Upsizing the outfall may require more extensive environmental permitting.

Environmental Constraints:

Based on preliminary review, SDIP 11 may be exempt from CEQA under Section 15303 (New Construction or Conversion of Small Structures) and 15304 (Minor Alterations to Land). To confirm SDIP 11 is exempt, additional site evaluation may be required to confirm the potential for impacts to biological resources associated with the roadside ditch.

In addition, environmental permitting approvals may be required depending on the characteristics of the roadside ditch and the extent of disturbance to the ditch. Such approvals may include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement
- U.S. Army Corps of Engineers – 404 Permit
- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost:*

Construction [(1)]:	$	140,000
Contingency:	$	40,000
Design:	$	45,000
CM:	$	22,000
TOTAL:	$	247,000

* Easement/land acquisition is not included.

Note: (1) Costs assume earthen berm and not concrete floodwall

7.3.12 SDIP 12 Hall Park Detention Basin

Problem Description:

This project was added during Phase 2 as part of a multi-phase approach to addressing the flooding at the intersection of the Old Redwood Highway and Dawn Way (see SDIP 8) by detaining runoff during large storm events upstream in the basin.

The Town considers this project a priority and has included this project in the Capital Improvement Program during fiscal year 2020/2021 – 2021/2022.

Proposed Improvements:

This project includes:

- Install a detention basin with a volume of approximately 2.15 acre-feet and depth of about 3 feet at Hall Park;

- Install 660 LF dual 36-inch pipeline from existing manholes north of Hall Park at the intersection of Camelot Drive and Pollard Way south along Camelot Drive to connect to the detention basin;
- Install 36-inch riser with 6-inch orifice at detention basin to discharge to Camelot Drive and Cricket Court; and
- Install 36-inch emergency spillway to an existing storm drain manhole west of Hall Park at the intersection of Camelot Drive and Jane Drive.

Flood Reduction:

See Figure SDIP 12 for a visual illustration of the reduction in flooding with implementation of SDIP 12. Note that this detention basin is modeled as a node within MU and therefore does not show inundation of the actual park. However, the detention basin will fill and the area will be intentionally inundated. The proposed project is primarily intended to reduce flooding in the area of Old Redwood Highway and Dawn Way, downstream of this project (refer to SDIP 8). The project also serves to alleviate flooding in the immediate project vicinity along Camelot Drive, Jane Drive and Cordellia Lane.

With reference to Figure SDIP 8 (Old Redwood Highway at Dawn Way Improvements), GHD performed an individual assessment/model run with the Hall Park detention basin and determined that the vast majority of flood reduction across Old Redwood Highway near Dawn Way is due to the conveyance enhancements of SDIP 8. The conveyance improvements alone; however, increase flooding downstream. SDIP 12 is designed to be performed in conjunction with SDIP 8 to add detention that largely offsets the increase in downstream flooding due to SDIP 8 improvements alone.

Environmental Constraints:

Based on a preliminary review, SDIP 12 is likely to be exempt from CEQA under CEQA Guidelines Section 15304 (Minor Alterations to Land). SDIP 12 is not expected to require removal of mature scenic trees, there are no known sensitive areas within project footprint, and the improvement would be a minor alteration to the condition of the land. Refer to the Environmental Summary in Section 7.5. This project is not located within the jurisdiction of an environmental permitting agency (i.e., open channel or creek), and therefore no environmental permits are anticipated.

Project Cost:*

Construction:	$ 1,100,000
Contingency:	$ 275,000
Design:	$ 345,000
CM:	$ 166,000
TOTAL:	$ 1,900,000

* Easement/land acquisition is not included.

7.3.13 SDIP 13 Starr Creek Tributary #5 Detention – South of Arata Lane

Problem Description:

This project was identified as an opportunity to incorporate detention into the storm drainage system on property owned by the Town. Stormwater flows emerge from under Arata Lane and are conveyed in an open channel (Starr Creek Tributary #5) through this parcel before entering an inlet located at the south end of the parcel and flowing under highway 101 to the west. This parcel already floods as a result of backwater from the highway 101 crossing.

Proposed Improvements:

This project includes:

- Construct detention basin on Town property located south of Arata Lane near Highway 101 The detention basin is assumed to use nearly the entire extent of the Town-owned parcel, which is approximately 2 acres, and to have a detention volume of 5.6 acre-feet;
- Improve the storm drain inlet structures on the north side of Arata Lane to increase hydraulic performance and reduce flooding across Arata Lane (or alternative improvements achieving equivalent results); and
- Improve the Storm drain inlet structure at the south of the parcel to improve hydraulic performance across highway 101.

A feasibility study is recommended in the first year of the project in order to refine project scope.

Flood Reduction:

See Figure SDIP 13 for a visual illustration of the reduction in flooding with implementation of SDIP 13. Note that this detention basin is modeled as a node within MU and therefore does not show inundation of the actual area. However, the detention basin will fill and the area will be intentionally inundated. The proposed project primarily reduces flooding in the immediate vicinity and will have impacts downstream. This project reduces, but not eliminates, flooding near the Highway 101/Arata Lane crossing. Co-benefits of this project include groundwater infiltration which can be used to supply a future irrigation well. The Town should consider this project as an opportunity to gain LID sediment offset credits for other Town projects.

Environmental Constraints:

Based on preliminary review, SDIP 13 may be exempt from CEQA under CEQA Guidelines Section 15304 (Minor Alterations to Land). To confirm SDIP 13 is exempt, additional site evaluation would be required to confirm that the project would not involve removal of mature scenic trees, that there are no sensitive areas within the detention basin area, and that the improvements would be a minor alteration to the condition of the land. If SDIP 13 does not qualify for an exemption from CEQA, then an Initial Study/MND would likely be the appropriate level of CEQA review. SDIP 13 would be subject to review under CEQA. In addtition, environmental permitting approvals likely may be required depending on the extent of disturbance to the Starr Creek tributary (#5) on the project site. Such approvals likely include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement

- U.S. Army Corps of Engineers – 404 Permit
- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost*:

Construction [(1)]:	$ 810,000
Contingency:	$ 203,000
Design:	$ 255,000
CM:	$ 123,000
TOTAL:	$1,400,000

* Easement/land acquisition is not included and may not be needed for this project depending on the location of the detention basin inlet and outfall.

7.3.14 SDIP 14 East Windsor Creek Flood Control Project

Problem Description:

Flooding occurs during the 10-year storm event upstream of the railroad tracks near the confluence of Windsor Creek when the creek overtops its banks during significant storm events. This flooding affects streets and residences along Grayson Way and Old Oak Rd. Flooding also occurs on the west side of Windsor Creek.

Proposed Improvements:

This project was added during Phase 2 of the SDMP as an opportunity to address the Town's desire to prioritize detention in this area. During Phase 2, F-SDIP 6 (see Section 7.4.9) was an existing condition project. This project was moved to the future conditions model during Phase 2 in order to evaluate the impact of the proposed detention at the Windsor Creek Elementary School, located upstream of the Windsor and East Windsor Creek confluence. The project will:

- Construct a detention basin at the playing fields at former Windsor Creek Elementary School. The project is assumed to use the full extent of the playing fields, approximately 2.2 acres, and to have a detention volume of 16.2 acre-feet.

The volume of the basin for the purposes of storm modelling was based on the approximate shape and size of the former Windsor Creek Elementary School ballfield. A larger or smaller sized basin can be modelled in the future if the location of a detention basin becomes more certain. It is anticipated that, like Hiram Lewis Park, the detention basin can serve dual purpose as a recreation area and stormwater detention during the wet season. The Town should consider this project as an opportunity to gain LID sediment offset credits for other Town projects.

The detention basin will address both existing and future needs and should therefore be designed and constructed in coordination with future development plans. The project cost assumes one project to address both existing and future needs. If the project is split and future need is addressed independently of existing need, project costs might be higher.

The method for transferring creek flow to and from the detention basin should be determined during preliminary design (i.e., pipelines, overflow weirs). During design, the Town should

Flood Reduction:

See Figure SDIP 14 for a visual illustration of the reduction in flooding with implementation of SDIP 14. Note that this detention basin is modeled as a node within MU and therefore does not show inundation of the school ballfields. However, the detention basin will fill and the area will be intentionally inundated.

Results indicate that the project mostly serves to offset the increase in flows caused by the proposed increase in conveyance capacity along Biggs Way and Natalie Drive as part of the Arata Lane & North Windsor Improvements project (SDIP 1) and, as a result, does not significantly alleviate the flooding at the East Windsor Creek and Windsor Creek confluence. The volume of the detention basin is limited by the space available.

Notably, backwater conditions exist downstream of the SDIP 14 detention basin at the railroad crossing over Windsor Creek. The railway bridge supports on either side constrict Windsor Creek. The backwater condition does not migrate all the way back to SDIP 14 before flooding the lower undeveloped property to the west and Grayson lane to the west. At the time of the writing of this report, there is a real possibility that the reconstruction of the SMART railway will alleviate the unnatural constriction and thus part of the backwater effect. As part of a separate project, GHD analyzed the removal of the creek constriction at the creek crossing. Results indicated that 100-year storm flood levels decreased by approximately 0.65 feet at the bridge location. If and when the SMART railway completes a new track and creek crossing, the SDMP current and future conditions models should be updated and SDIP 14 should be reevaluated to determine the degree of flood mitigation in this area due to detention. As mentioned above, SDIP 14 would still mostly serve to offset the increase in flows caused by SDIP 1.

Environmental Constraints:

Based on preliminary review, SDIP 15 may be exempt from CEQA under CEQA Guidelines Section 15303 (New Construction or Conversion of Small Structures) and 15304 (Minor Alterations to Land). To confirm SDIP 14 is exempt, additional site evaluation would be required to confirm that the project would not involve removal of mature scenic trees, that there are no sensitive areas within the detention basin area or the outlets to East Windsor Creek, and that the improvements would be a minor alteration to the condition of the land. If SDIP 14 does not qualify for an exemption from CEQA, then an Initial Study/MND would likely be the appropriate level of CEQA review. In addtition, environmental permitting approvals may be required depending on the extent of disturbance or inlet/outlet structures to East Windsor Creek. Such approvals LIkely include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement
- U.S. Army Corps of Engineers – 404 Permit
- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost*:

Construction:	$ 1,920,000
Contingency:	$ 480,000
Design:	$ 600,000
CM:	$ 288,000
TOTAL:	$ 3,290,000

* Easement/land acquisition is not included.

7.4 Future Conditions Storm Drainage Improvement Projects

The coupled MIKE FLOOD and MIKE URBAN future conditions model was reviewed under 10-year and 100-year future hydrology flood conditions. The future conditions model assumed the existing conditions SDIP projects described above in Section 7.3 have been fully implemented and parcels within Town are developed according to the 2040 General Plan, Future Land Use Map. Future conditions storm drain improvement projects (F-SDIPs) were developed based on a review of the MF and MU model results (which identified flooding locations) and discussions with Town staff. Eight F- SDIPs were selected for evaluation and cost estimate purposes, and are summarized in Table 7-2 and shown on Figure 7-3. A detailed description of MF and MU model results is provided below.

Table 7-2 Future Conditions SDIPs

SDIP ID	SDIP Name
F-SDIP 1	Old Redwood Highway Bridge at Sotoyome Creek
F-SDIP 2	Proposed Detention Basin on Pruitt Creek on East Side of US HWY 101 **REMOVED DURING PHASE 2**
F-SDIP 3	Proposed Detention Basin between Pool Creek and Faught Creek
F-SDIP 4	Starr Road and Colleen Drive
F-SDIP 5	Pool Creek at Windsor Road
F-SDIP 6 (formerly SDIP 2)	Windsor Creek and East Windsor Creek Confluence
F-SDIP 7 (formerly SDIP 4)	Jensen Lane Conveyance Improvements
F-SDIP 8	Detention at Jensen Lane Development
F-SDIP 9	North of Arata Lane Drainage Project

Prioritization of the eight F- SDIP projects is based on the following objectives:

1. Address flooding in locations where land use changes result in increased flooding of Town infrastructure or private property.
2. Accommodate anticipated growth, based on Town land use, to minimize downstream impacts within creeks and other open channels.
3. Utilize open space for dual purpose as park/recreation and storm water detention

7.4.1 MIKE FLOOD (MF) Future Conditions Results

The coupled MF model was used to evaluate future conditions flooding within the Town. Future conditions overland flooding results are shown on Figures 7-4, 7-5, and 7-6 for the 10-, 25-, and 100-year return period storms, respectively. As noted in the previous section, the 10- and 100-year storms were reviewed for future hydrology flood conditions to meet FCDC design criteria.

Figure 7-4 reflects some areas of flooding that are resolved by implementation of the existing conditions SDIP projects during the 10-year return period storm (compare flooding shown on Figure 6-4 under existing conditions for the 10-year return period storm). The improved flood condition is most evident at the intersection of Old Redwood Highway and Dawn Way, along the upper Gumview Creek storm drain extension, and downstream of the proposed detention to the south of Arata Ln including where flow emerges on the east side 101 at Old Redwood Highway and Miller Ln and on Twin Oaks Ln.

Figure 7-5 reflects future conditions flooding results for the 25-year storm, and also shows many improved flooding conditions in the areas noted above. There are also visible benefits in the Pleasant Avenue area, along Natalie Dr. However, generally speaking, future conditions hydrology, in conjunction with implementation of existing conditions SDIP projects, result in slightly higher inundation depths than experienced under baseline conditions and potentially greater flooding depths. This is in part due to existing SDIPs that result in more flow being contained within the storm drainage system, detention basins and creeks. For example, the model indicates that areas in upper East Windsor Creek (i.e. neighborhoods along Vinecrest Rd, Hembree Ln, Peppertree Dr) will experience increased flooding. Flooding is also exacerbated in the lower gradient portions of the Town, particularly adjacent to Windsor and Pool Creeks near the town limits at Windsor Road.

As shown in Figure 7-6, future conditions flooding results for the 100-year storm highlights many of the same trends seen in comparing the baseline and future conditions 25-year flooding, with few notable differences including Hiram Lewis detention no longer overtopping during the large storm event and increased flooding along Victory Ln due to development.

7.4.2 MIKE URBAN (MU) Future Conditions Results

Model results for future conditions from MU were also used to develop the same results layers described previously for the 10-, 25-, and 100-year return period storms under the baseline condition model. Figures 7-7, 7-8, and 7-9 present the *Max Link* $Q/Q_{MANNING}$ and *Max Node Discharge* results for the 10-, 25-, and 100-year return period events. The *Max Link* $Q/Q_{MANNING}$ result highlights pipes that are flowing above hydraulic capacity, the additional *Max Node Discharge* result highlights those pipe conditions that are actually resulting in flows being discharged to the surface as a result of the system HGL exceeding the ground elevation.

The MU results generally corroborate the MF results presented above, showing increased storm drainage system surcharging during the higher event return periods resulting from increased runoff driven by future development.

7.4.3 MIKE 11 (M11) Future Conditions Results

Future conditions flooding resulting from the creeks is also largely evident within the 2-D overland flooding results shown in Figures 7-4, 7-5, and 7-6. Appendix C (6C) includes WSE profiles associated with all the creeks and tributaries within the Town for future conditions.

Appendix C (6D) presents tables of future conditions MIKE 11 results alongside baseline results, comparing both WSE and peak flowrates throughout the Town's creeks and tributaries.

7.4.4 F-SDIP 1 Old Redwood Highway Bridge at Sotoyome Creek Improvement

Problem Description:

Sotoyome Creek has eroded in various locations between Highway 101 and Old Redwood Highway, causing sediment transport and downstream deposition along with destabilization of creek embankments. This sediment deposition has greatly reduced the channel capacity at the Old Redwood Road Bridge crossing. Improvements to Sotoyome Creek were evaluated based on hydraulic evaluation and field observations and presented in GHD's March 2012 *North Old Redwood Highway Area Utility Infrastructure Study*, including removal of sediment from the creek at its crossing of Old Redwood Highway and eventual replacement of the Sotoyome Creek Bridge on Old Redwood Highway to improve creek hydraulics and accommodate road enhancements (i.e., road widening to add bike lanes and sidewalk). Work would be scheduled when redevelopment in the area requires widening the bridge. At the time of this report, Sotoyome Creek watershed was not included in the SDMP model because the creek was evaluated in the 2012 GHD report and it is an isolated watershed not hydraulically connected with watersheds to the south. Therefore, it was not modeled in the overall hydrologic/hydraulic model for the Town.

Electronic and hard copies of the North Old Redwood Highway Area Utility Infrastructure Study are kept on file at the Town.

Proposed Improvements:

F-SDIP 1 proposes to remove sediment from the creek, and replace the bridge on Old Redwood Highway to improve creek hydraulics and accommodate road enhancements. The new bridge is assumed to have a width of 46 feet, which is comprised of two 12-foot travel lanes, two 6-foot wide bicycle lanes, and one 5-foot wide sidewalk, 1.5-feet on each side of the bridge for guardrails, and 2-feet of additional width as a safety precaution. Based on the hydraulic evaluation for the creek, the bridge span may not require expansion; however, for the purpose of this cost analysis, the existing 21-foot clear span is assumed to be expanded to 25-feet, adding 5-feet to the overall bridge span for total span of 30-feet. Therefore, the new bridge span would be approximately 1,380 square feet.

It is recommended that Sotoyome Creek be incorporated into the MIKE model to confirm recommended improvements for sediment removal and bridge replacement. Timing for bridge replacement should be coordinated with redevelopment of the area. Note that maintenance removal of sediment deposition at the bridge site will help channel capacity, and can occur prior to an actual future SDIP project being completed.

Flood Reduction:

See Figure F-SDIP 1 for a visual illustration of the limits of project improvements from the 2012 GHD report. No significant flood reduction is expected but the bridge replacement will improve hydraulics and is a Town recommendation for overall area development. Note that this will not solve erosion problems in private property between Highway 101 and Old Redwood Highway.

Environmental Constraints:

Based on a preliminary review, F-SDIP 1 is likely to require a CEQA Initial Study to evaluate potential impacts to Sotoyome Creek associated with the proposed bridge replacement. It is anticipated that the Initial Study would identify measures to mitigate project impacts to a less-than-significant level, and that a Mitigated Negative Declaration would be the appropriate level of CEQA review. In addition, environmental permitting approvals would likely be required for work that affects Sotoyome Creek. Such approvals likely include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement
- U.S. Army Corps of Engineers – 404 Permit
- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost:*

Construction:	$ 2,180,000
Contingency:	$ 550,000
Design:	$ 683,000
CM:	$ 328,000
TOTAL:	$ 3,750,000

* Easement/land acquisition is not included.

Note: The project costs included here differ from the GHD 2012 study. Differences are attributed to the use of different planning numbers for assumed soft costs, as well as the inclusion of potential road improvements adjacent to the bridge structure that are needed to transition the new bridge deck elevation with the existing roadway.

7.4.5 F-SDIP 2 Proposed Detention Basin on Pruitt Creek on East Side of US HWY 101

This project was removed as part of Phase 2. Phase 1 of the Storm Drainage Master Plan proposed F-SDIP 2 which was to create a new detention basin in the open field east of the Highway 101 northbound off-ramp at Shiloh Road.

Problem Description:

Flooding of the Highway 101 northbound off-ramp at Shiloh Road was observed during a December 2014 storm event. Modeling shows that larger storm events (25-year and greater) could cause even more flooding, potentially onto the highway itself. Also, Pruitt Creek and Pool Creek downstream of the Highway 101 crossing and this location are also near their maximum conveyance capacities during larger storm events.

An existing Vision Plan for a portion of the conceptual area impacts a significant portion of the site and the location of a potential detention basin. However, the viability of the Vision Plan is unknown, mainly due to the designation of part of the planning area as within the existing FEMA flood plain.

The area along the creek has been designated as a wetlands according to the Army Corps of Engineers. Due to the designation of a portion of the area as wetlands, and ongoing plans for development in this area, this project was removed from consideration by the Town. Development in this area will likely have to consider and work within the wetlands designation; therefore, the SDMP model should be revisited when development plans are further defined.

7.4.6 F-SDIP 3 Proposed Detention Basin between Pool Creek and Faught Creek

Problem Description:

Severe scouring and embankment erosion is observed in Pool Creek and Faught Creek between Highway 101 and Conde Lane. This action has likely caused a loss of conveyance capacity in the downstream system due to sediment transport and deposition in the Conde Lane culvert and further downstream. Also, a portion of the future SDIP area, near the confluence of Pool Creek and Faught Creek, has been used as cow pasture in the recent past. It is apparent that cows were unrestricted in crossing the creeks, which caused additional erosion and water quality impacts from waste. Pruitt Creek and Pool Creek are also near their maximum conveyance capacities during larger storm events downstream of this location. With stream bank restoration and proper land management, capacity may be restored within the creeks. The Town could also see a benefit towards national pollutant discharge elimination system (NPDES) nutrient goals and receive a nutrient credit for reducing the amount of waste entering the two creeks. This site has the potential for providing detention in the area near the the confluence of the two creeks. A preliminary estimate indicates approximately 4 acres may be available for a detention site.

Proposed Improvements:

Two types of improvements are recommended, including improvement of existing creeks to improve water quality and the addition of storm water detention to reduce downstream flooding. These improvements could be implemented by the Town as separate or combined projects.

Improve Water Quality: F-SDIP 3 proposes to improve Pool Creek and Faught Creek in private property located between Highway 101 and Conde Lane, including bank stabilization and removal of excess sediment and livestock waste.

Reduce Flooding: F-SDIP 3 also proposes to construct a storm water detention basin upstream of the confluence of Pool Creek and Pruitt Creek, west of Highway 101. For the purposes of costing, it was assumed that the detention basin would be approximately 15.5 acre-feet within a 4 acre footprint, with levees constructed along Pool and Faught Creeks to retain peak storm flows from those creeks (effectively raising the hydraulic grade line without causing additional flooding). The method for transferring creek flow to and from the detention basin should be determined during preliminary design (i.e., pipelines, overflow weirs). The Town should consider integrating detention into future development that is located within this SDIP area.

Flood Reduction:

See Figure F-SDIP 3 for a visual illustration of the reduction in flooding with implementation of F-SDIP 3. The addition of storm water detention upstream of the Pool Creek and Faught Creek confluence would help to manage peak storm water flows in Pool Creek. Alternate locations for a stormwater detention basin, such as between the confluence of Faught/Pool Creeks and Pruitt Creek, which could also help alleviate some flooding in Pool Creek, should be considered in future evaluations prior to project implementation. By detaining flows, the hydraulic grade line would be reduced in the creeks; however, the golf course area would still experience flooding during larger storm events.

Environmental Constraints:

Based on preliminary review, F-SDIP 3 migth be exempt from CEQA under CEQA Guidelines Section 15303 (New Construction or Conversion of Small Structures) and 15304 (Minor Alterations to Land). To confirm F-SDIP 3 is exempt, additional site evaluation would be required to confirm that the project would not involve removal of mature scenic trees, that there are no sensitive areas within the detention basin area or the Pool Creek and Pruitt Creek improvement areas, and that the improvements would be a minor alteration to the condition of the land. If F-SDIP 3 does not qualify for an exemption from CEQA, then an Initial Study/MND would likely be the appropriate level of CEQA review. In addition, environmental permitting approvals may be required depending on the extent of of work within Pool Creek and Faught Creek. Such approvals likely include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement
- U.S. Army Corps of Engineers – 404 Permit
- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost:*

Construction:	$ 2,000,000
Contingency:	$ 500,000
Design:	$ 625,000
CM:	$ 300,000
TOTAL:	$ 3,430,000

* Easement/land acquisition is not included. Project assumes reuse of excavated soil for the earthen berm (which impacts off haul cost and material cost for berm).

7.4.7 F-SDIP 4 Starr Road and Colleen Drive Improvements

Problem Description:

There is an existing 4-foot x 8-foot box culvert located underneath a residential property and possibly under the house immediately upstream of Starr Creek Tributary 6 at the intersection of Starr Road and Starr View Drive. Downstream of this location, where Starr Creek Tributary 6 crosses Colleen Drive, there are two 54-inch diameter culverts that convey creek flows to the south. These culverts are undersized and during 10-year and larger storm events, the creek overtops its banks and could cause flooding in Starr Road. Abandoning the existing box culvert

under the house and installing a new box culvert within Starr Road and possibly beneath Colleen Drive could alleviate flooding at this location and move the existing box culvert out of private property.

Proposed Improvements:

F-SDIP 4 proposes to install pipeline / box culvert improvements in Starr Road and Colleen Drive. A new pipeline or box culvert would convey flow from Starr Road in the vicinity of Starr Circle and Gumview Road to Starr Creek Tributary #6 at Colleen Drive. There are two apparent options for improvements: 1) the new pipeline / box culvert connects to the creek via an easement across from Starr View Drive and the two existing pipelines crossing Colleen Drive are upsized; or 2) a new pipeline and box culvert is installed in Starr Road and Colleen Drive up to the two existing pipelines, bypassing flows around the problem area. Option 2 is assumed for the summary below, as the proposed improvements would be located within Town right-of-way:

- Install 1,010 LF of 4-foot x 8-foot reinforced concrete box (RCB) culvert in Starr Road from Starr Circle south to Colleen Drive;
- Abandon the existing box culvert located underneath the residential property; and
- Install 350 LF of 4-foot x 8-foot RCB in Colleen Drive from Starr Road to culvert crossing on Colleen Drive. Discharge the new box culvert to the creek on the downstream side of Colleen Drive.
- Note: the Town may also consider maintaining the existing box culvert located in the private property for use as a bypass during high flow events or for maintenance of the new conveyance system.

Flood Reduction:

See Figure F-SDIP 4 for a visual illustration of the reduction in flooding with implementation of F-SDIP 4. The proposed project reduces flooding along Starr Road mainly in the vicinity of the intersection with Gumview Road and also moves drainage facilities onto public right-of-way. The secondary benefit of the project is the elimination of the need to convey stormwater through the private property east of the intersection of Starr Road and Starr View Drive.

Environmental Constraints:

Based on a preliminary review, F-SDIP 4 may be exempt from CEQA under Public Resources Code Section 21080.21 (Exclude Pipelines of Less than One Mile), and under CEQA Guidelines Section 15301 (Existing Facilities), 15302 (Replacement or Reconstruction), and Section 15303 (New Construction or Coversion of Small Structures). To confirm F-SDIP 4 is exempt, additional site evaluation may be required to evaluate the potential for impacts to biological habitat work would occur near Starr Creek. In addition, environmental permitting approvals may be required if the project includes a new connection to Starr Creek. Such approvals likely include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement
- U.S. Army Corps of Engineers – 404 Permit
- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost*:

Construction:	$ 2,260,000
Contingency:	$ 570,000
Design:	$ 708,000
CM:	$ 340,000
TOTAL:	$ 3,880,000

* Easement/land acquisition is not included.

7.4.8 F-SDIP 5 Pool Creek at Windsor Road

Problem Description:

Frequent road flooding has been observed at the Windsor Road/Pool Creek crossing, even during smaller than 10-year storm events. The road is typically closed during medium to strong storms. Improvements in the area that frequently floods would allow for traffic to be unimpeded during minor storms up to a 100-year storm. The Windsor Road/Pool Creek crossing is located at the western downstream boundary of the 2-D model; however, both the 1-D model (MIKE 11) and FEMA FIS indicate a significant restriction occurs at a private bridge located approximately 1,850-feet downstream of Windsor Road. This downstream condition along with the additional constriction at the Windsor Road/Pool Creek bridge crossing contribute to flooding of Pool Creek within the golf course area.

Proposed Improvements:

The existing MIKE 21 model does not extend the 2-D surface beyond Windsor Road at the Pool Creek crossing. However, the 1-D results (MIKE 11) extend beyond the 2-D surface model and indicate the backwater conditions mentioned above.

Because Pool Creek is designated by Sonoma Water's FMDM as a Major Waterway, the 100-year future conditions model (with all SDIPs implemented) was used to determine the 100-year storm HGL at the Windsor Road / Pool Creek Bridge. This HGL is 90.50 feet NAVD. The proposed improvement is to construct a bridge over Pool Creek that is clear of the 100-year future conditions model HGL. Improvements would not be intended to reduce the HGL or flooding in Pool Creek, but rather, to allow traffic to be unimpeded during storm events up to the 100-year event.

The current bridge deck (road surface) is lower, at Elevation 87.13 feet NAVD. The bridge deck is approximately 1.3 feet thick. Assuming one foot of freeboard above the 100-year HGL (i.e., the 100-year HGL would be one foot lower than the bridge soffit), a new bridge deck (road surface) needs to be set at an Elevation of 92.8 feet NAVD; a 5.67-foot rise. For road approach reconstruction, a road grade of 0.5% sloping to the bridge from the north and south was assumed. Based on these assumptions, the road reconstruction limits are approximately 250 feet to the south and 830 feet to the north of Pool Creek as shown in Figure F-SDIP 5. For cost estimation, a unit cost of $639 per square foot for bridge construction was assumed (similar to F-SDIP 1).

As noted previously, the water surface elevation along Windsor Road near Pool Creek is at the edge of the MIKE 21 surface model; therefore the modeled floodwater elevations in this vicinity

are approximate. It is recommended, for future design of this project, to extend the MIKE 21 model further downstream, possibly using County LiDAR, to get a better understanding of the Windsor Road bridge impacts, as well as impacts from the private downstream bridge. Pool Creek is currently maintained by Sonoma Water so coordination of this project with Sonoma Water would be warranted.

Flood Reduction:

With the bridge structure raised, flooding across Windsor Road should be eliminated and traffic on Windsor Road would be able to pass over Pool Creek during a 100-year storm event.

Environmental Constraints:

Based on preliminary review, F-SDIP 5 may be exempt from CEQA under CEQA Guidelines Section 15301 (Existing Facilities) and 15302 (Replacement or Recontruction). To confirm F-SDIP 5 is exempt, additional site evaluation would be required to confirm the potential for impacts to biological resources associated with reconstruction of the bridge over Pool Creek. If F-SDIP 5 does not qualify for an exemption from CEQA, then an Initial Study/MND would likely be the appropriate level of CEQA review. In addition, environmental permitting approvals may be required depending on the extent of disturbance of Pool Creek for the bridge reconstruction. Such approvals likely include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement
- U.S. Army Corps of Engineers – 404 Permit
- Regional Water Quality Control Board – 401 Water Quality Certification
- Sonoma Water Revocable License or Permanent Easement

Project Cost:*

Construction:	$ 4,480,000
Contingency:	$ 1,120,000
Design:	$ 1,400,000
CM:	$ 672,000
TOTAL:	$ 7,680,000

* Easement/land acquisition is not included.

7.4.9 F-SDIP 6 Windsor Creek and East Windsor Creek Confluence Improvements

Problem Description:

This project is in the same area as SDIP 14 and addresses the same issues, described below. This project may be considered along with or in lieu of SDIP 14.

Flooding occurs during the 10-year storm event upstream and downstream of Bell Road and the railroad tracks near the confluence of Windsor Creek and East Windsor Creek when the creeks overtop their banks during significant storm events. This flooding affects streets, residences, and the Town WWTP. East Windsor Tributary #11, which runs east through the Windsor Mobile

Country Club also overtops its banks causing significant flooding in the mobile home park at Joshua Drive. There is a dual 72-inch storm drain bypass on East Windsor Creek that also surcharges, flooding the area around Enzos Way and Oakfield Lane.

Proposed Improvements:

- Install 4,900 LF of floodwall/levees along East Windsor Creek and East Windsor Tributary #11 to reduce overtopping;
- Install two storm water sump pumps, one on each side of East Windsor Tributary #11 to collect local runoff at the Windsor Mobile Country Club. Install flap gates on the storm drains leaving the mobile home park to keep rising creek flows out of the mobile home park. Pump sizing to be determined during project design; and
- Cap manholes on the dual 72-inch bypass pipeline to keep bypass flow within the bypass system.

Note that the Town of Windsor Class 1 Bicycle and Pedestrian Trails Study (Questa Engineering Corporation, 2018) recommends a bike and pedestrian trail along Windsor Creek from Johnson Street (near the 101 Freeway) to the SMART Railway tracks. The study reviewed the Phase 1 Storm Drainage Master Plan and recommended the potential for a combined levee/trail in the vicinity of this area and Windsor Creek. This project would have a combined benefit with the construction of the detention basin in SDIP 15. As seen in Figure F-SDIP 6, a levee/trail was not modeled in Phase 2; however, it may provide added mitigation to flooding in the private property on the east side of Windsor Creek and push the backwater effect upstream into the SDIP 15 detention basin.

There is a significant drainage ditch that runs east/west along the south side of the south ballfield of Windsor Creek Elementary School. This ditch runs into Windsor Creek and would be cut off by the combined levee/trail along Windsor Creek. Additional pipeline(s) with flap gate(s) might need to be installed between the drainage ditch and Windsor Creek through the floodwall improvements. In the vicinity of the intersection of Old Oak Road and Grayson Way, the east bank of Windsor Creek impinges upon developed residential private property. Due to space restrictions a levee may not be constructible here; however, an engineered floodwall may be suitable in this location and a trail could bridge the creek here. Improvements to Grayson Way may also be needed to increase roadway elevations to prevent flooding. These design constraints should be considered.

There are numerous oak trees along the bank of Windsor Creek; and, oak trees are generally protected by Town policy. Construction in this area will likely need to minimize the loss of these trees and environmental impacts to the riparian habitat.

Note that F-SDIP 6 will require easements along the creeks and likely from the SMART (railroad).

Flood Reduction:

See Figure F-SDIP 6 for a visual illustration of the reduction in flooding with implementation of F-SDIP 6. The proposed improvements significantly reduce flooding at the WWTP, Windsor Mobile Country Club, and on Bell Road. It should be reiterated that these results are in combination with the effecs of SDIP-14, the detention basin in the vicinity of former Windsor Creek Elementary

School. The combination of floodwalls and detention (SDIP 6) drastically improve conditions in already developed neighborhoods on the east side of Windsor Creek.

Environmental Constraints:

Based on a preliminary review, F-SDIP 6 is likely to require a CEQA Initial Study to evaluate potential impacts to Windsor Creek and East Windsor Creek associated with the proposed improvements. It is anticipated that the Initial Study would identify measures to mitigate project impacts to a less-than-significant level, and that a Mitigated Negative Declaration would be the appropriate level of CEQA review. In addition, environmental permitting approvals would likely be required for work within and adjacent to Windsor Creek and East Windsor Creek. Such approvals likely include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement
- U.S. Army Corps of Engineers – 404 Permit
- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost:*

Construction:	$ 1,710,000
Contingency:	$ 430,000
Design:	$ 540,000
CM:	$ 260,000
TOTAL:	$ 2,940,000

* Easement/land acquisition is not included.

For future planning for F-SDIP 6, the Town may consider additional improvements to protect and enable continued operation of the WWTP during a storm event greater than the 100-year storm event. FEMA guidelines may be referenced in this regard.

7.4.10 F-SDIP 7 Franklin Street and Leafhaven Lane Improvements

Problem Description:

This project was moved to future SDIP in Phase 2 (previously SDIP 4 in Phase 1) due to Town prioritization of detention projects.

The upper portion of the East Windsor Creek watershed drains from east of the Town boundary to a storm drainage system on Jensen Lane. This pipe system is overwhelmed during larger storm events, causing flooding of streets and residences in the area. Review of the storm drainage system indicates that the pipe network has capacity issues downstream on Franklin Street and 4th Street where the system discharges to East Windsor Creek.

Proposed Improvements:

- Improve existing catch basin inlet capacity along the pipe network within the project reach, from East Windsor Creek to the upstream end of Jensen Lane to increase flow from the roadside ditch into the pipe network;

- Install a 60-inch storm drain paralleling the existing 66-inch storm drain in pavement from the discharge to East Windsor Creek upstream for a distance of 1,020 LF on 4th Street and Franklin Street to Esmond Circle;
- Construct a new outfall adjacent to the existing 66-inch outfall in East Windsor Creek;
- Replace 150 LF of existing 36-inch storm drain pipeline on Leafhaven Lane in pavement from Hembree Lane to Planetree Drive with a 48-inch storm drain pipeline; and
- Replace 380 LF of existing 30-inch storm drain pipeline in pavement on Leafhaven Lane from Sassafrass Street east with a 36-inch storm drain pipeline.

Flood Reduction:

See Figure F-SDIP 7 for a visual illustration of the reduction in flooding with implementation of F-SDIP 7. The proposed project reduces flooding along Jensen Lane, Ginkgo Place, Willowood Way and Planetree Drive.

Environmental Constraints:

F-SDIP 7 would be subject to review under CEQA. Refer to the Environmental Summary in Section 7.5. Based on a preliminary review, F-SDIP 7 may be exempt from CEQA under Public Resources Code Section 21080.21 (Exclude Pipelines of Less than One Mile), and under CEQA Guidelines Section 15301 (Existing Facilities), 15302 (Replacement or Reconstruction), and Section 15303 (New Construction or Coversion of Small Structures). To confirm F-SDIP 7 is exempt, additional site evaluation would be required to evaluate the potential for impacts to biological resources would occur near East Windsor Creek. If F-SDIP 7 does not qualify for an exemption from CEQA, then an Initial Study/MND would likely be the appropriate level of CEQA review. In addition, environmental permitting approvals may be required if the project includes a new outfall to East Windsor Creek. Such approvals may include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement
- from:U.S. Army Corps of Engineers – 404 Permit
- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost:*

Construction:	$ 2,200,000
Contingency:	$ 550,000
Design:	$ 688,000
CM:	$ 330,000
TOTAL:	$ 3,770,000

* Easement/land acquisition is not included.

7.4.11 F-SDIP 8 Detention at Jensen Lane Development

Problem Description:

Development of Jensen Lane is expected to increase stormwater runoff to the downstream pipe network. Detention at Jensen Lane is sized to mitigate increased runoff from future development and the impact to downstream networks.

Proposed Improvements:

The The proposed project is a detention basin with a volume of 10 acre-feet to mitigate the increased runoff from the the development of the land north of Jensen Lane and east of Hembree Lane so as not to impact the downstream storm drainage network. The location of the detention basin is to be determined in conjunction with development planning and it is assumed that 1,000 LF of 30-inch storm drain pipeline will convey flow to the site of the detention basin; however, this could be more or less depending on site selection.

Flood Reduction:

See Figure F-SDIP 8 for a visual illustration of the reduction in flooding with implementation of F-SDIP 8. Note that this detention basin location is undetermined at this stage and is modeled as a node within MU and therefore does not show inundation of the actual basin. However, the detention basin will fill and the area will be intentionally inundated. It is expected that a detention volume of 10 acre-feet will be necessary to mitigate downstream impacts of additional flows to the storm drain system due to future development.

Environmental Constraints:

F-SDIP 8 would be subject to review under CEQA. Refer to the Environmental Summary in Section 7.5. Based on preliminary review, F-SDIP 8 may be exempt from CEQA under CEQA Guidelines Section 15303 (New Construction or Conversion of Small Structures) and 15304 (Minor Alterations to Land). To confirm F-SDIP 8 is exempt, additional site evaluation would be required to confirm that the project would not involve removal of mature scenic trees, that grading would not occur on slopes greater than 10 percent, that there are no environmentally sensitive areas within the detention basin area, and that the improvements would be a minor alteration to the condition of the land. If F-SDIP 8 does not qualify for an exemption from CEQA, then an Initial Study/MND would likely be the appropriate level of CEQA review. This project is not located within the jurisdiction of an environmental permitting agency (i.e., open channel or creek), and therefore no environmental permits are anticipated.

Project Cost:*

Construction:	$ 2,260,000
Contingency:	$ 565,000
Design:	$ 708,000
CM:	$ 340,000
TOTAL:	$ 3,880,000

* Easement/land acquisition is not included.

7.4.12F-SDIP 9 North of Arata Lane Drainage Project

Problem Description:

This project was added to phase 2 as part of a multi-phase approach to addressing the flooding at the intersection of the Old Redwood Highway and Dawn Way. This project also serves to address flooding issues in the Arata Lane as well as address future development in the northern portion of the Town. The portion of the Starr Creek and Windsor Creek watersheds located north of the Town boundary drain to Arata Lane. Roadside open channels (i.e., ditches) and storm drains collect this runoff and convey flow to the south and west. During large storm events the existing system is overwhelmed, at which point water sheets across Arata Lane and overland to the south causing flooding of streets, residences, and at Brooks Elementary School.

Proposed Improvements:

This project will:

- Construct a detention basin in the North of Arata area, which is planned for development, with an approximate volume of 12.97 acre-feet. This may take the form of one large detention basin or multiple smaller ones;
- Intall intake structure and diversion facilities from existing channel along Hillview Road; and
- Install conveyance from detention basin to storm drain network along Arata Lane.

Project implementation should align with future development of the area to the North of Arata Lane.

NOTE: Cost was done for one large basin to address both existing and future needs. The costs presented herein reflect portion of capacity needed to address existing impacts. Total project cost is $6.33M (in 2019 dollars) with 43% capacity needed to address existing issues and 57% attributable to future development.

Flood Reduction:

See Figure F-SDIP 9 for a visual illustration of the reduction in flooding with implementation of F-SDIP 9. Note that this detention basin location is undetermined at this stage and is modeled as a node within MU and therefore does not show inundation of the actual area. However, the detention basin will fill and the area will be intentionally inundated. The proposed project will mitigate the impact from future develop and associated increased runoff; reduce flooding downstream, in particular, in the vicinity of Old Redwood Highway and Dawn Way; and alleviate flooding immediately downstream in the area along Arata Lane.

Environmental Constraints:

Based on preliminary review, SDIP 13 may be exempt from CEQA under CEQA Guidelines Section 15303 (New Construction or Conversion of Small Structures) and 15304 (Minor Alterations to Land). To confirm SDIP 13 is exempt, additional site evaluation would be required to confirm that the project would not involve removal of mature scenic trees, that grading would not occur on slopes greater than 10 percent, that there are no sensitive areas within the detention basin area or connecting drainage channel, and that the improvements would be a minor

alteration to the condition of the land. If F-SDIP 9 does not qualify for an exemption from CEQA, then an Initial Study/MND would likely be the appropriate level of CEQA review. In addtition, environmental permitting approvals may be required depending on the extent of disturbance to the connecting drainage channel. Such approvals likely include:

- California Department of Fish and Wildlife – 1600 Streambed Alteration Agreement
- SDIP 13 would be subject to review under CEQA. affectsU.S. Army Corps of Engineers – 404 Permit
- Regional Water Quality Control Board – 401 Water Quality Certification

Project Cost*:

Construction:	$ 3,690,000
Contingency:	$ 923,000
Design:	$ 1,155,000
CM:	$ 555,000
TOTAL:	$ 6,330,000

* Easement/land acquisition is not included. The project cost assumes one detention basin; however, cost might be higher if multiple detention basins are constructed to achieve a similar volume of detention.

7.5 Environmental Review for SDIP Projects

7.5.1 CEQA Compliance

Table 7-3 summarizes the preliminary CEQA review of the SDIP projects as identified in Section 7.3 and 7.4 of this report. Several of the Town's SDIPs may qualify for exemptions from CEQA. To confirm qualification for an exemption from CEQA for a specific project, additional site evaluation would be required.

Table 7-3 Preliminary CEQA Review

Project	Potentially Exempt*	Unlikely to be Exempt*
SDIP 1 – Arata Lane & North Windsor Improvements	X	
SDIP 5 – Gumview Drive, Berry Lane and Starr View Drive Improvements	X	
SDIP 6 – Hiram Lewis Park Detention Basin Improvements	X	
SDIP 8 – Old Redwood Highway at Dawn Way Improvements	X	
SDIP 9 – Old Redwood Highway and Pleasant Avenue Improvements	X	
SDIP 11 – Shiloh Road at Caletti Avenue Improvements	X	
SDIP 12 – Hall Park Detention Basin	X	
SDIP 13 – Starr Creek Tributary #5 – South of Arata Lane	X	
SDIP 14 – East Windsor Creek Flood Control Project	X	
F-SDIP 1 – Old Redwood Hwy Bridge at Sotoyome Creek Improvement		X
F-SDIP 3 – Proposed Detention Basin between Pool Creek & Faught Creek	X	
F-SDIP 4 – Starr Road and Colleen Drive Improvements	X	
F-SDIP 5 – Pool Creek at Windsor Road	X	

Project	Potentially Exempt*	Unlikely to be Exempt*
F-SDIP 6 – Windsor Creek & East Windsor Cr. Confluence Improvements		X
F-SDIP 7 – Franklin Street and Leafhaven Lane Improvements	X	
F-SDIP 8 – Detention at Jensen Lane Development	X	
F-SDIP 9 – North of Arata Lane Drainage Project	X	

Note: *Requires further review at time of Project approval

Potential CEQA Exemptions

As summarized in Section 7.3 and 7.4, the Town's SDIP projects may qualify for several different CEQA exemptions. The language of the pertinent exemptions are included below:

- **PRC Section 21080.21 (Exclude Pipelines of Less than One Mile)**: This statutory exemption covers projects of less than one mile in length within a public street or highway or other public right of way for the installation of a new pipeline or for maintenance, repair, restoration, reconditioning, relocation, removal, replacement, or demolition of an existing pipeline.
- **Class 1 Exemption**. This exemption covers "operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures involving negligible or no expansion of existing or former use." (14 CCR, 15301) A non-exclusive list of examples includes existing facilities of both investor and publicly owned utilities used to provide public utility services, existing highways and streets, gutters, and similar facilities, and restoration or rehabilitation of deteriorated or damaged structures to meet current standards of public health and safety.
- **Class 2 Exemption**. This exemption covers "replacement or reconstruction of existing structures and facilities where the new structure will be located on the same site as the structure replaced and will have substantially the same purpose and capacity as the structure replaced." (14 CCR, 15302) A non-exclusive list of examples includes replacement or reconstruction of existing utility systems and/or facilities involving negligible or no expansion of capacity.
- **Class 3 Exemption**. This exemption covers "construction and location of limited numbers of new, small facilities or structures". (14 CCR, 15303) A non-exclusive list of examples includes water main, sewage, electrical, gas, and other utility extensions, including street improvements, of reasonable length to serve such construction.
- **Class 4 Exemption**. This exemption covers "minor public or private alterations in the condition of land, water, and/or vegetation which do not involve removal of healthy, mature, scenic trees except for forestry or agricultural purposes." (14 CCR, 15304) A non-exclusive list of examples includes grading on land with a slope of less than 10 percent and filling of earth into previously excavated land with material compatible with the natural features of the site.

Categorical exemptions are subject to several exceptions listed under Section 15300.2 of the CEQA Guidelines. If any of these exceptions apply to a SDIP, the SDIP would not be eligible for

coverage under a categorical exemption. Examples include significant effects from unusual circumstances, which generally includes removal of sensitive habitat, riparian habitat, or adverse effects to special-status species. Other exceptions relate to cumulative impacts, scenic highways, hazardous waste sites, and historical resources. These exceptions would need to be investigated further at the time of project approval.

Initial Study/Mitigated Negative Declaration

Based on a preliminary review, F-SDIP 1 and F-SDIP 6 are unlikely to qualify for exemptions from CEQA. These projects potentially require completion of a CEQA Initial Study to evaluate potential impacts to Sotoyome Creek associated with the proposed bridge replacement (F-SDIP 1), and potential impacts to Windsor Creek and East Windsor Creek (F-SDIP 6). It is anticipated that an Initial Study would identify measures to mitigate project impacts to a less-than-significant level, and that a Mitigated Negative Declaration would be the approporate appropriate level of CEQA review.

In addition, it is possible that other SDIPs will not qualify for exemptions from CEQA once project details are further developed. As an overall CEQA strategy, the Town may choose to verify anticipated SDIP timeframes and organize the recommended projects into a list of “near-term” projects and “long-term” projects. The Town could consider preparing a single CEQA Initial Study/Mitigated Negative Declration that includes an evaluation of potential impacts for multiple SDIPs to be implemented under multiple phases.

7.5.2 Permit Requirements

SDIPs 1, 5, 8, 11, 13, 14, and 15 and F-SDIPs 1, 3, 4, 5, 6, and 7 would require work within a potentially jurisdictional feature. Depending on the exent of disturbance to such features, permitting approvals may be required from the following agencies:

- California Department of Fish and Wildlife (1600 Streambed Alteration Agreement);
- U.S. Army Corps of Engineers (404 Permit);
- Regional Water Quality Control Board (401 Water Quality Certification)
- Sonoma Water (Revocable License / Easement)

A formal delineation report would need to be prepared to verify that the features are considered jurisdictional and require permits. As the design process progresses, it may happen that fewer permits need to be acquired for various SDIPs. A description of the above-listed agencies and their jurisdiction is described below.

U.S. Army Corps of Engineers

The Army Corps of Engineers (USACE) has permitting authority over activities affecting waters of the United States. Under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act, the USACE has authority over all waters including wetlands that have sufficient nexus to interstate commerce (e.g., navigable waters and their tributaries). If jurisdictional waters (i.e., below the ordinary high water line [OHWL]) or wetlands are impacted during construction or operation of the Project, then a Corps Section 404 permit would be required.

California Department of Fish and Wildlife

Fish and Game Code section 1602 requires notification to the California Department of Fish and Wildlife (CDFW) prior to commencing any activity that may: 1) substantially divert or obstruc the natural flow of any river, stream or lake; 2) substantially change or use any material from the bed, channel or bank of any river, stream, or lake; or 3) deposit debris, waste or other materials that could pass into any river, stream or lake. If the Project alters the existing streambed or banks of Coyote Creek, including removing or impacting riparian vegetation, a Lake and Streambed Alteration Agreement (Agreement) would be required.

Regional Water Quality Control Board

Section 401 Water Quality Certifications are required when the activity results in fill or discharge directly below the OHWL of waters of the United States. Additionally, any activity that results or may result in a discharge that directly or indirectly impacts waters of the State or the beneficial uses of those waters are subject to WDRs under California's Porter-Cologne Water Quality Control Act (Porter-Cologne). In practice, State waters typically include impacts to a stream channel up to the top of bank, and associated riparian areas.

Sonoma Water

A Revocable License is required for both short term and long term access to Sonoma Water's properties. Examples of short-term use are: construction of storm drain outlets into flood protection channels; perpendicular utility crossings both overhead and underground; short term surface use and access; and landscaping and channel beautification projects. Examples of long term use are: pedestrian, bike paths; long-term maintenance; and roadways.

7.6 Repair and Rehabilitation Capital Improvement Projects

As part of the data collection and field survey efforts, a condition assessment was conducted on surveyed structures. Refer to Tables 3-5 and 3-6 and Figures 3-5 and 3-6 in Chapter 3. Table 7-4 lists those structures that are in poor condition and summarizes the problems noted during the field survey efforts. Possible repairs relate to the noted defects (i.e., replace the damaged structure component noted in the table). In general, the Town should conduct follow up investigation for each of the structures to determine the current and appropriate scope of improvements. Structures associated with recommended SDIPs should be improved with those projects.

A majority of the structure defects could be repaired by replacing the frame and cover or lid or rehabilitating the inside of the structure to fill cracks. Note that these potential repairs were recorded at the time of the field survey and may since be repaired or replaced by Town crews.

Table 7-4 High Priority Structure Rehabilitation Projects

System Component	Description	Location
Inlet 128	Wooden Field Inlet	N of Arata Lane at Camelot Drive
Inlet 130	Wooden Field Inlet	NW of Arata Lane & Biggs Way
Inlet 1928	Top Cracked	SW of Grove Street and Kidd Road
Inlet 1932	Top Cracked and Soil Stability Issues	Kidd Road, North of Maduro Street
Inlet 2063	Top Cracked, Tripping Hazard	SE of Rio Ruso Drive and Veronica Drive
Inlet 2163	Cracked Structure	Claudius Way at Othello Court
Inlet 2172	Cracked Top and Rough Channel	Cricket Court at Camelot Drive
Inlet 2629	Cracked/Deteriorated Top	NE of Hastings Place and Northampton Drive
Inlet 2643	Cracked Structure	Shadetree Drive, North of Smoketree Court
Inlet 2645	Cracked Structure	Shadetree Drive, North of Quince Street
Inlet 2649	Cracked Structure	Leafhaven Lane, West of Sassafras Street
Inlet 2792	Cracked Top, Exposed Angle Iron	Starr View Drive (North side), West of Orion Drive
Inlet 2795	Cracked Top and Rough Channel	Polaris Drive (South side), West of Orion Drive
Inlet 2955	Severely Cracked Top, Tripping Hazard	Park Glen Drive (North side) at Daybrook Drive
Inlet 3687	Cracked Structure	Windsor Road (East side), North of Berwyn Way
Inlet 3978	Cracked Structure	Vancouver Lane, South of Vinecrest Road
Inlet 4016	Cracked Structure	Flametree Circle (South side), West of Shadetree Drive
Inlet 4032	Cracked Structure	Leafhaven Lane, East of Sassafras Street
Inlet 4358	Very Rough Bottom Channel	Hembree Lane, North of Creekside Drive

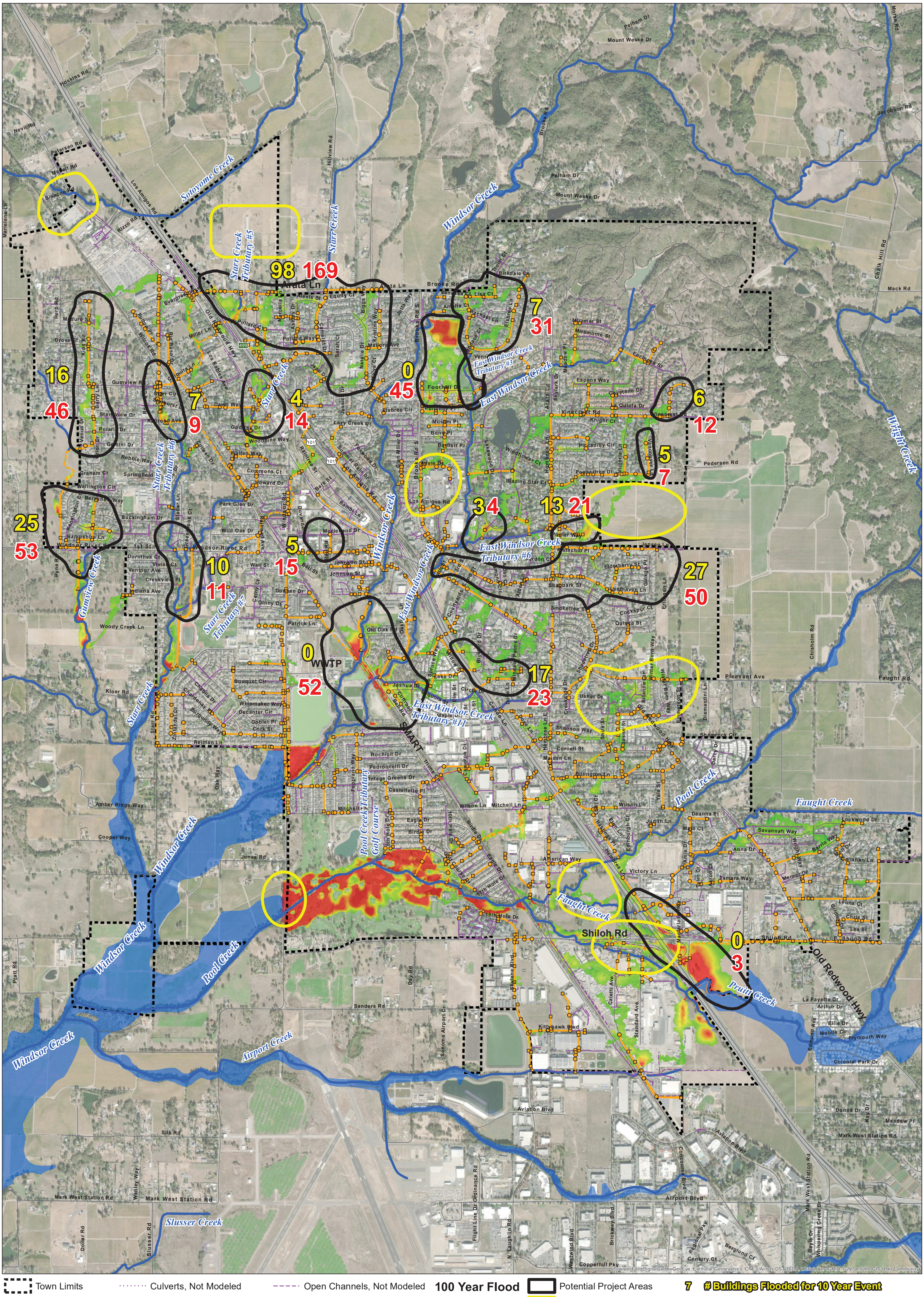
System Component	Description	Location
GHD Inlet 4694	Heavy Rust on CMP under RR Tracks	West of Emily Rose Circle and David Clayton Lane
GHD Inlet 4710	Field Inlet, Missing Frame and Cover	Gumview Road (South side), West of Tolleson Lane
GHD Inlet 4717	Cracked Structure, Missing Cover, Hole in CMP	In field, East of Lockwood Drive
GHD Inlet 4721	Grate Missing/Broken/Plugged	Shira Street, South of Shannon Way
GHD Inlet 4772	Cracked Structure	Cock Robin Drive (North side), East of Winsor Palms Drive
GHD Inlet 4777	Very Structurally Compromised CMP, Trash	Conde Lane, North of Mitchell Lane
MH 707	Trash Accumulation	Mitchell Lane (North side), West of Conde Lane
MH 708	Trash Accumulation	Mitchell Lane (South side), West of Conde Lane

7.7 Summary of Project Costs

Table 7-5 provides an overall summary of project costs for identified SDIPs. Note that the costs tabulated below do not include various soft costs such as easements/land acquisition and wetland mitigation) as noted in Section 7.1.

Table 7-5 Opinions of Probable Project Costs Summary

SDIP	Cost
Existing Conditions SDIP Projects	
SDIP 1 – Phase 1 **PROJECT REMOVED DURING PHASE 2**	NA
SDIP 1	$ 5,510,000
SDIP 2 **MOVED TO FUTURE DURING PHASE 2**	NA
SDIP 3 **PROJECT REMOVED DURING PHASE 2**	NA
SDIP 4 **MOVED TO FUTURE DURING PHASE 2**	NA
SDIP 5	$ 3,950,000
SDIP 6	$ 880,000
SDIP 7 **PROJECT REMOVED DURING PHASE 2**	NA
SDIP 8	$ 1,020,000
SDIP 8 – Phase 2 **PROJECT REMOVED DURING PHASE 2**	NA
SDIP 9	$ 1,810,000
SDIP 10 **PROJECT REMOVED DURING PHASE 2**	NA
SDIP 11	$ 247,000
SDIP 12	$ 1,900,000
SDIP 13	$ 1,400,000
SDIP 14	$ 3,290,000
Total Cost of Existing SDIP Projects	$ 20,007,000
Future Conditions SDIP Projects	
F-SDIP 1	$ 3,750,000
F-SDIP 2 **PROJECT REMOVED DURING PHASE 2**	NA
F-SDIP 3	$ 3,430,000
F-SDIP 4	$ 3,880,000
F-SDIP 5	$ 7,680,000
F-SDIP 6 (formerly SDIP 2)	$ 2,940,000
F-SDIP 7 (formerly SDIP 4)	$ 3,770,000
F-SDIP 8	$ 3,880,000
SDIP 13	$ 6,330,000
Total Cost of Future SDIP Projects	$ 35,660,000



Town Limits
Streets
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Modeled
Manholes, Modeled
Discharge Points, Modeled

100 Year Flood Depth (ft)
> 2
> 0

Potential Project Areas
Town Added Project Areas
FEMA 100 Year Flood Zone (Outside Model Extents)

7 # Buildings Flooded for 10 Year Event
31 # Buildings Flooded for 100 Year Event

Paper Size 22" x 34" (ANSI D)
0 450 900 1,350 1,800
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

GHD ESA TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100-Year Storm Baseline Flood and Potential Project Areas

Job Number	11159126
Revision	5
Date	10 Feb 2020

Figure 7-1

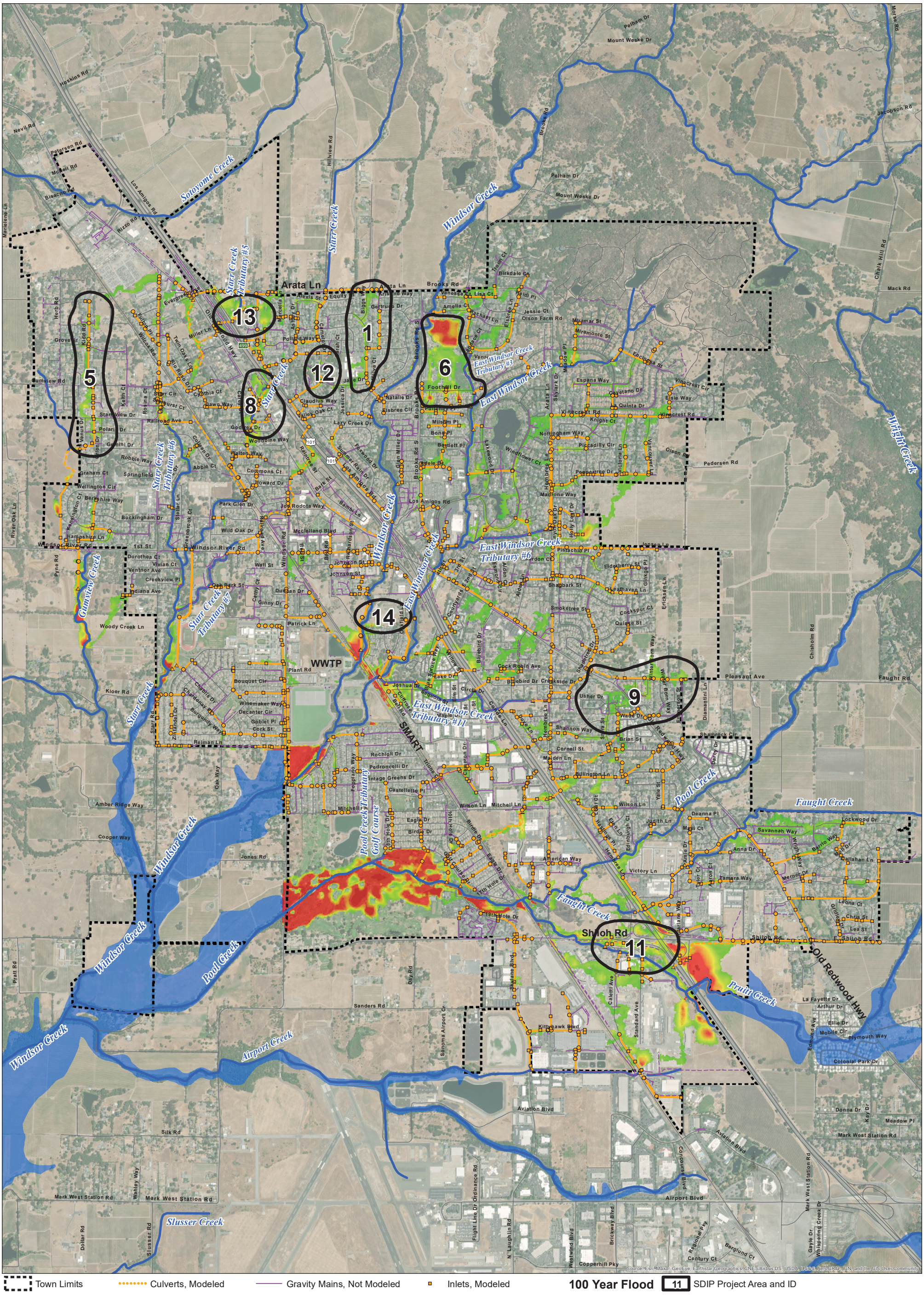
N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 7-1 Potential Project Areas.mxd

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Data source: FEMA, Flood Zone, December 1019; PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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Town Limits
Streets
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Modeled
Manholes, Modeled
Discharge Points, Modeled
FEMA 100 Year Flood Zone
(Outside Model Extents)

100 Year Flood
Depth (ft)
> 2
> 0

11 SDIP Project Area and ID

Paper Size 22" x 34" (ANSI D)
0 450 900 1,350 1,800
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

Existing Conditions Storm Drain Improvement Projects (SDIPs), 100-Year Storm Baseline

Figure 7-2

Job Number 11159126
Revision 6
Date 05 May 2021

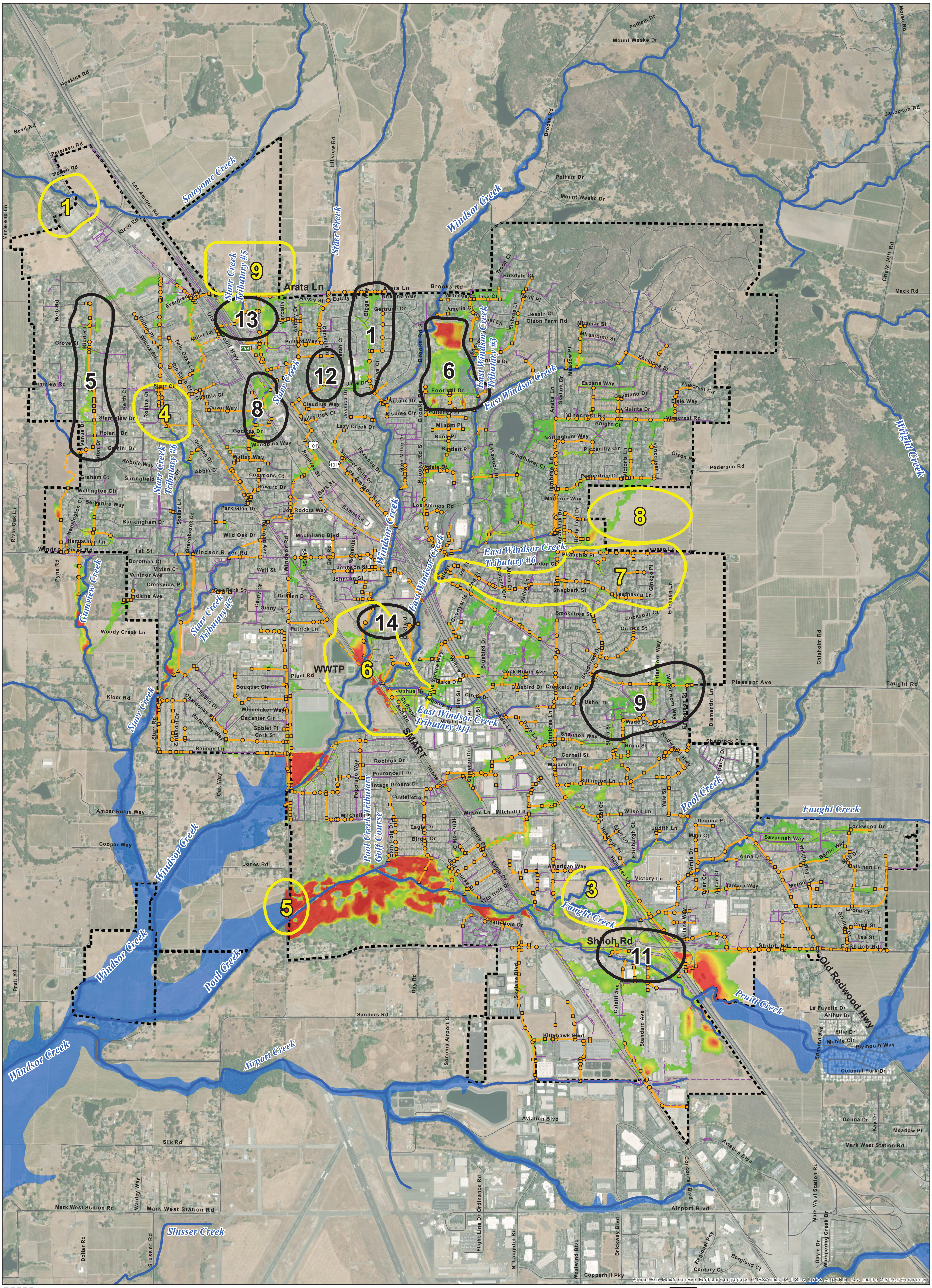
N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 7-2 Existing SDIPs.mxd

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Data source: FEMA, Flood Zone, March 2017; PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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Town Limits | Streets | Rivers and Creeks | Culverts, Modeled | Culverts, Not Modeled | Gravity Mains, Modeled | Gravity Mains, Not Modeled | Open Channels, Modeled | Open Channels, Not Modeled | Inlets, Modeled | Manholes, Modeled | Discharge Points, Modeled | FEMA 100 Year Flood Zone (Outside Model Extents)

100 Year Flood Depth (ft)
> 2
> 0

11 Existing SDIP Project Area and ID
3 Future SDIP Project Area and ID

Paper Size 22" x 34" (ANSI D)
0 450 900 1,350 1,800
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

GHD ESA TOWN OF WINDSOR

Town of Windsor
Storm Drain Master Plan

Job Number 11159126
Revision 6
Date 05 May 2021

Future Conditions Storm Drain Improvement Projects (F-SDIPs), 100-Year Storm Baseline

Figure 7-3

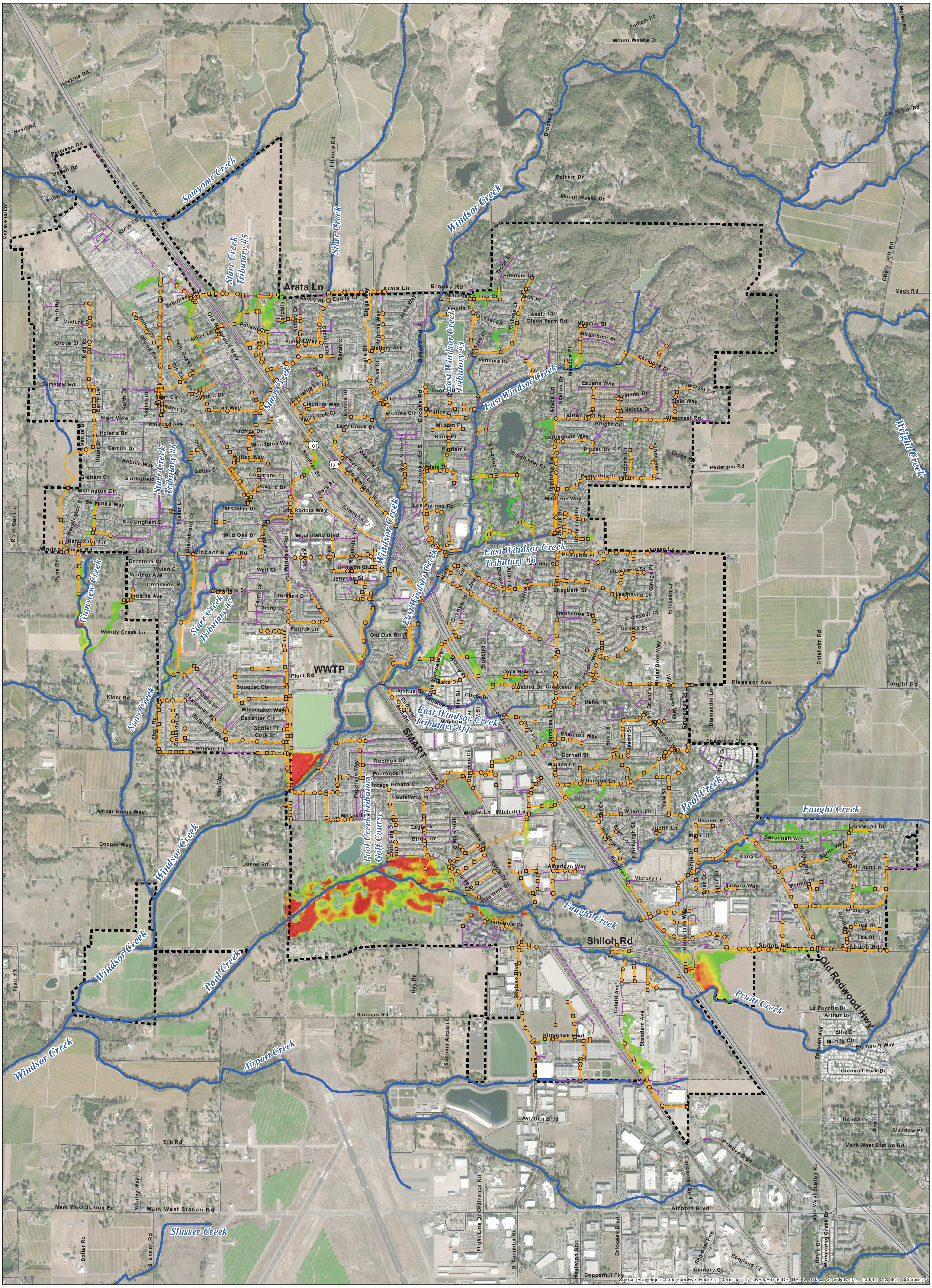
N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 7-3 Future SDIPs.mxd

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Town Limits	Culverts, Modeled	Gravity Mains, Not Modeled	Inlets, Modeled
Streets	Culverts, Not Modeled	Open Channels, Modeled	Manholes, Modeled
Rivers and Creeks	Gravity Mains, Modeled	Open Channels, Not Modeled	Discharge Points, Modeled

10 Year Flood (Includes Existing SDIPs)

Depth (ft)

> 2

> 0

Paper Size 22" x 34" (ANSI D)

0 450 900 1,350 1,800

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

10-Year Storm
Future Conditions Flood Map

Job Number	11159126
Revision	5
Date	11 Feb 2020

Figure 7-4

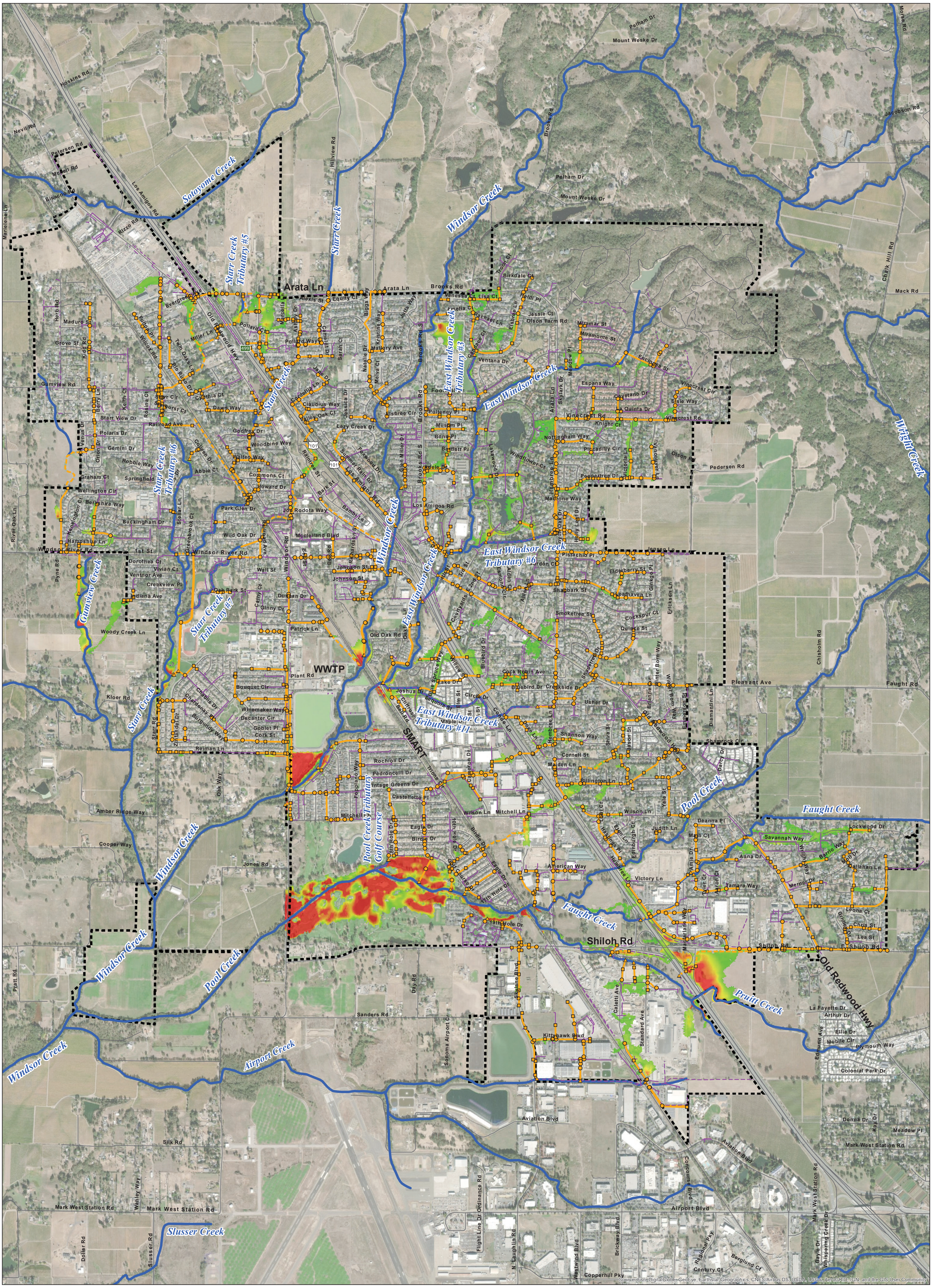
N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 7-4 10-Year Future Flood.mxd

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Town Limits
Streets
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Modeled
Manholes, Modeled
Discharge Points, Modeled

25 Year Flood (Includes Existing SDIPs)

Depth (ft)

> 2

> 0

Paper Size 22" x 34" (ANSI D)

0 450 900 1,350 1,800

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

25-Year Storm
Future Conditions Flood Map

Job Number	11159126
Revision	5
Date	11 Feb 2020

Figure 7-5

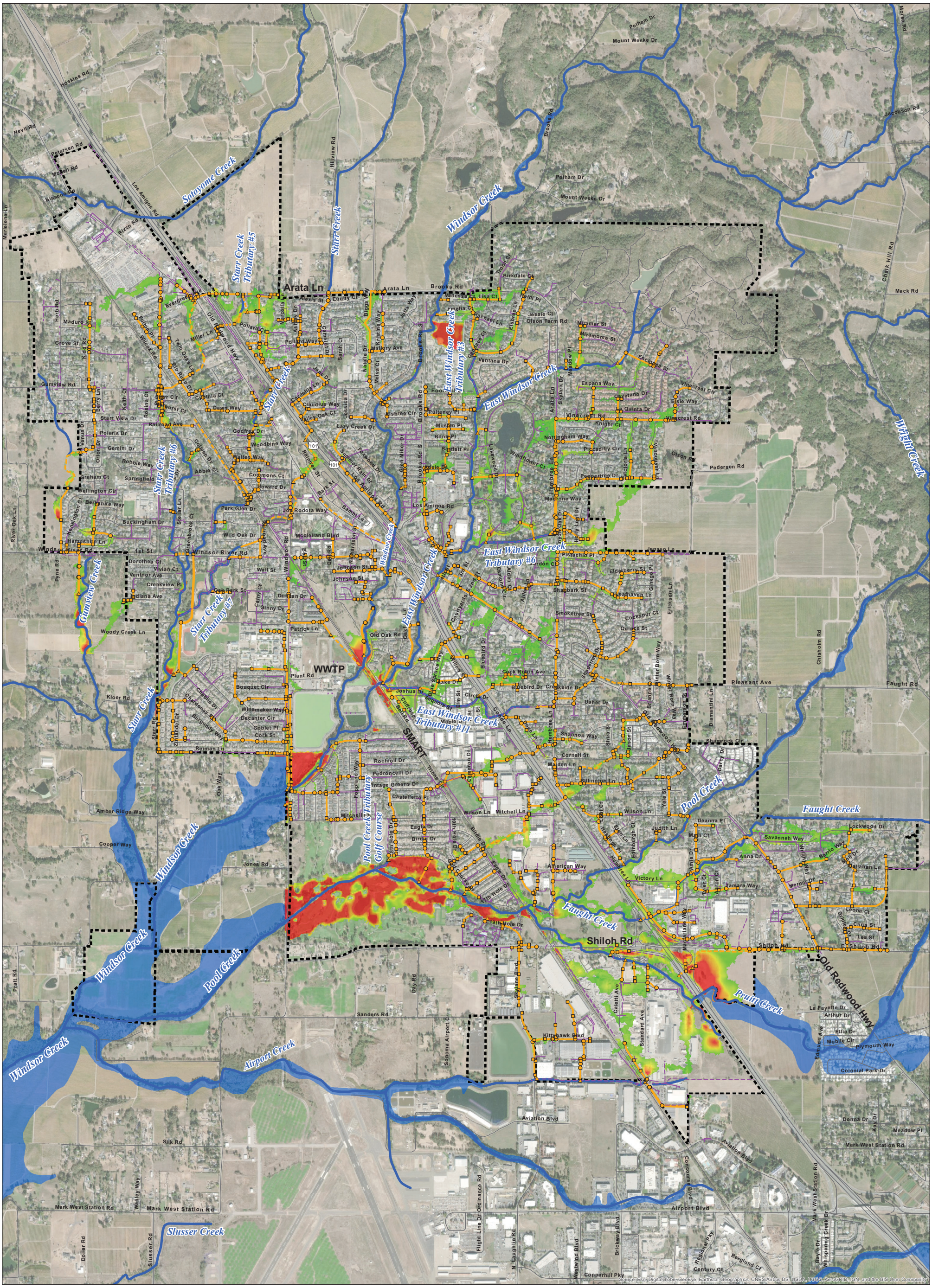
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Town Limits
Streets
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Modeled
Manholes, Modeled
Discharge Points, Modeled
FEMA 100 Year Flood Zone
(Outside Model Extents)

100 Year Flood (Includes Existing SDIPs)

Depth (ft)

> 2

> 0

Paper Size 22" x 34" (ANSI D)

0 450 900 1,350 1,800

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drain Master Plan

100-Year Storm Future Conditions Flood Map

Job Number	11159126
Revision	5
Date	11 Feb 2020

Figure 7-6

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 7-6 100-Year Future Flood.mxd

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Data source: FEMA, Flood Zone, December 2019; PRMD (edited by GHD per Windsor's direction), Town Limits, 2019; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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10-Year Storm Future Conditions Storm Drain System Results

Town of Windsor
Storm Drainage Master Plan

Job Number 11159126
Revision 5
Date 12 Feb 2020

Figure 7-7

Paper Size 22" x 34" (ANSI D)
0 450 900 1,350 1,800
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town Limits
Streets
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Modeled
Manholes, Modeled
Discharge Points, Modeled

10 Year Flood (Include Ex. SDIPs)
Depth (ft)
> 2
> 0

Discharge to Surface (cfs)
> 0 to 1.0
> 1.0 to 5.0
> 5.0 to 20
> 20

Capacity Deficiency (q/Qmanning)
> 1.0 to 1.5
> 1.5

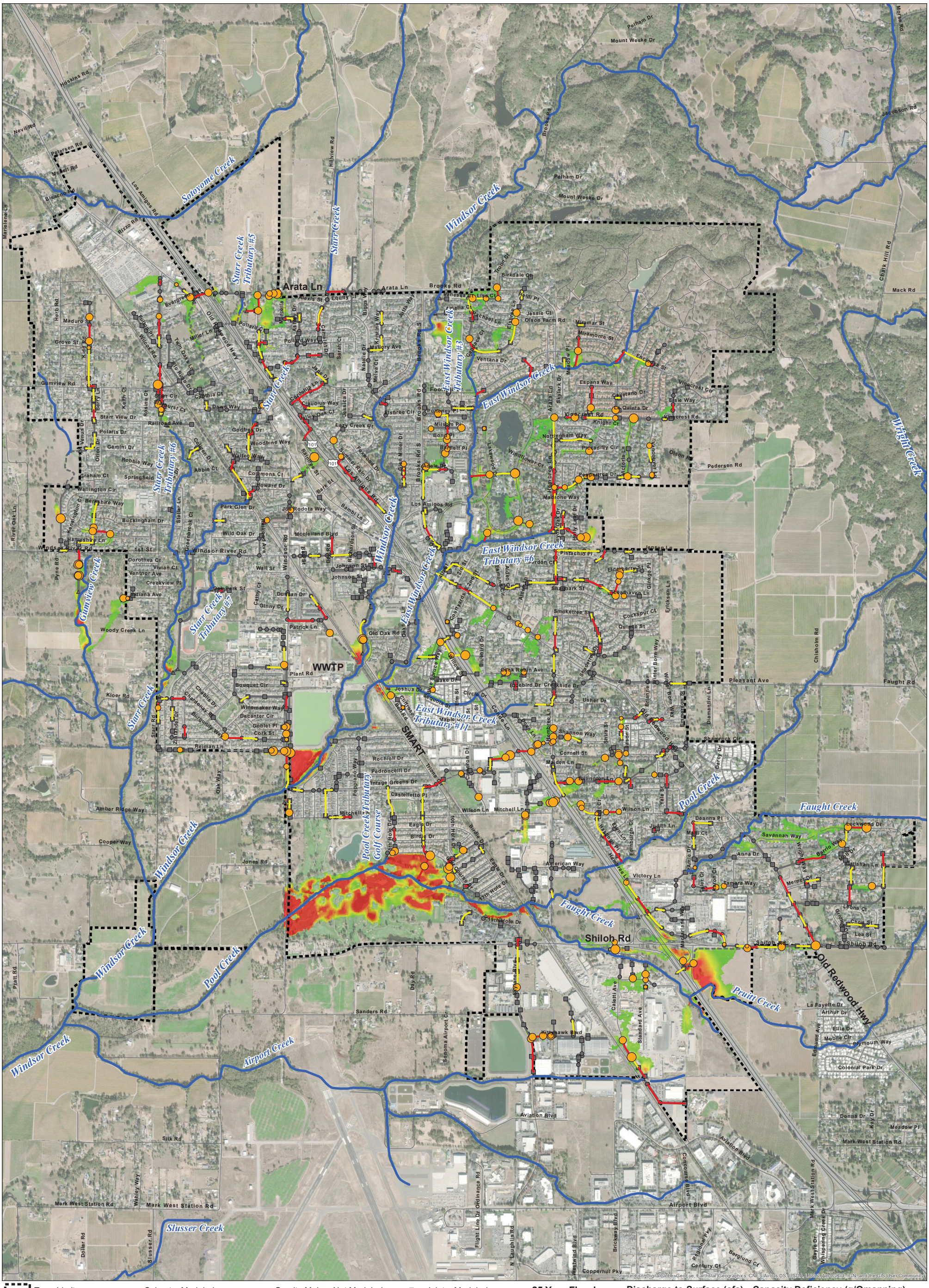
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 7-7 10-Year Future Storm Drain System Results.mxd
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Town Limits
Streets
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Modeled
Manholes, Modeled
Discharge Points, Modeled

25 Year Flood (Include Ex. SDIPs)
Depth (ft)
> 2
> 0

Discharge to Surface (cfs)
> 0 to 1.0
> 1.0 to 5.0
> 5.0 to 20
> 20

Capacity Deficiency (q/Qmanning)
> 1.0 to 1.5
> 1.5

Paper Size 22" x 34" (ANSI D)
0 450 900 1,350 1,800
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

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TOWN OF WINDSOR

Town of Windsor
Storm Drain Master Plan

25-Year Storm Future Conditions Storm Drain System Results

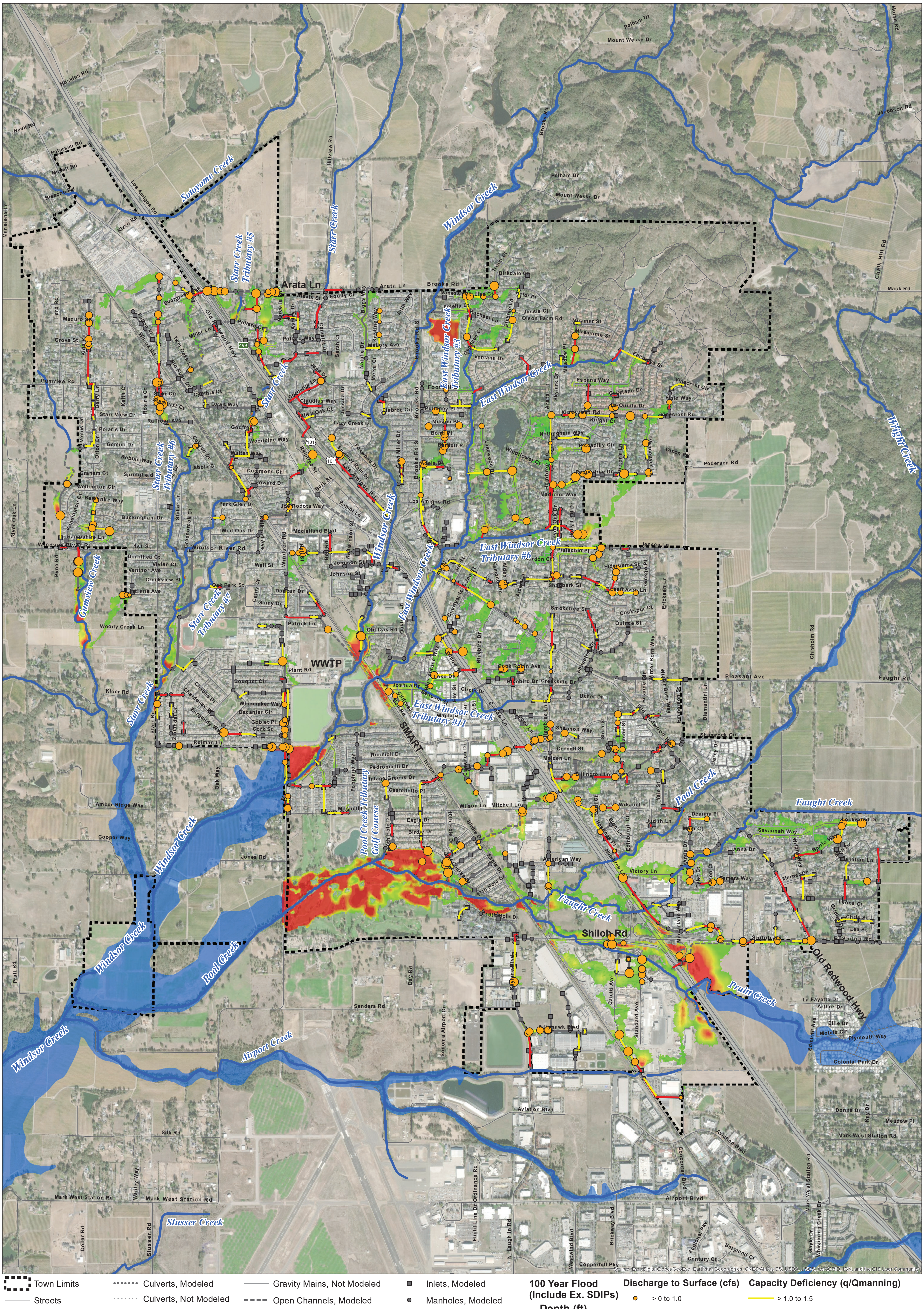
Job Number 11159126
Revision 5
Date 12 Feb 2020

Figure 7-8

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 7-8 25-Year Future Storm Drain System Results.mxd
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Legend			
Town Limits	Culverts, Modeled	Gravity Mains, Not Modeled	Inlets, Modeled
Streets	Culverts, Not Modeled	Open Channels, Modeled	Manholes, Modeled
Rivers and Creeks	Gravity Mains, Modeled	Open Channels, Not Modeled	Discharge Points, Modeled

100 Year Flood (Include Ex. SDIPs)

(Outside Model Extents)

Depth (ft)

> 2

> 0

Discharge to Surface (cfs)

- > 0 to 1.0
- > 1.0 to 5.0
- > 5.0 to 20
- > 20

Capacity Deficiency (q/Qmanning)

- > 1.0 to 1.5
- > 1.5

Paper Size 22" x 34" (ANSI D)

0 450 900 1,350 1,800

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100-Year Storm Future Conditions Storm Drain System Results

Job Number	11159126
Revision	5
Date	12 Feb 2020

Figure 7-9

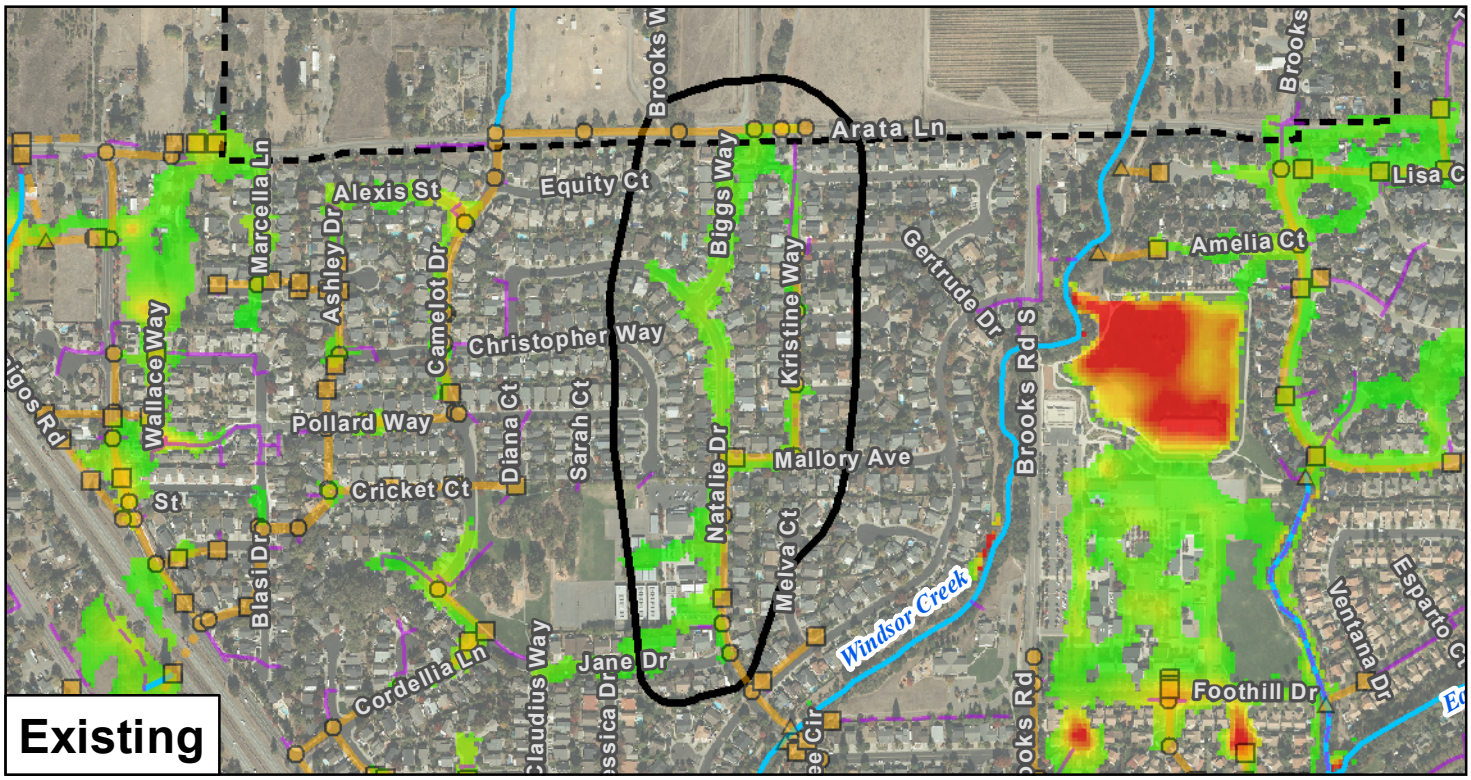
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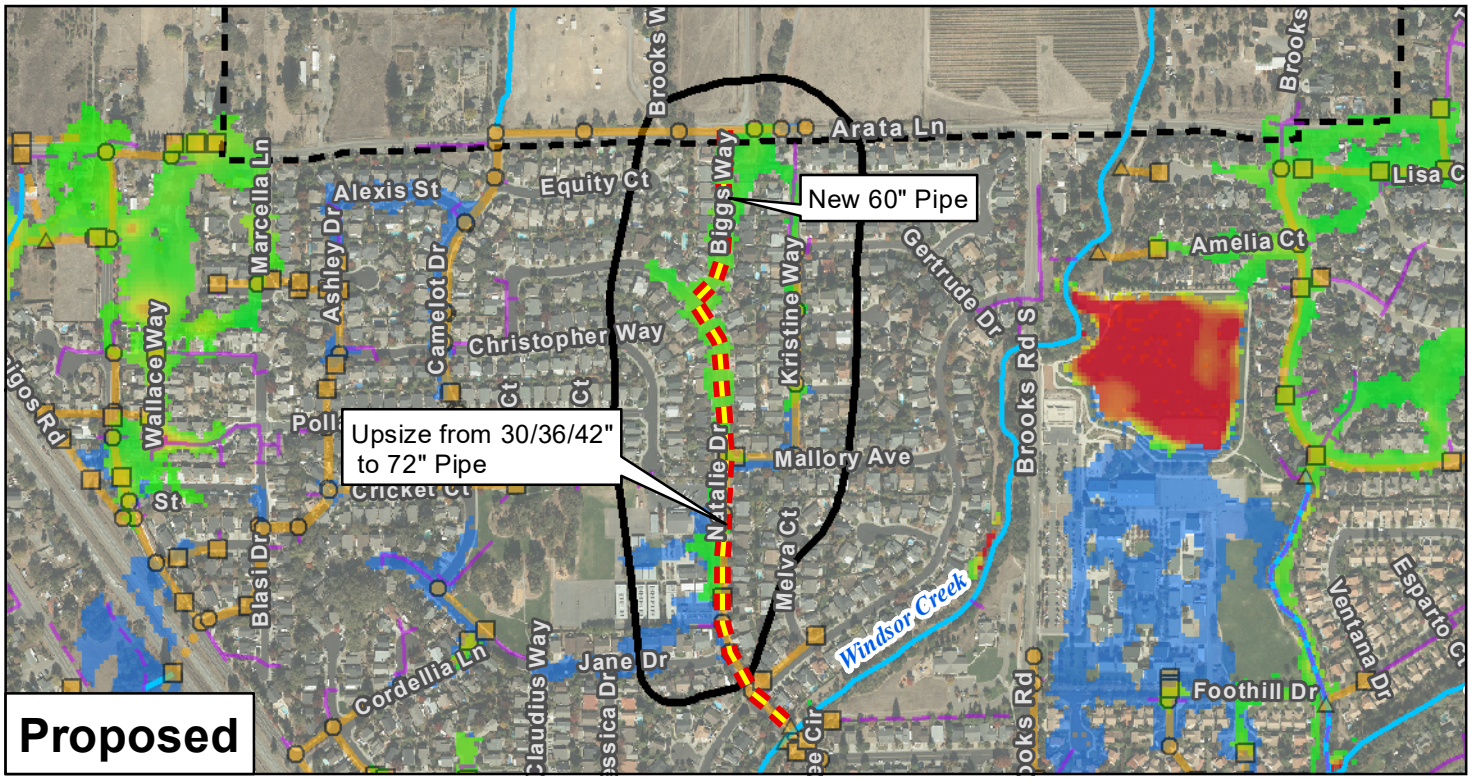
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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 350 700
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Flood and Impacts of SDIP 1

Job Number 11159126
Revision 6
Date 12 Feb 2020

Figure SDIP 1

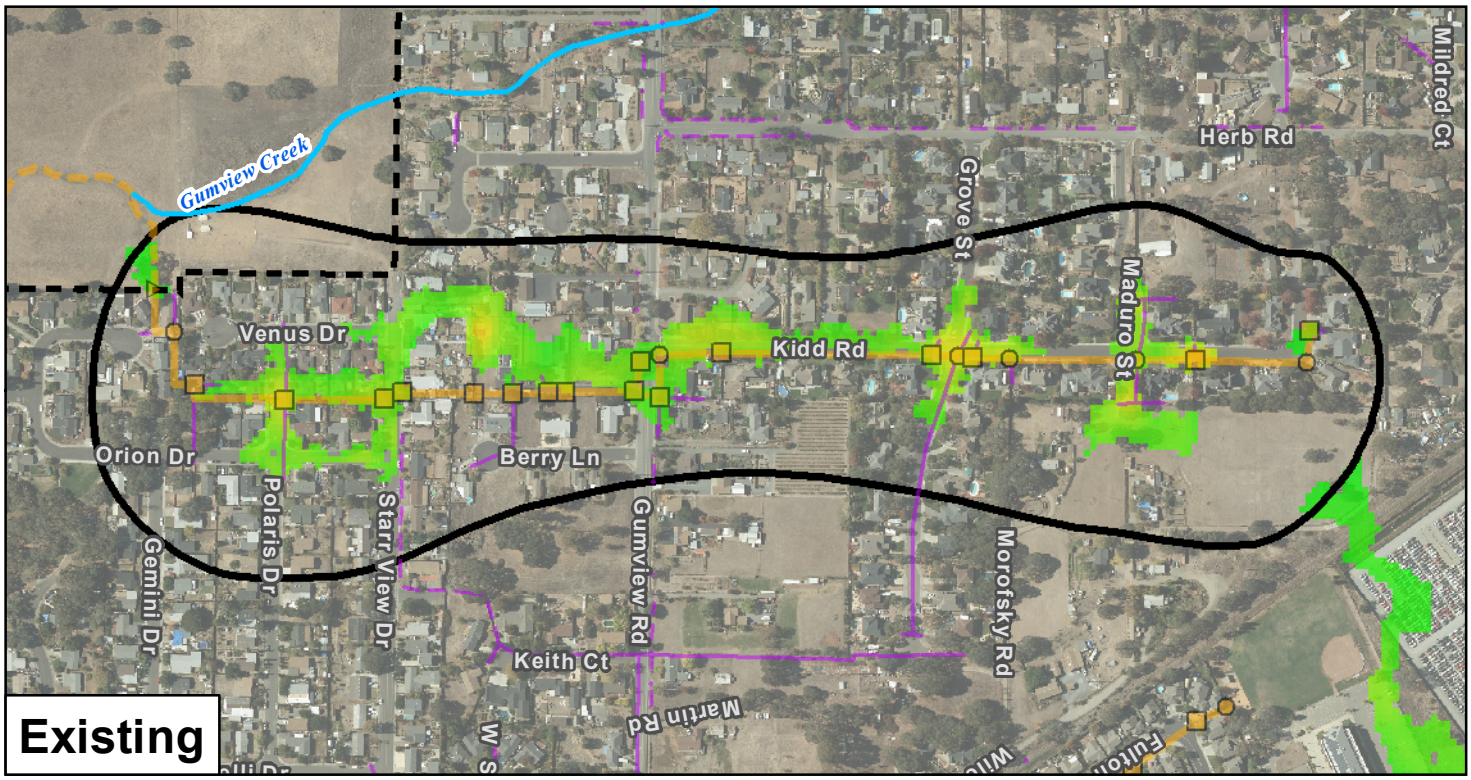
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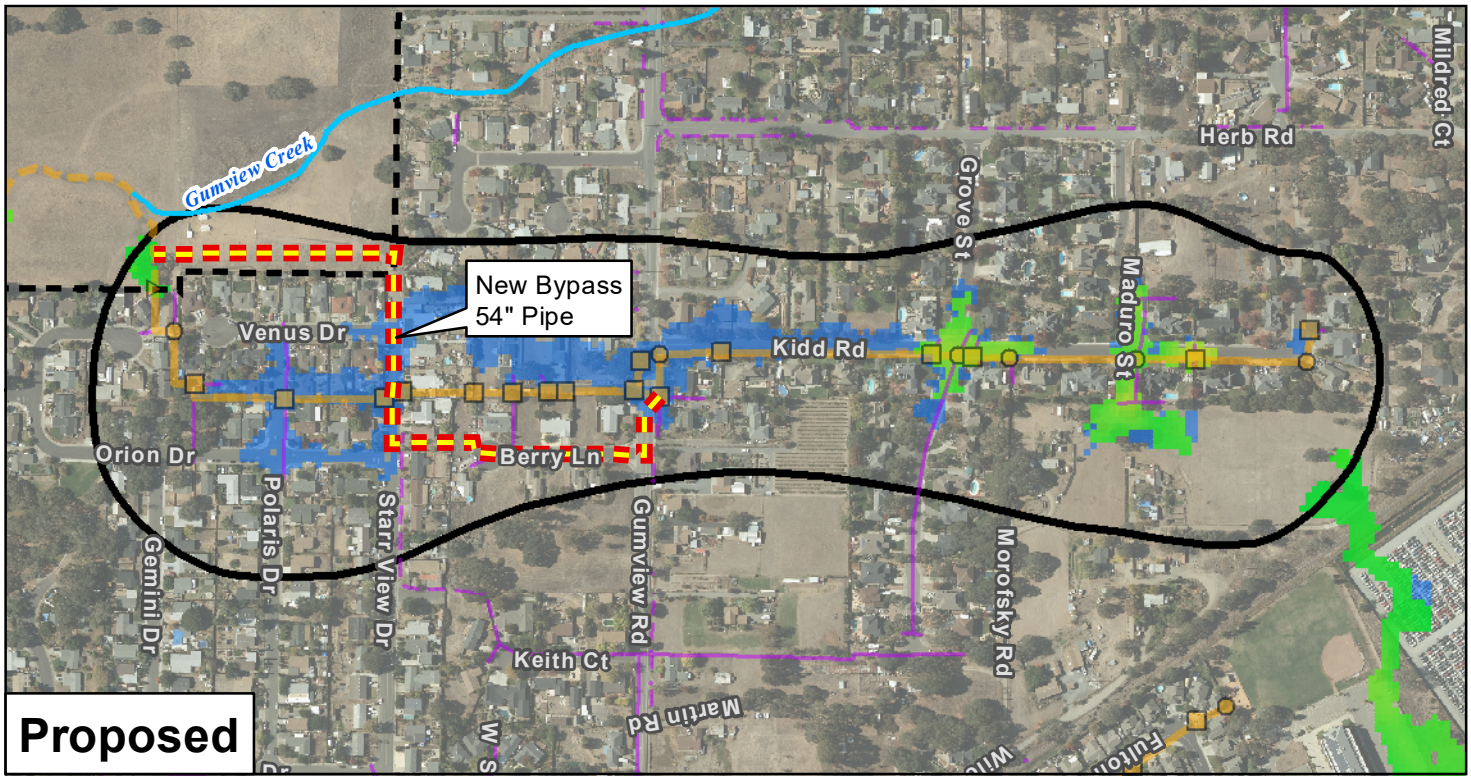
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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 250 500
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Flood and Impacts of SDIP 5

Job Number 11159126
Revision 5
Date 12 Feb 2020

Figure SDIP 5

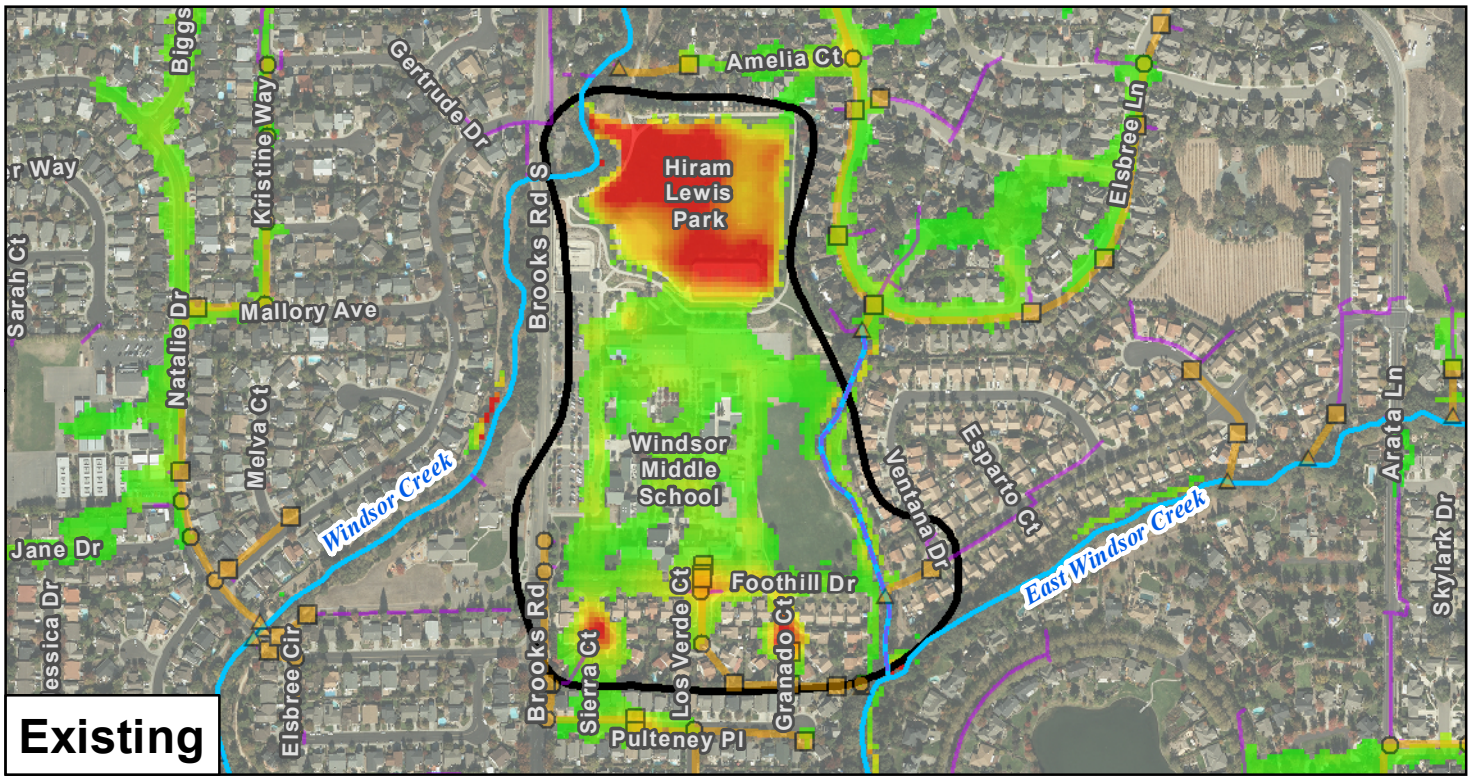
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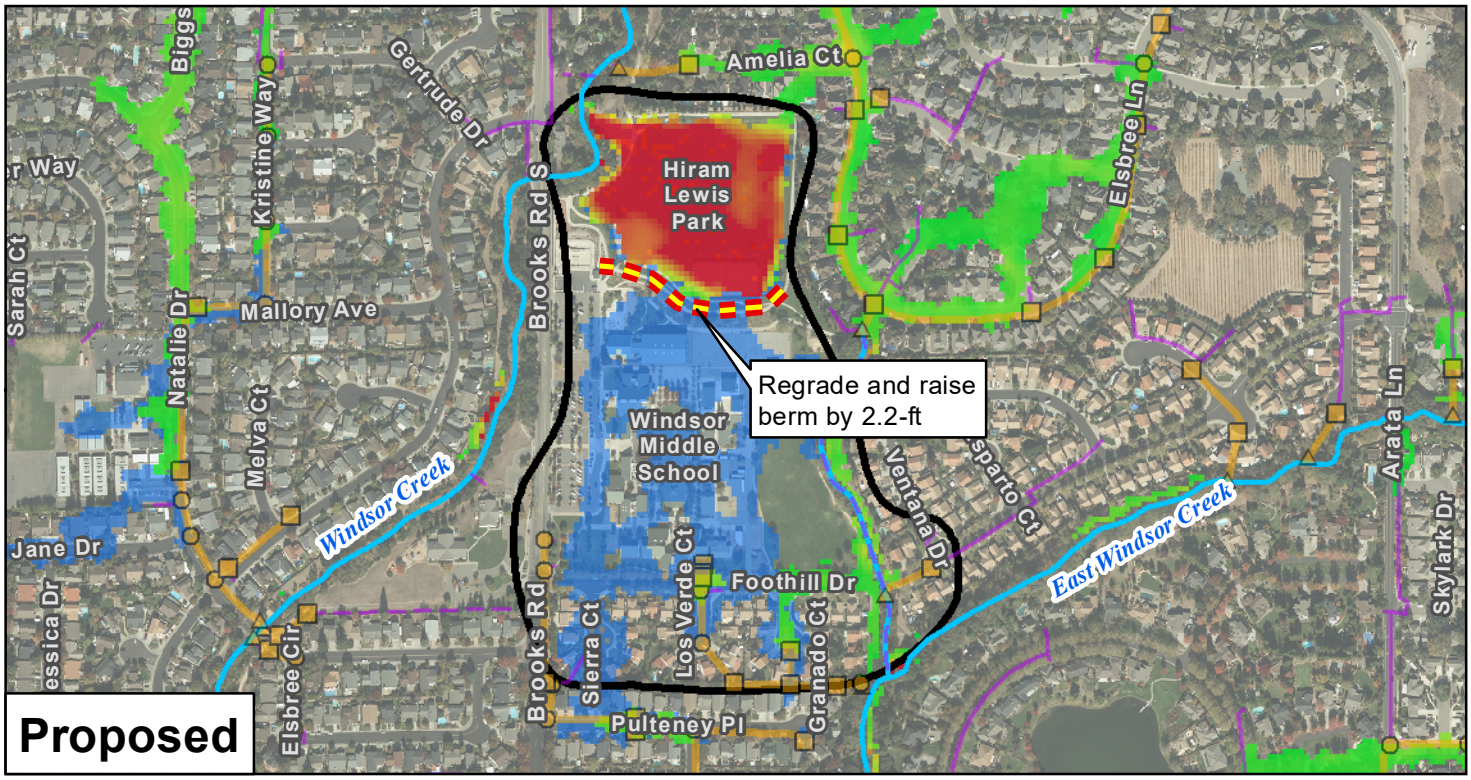
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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 300 600
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Flood and Impacts of SDIP 6

Job Number	11159126
Revision	6
Date	12 Feb 2020

Figure SDIP 6

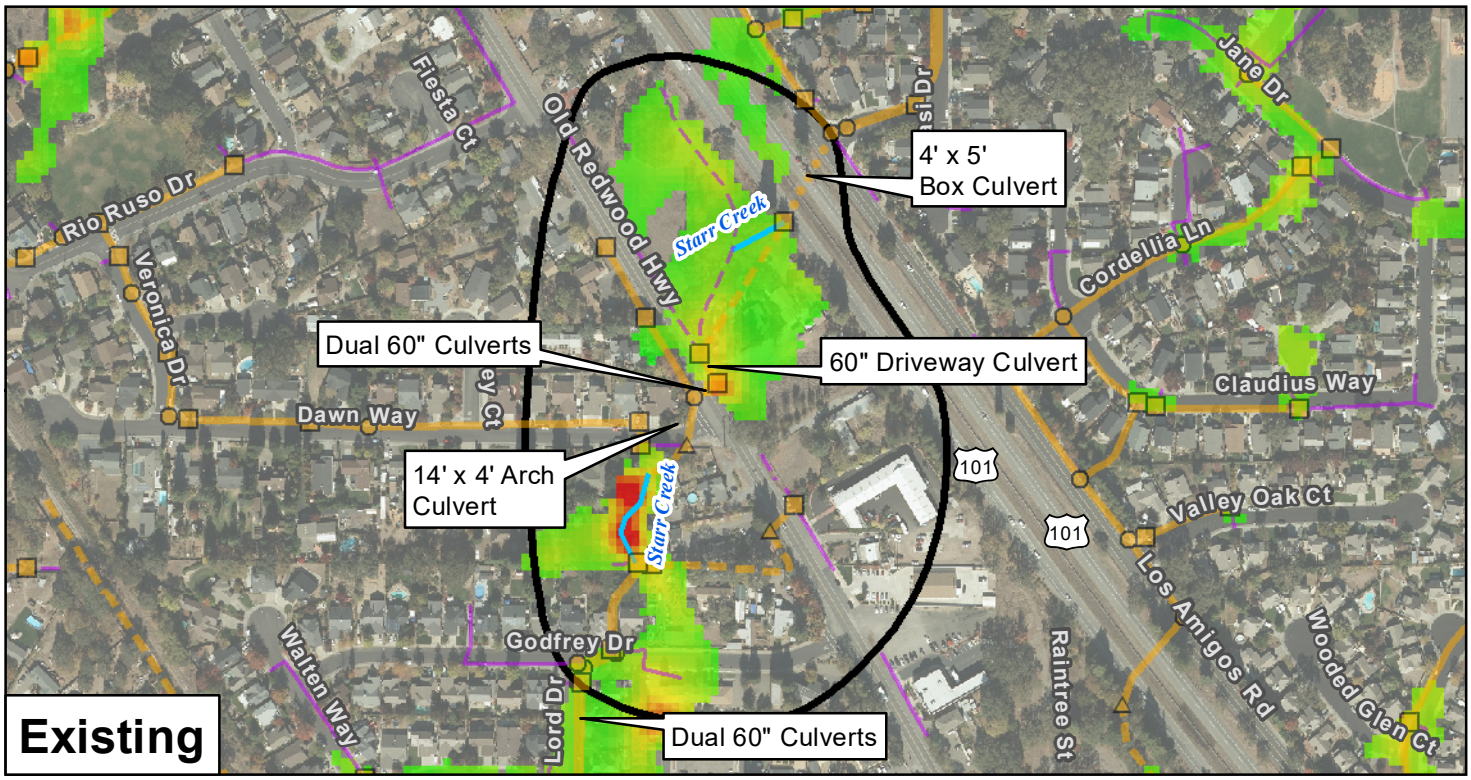
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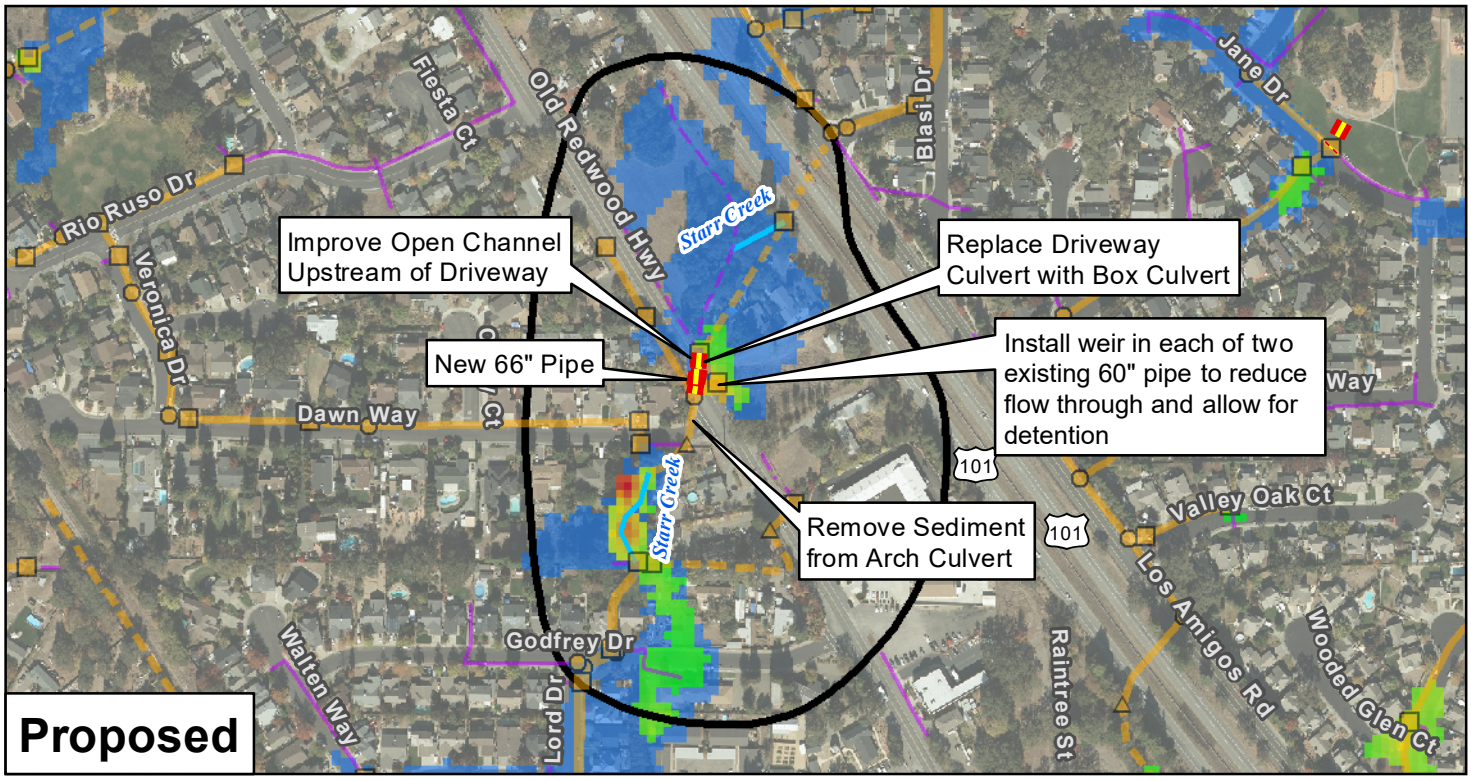
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Data source: Sonoma County GIS, Town Limits, Imagery, Roads, 2013; GHD, Storm Drain System, 2019; GHD, Modeling Results, Modeded Creeks, 2019. USGS, Creeks, 2014. Created by:afisher2

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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 200 400
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Flood and
Impacts of SDIP 8

Job Number 11159126
Revision 6
Date 12 Feb 2020

Figure SDIP 8

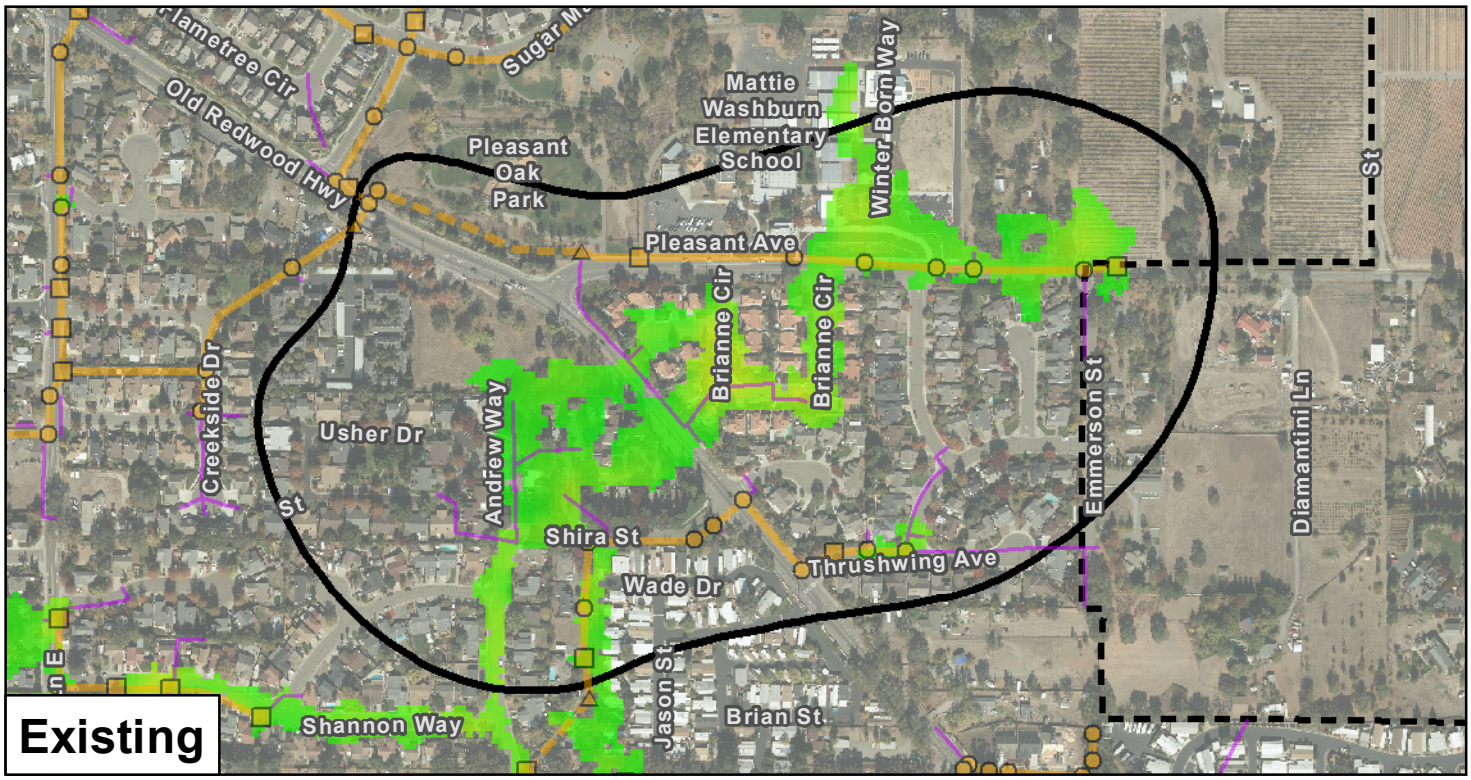
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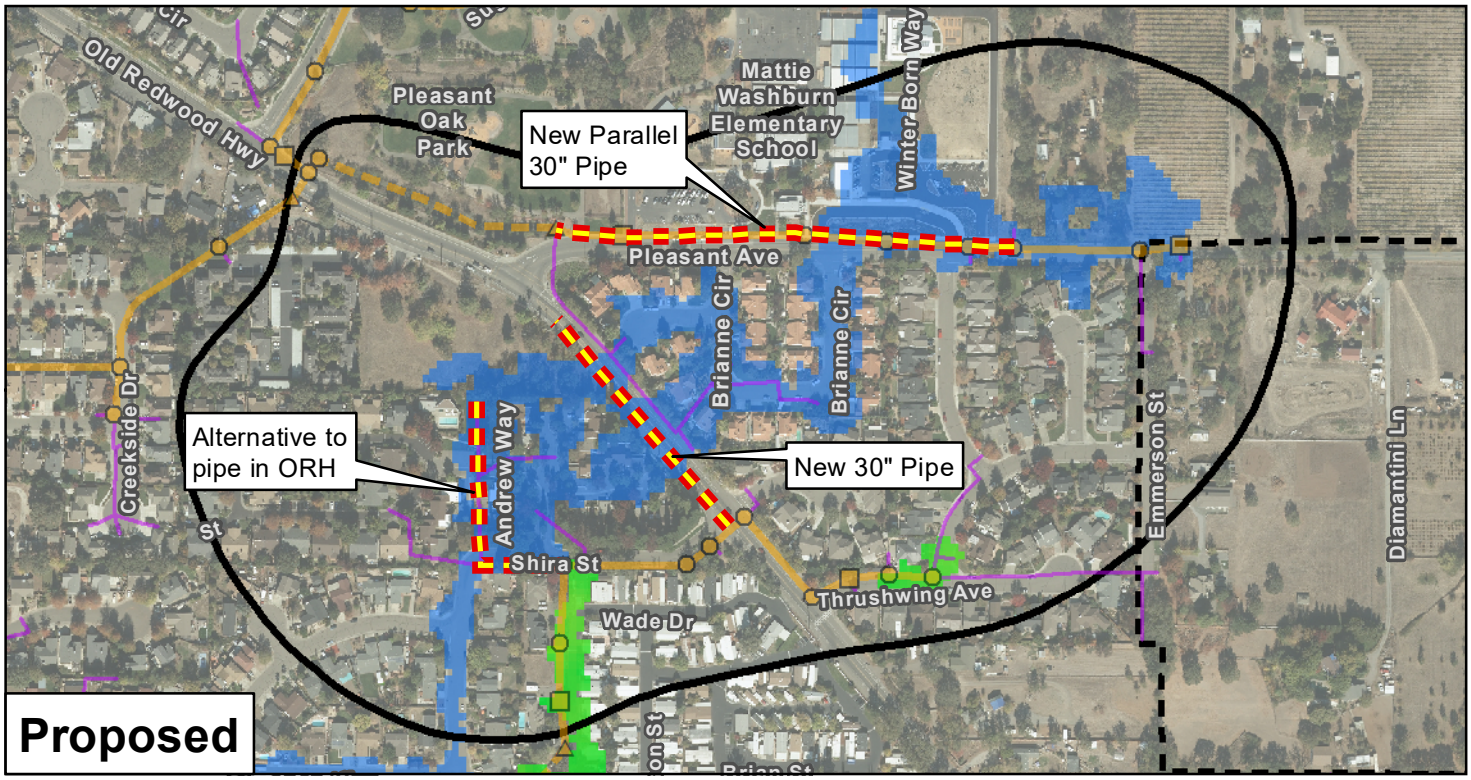
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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 200 400
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Flood and Impacts of SDIP 9

Job Number 11159126
Revision 5
Date 12 Feb 2020

Figure SDIP 9

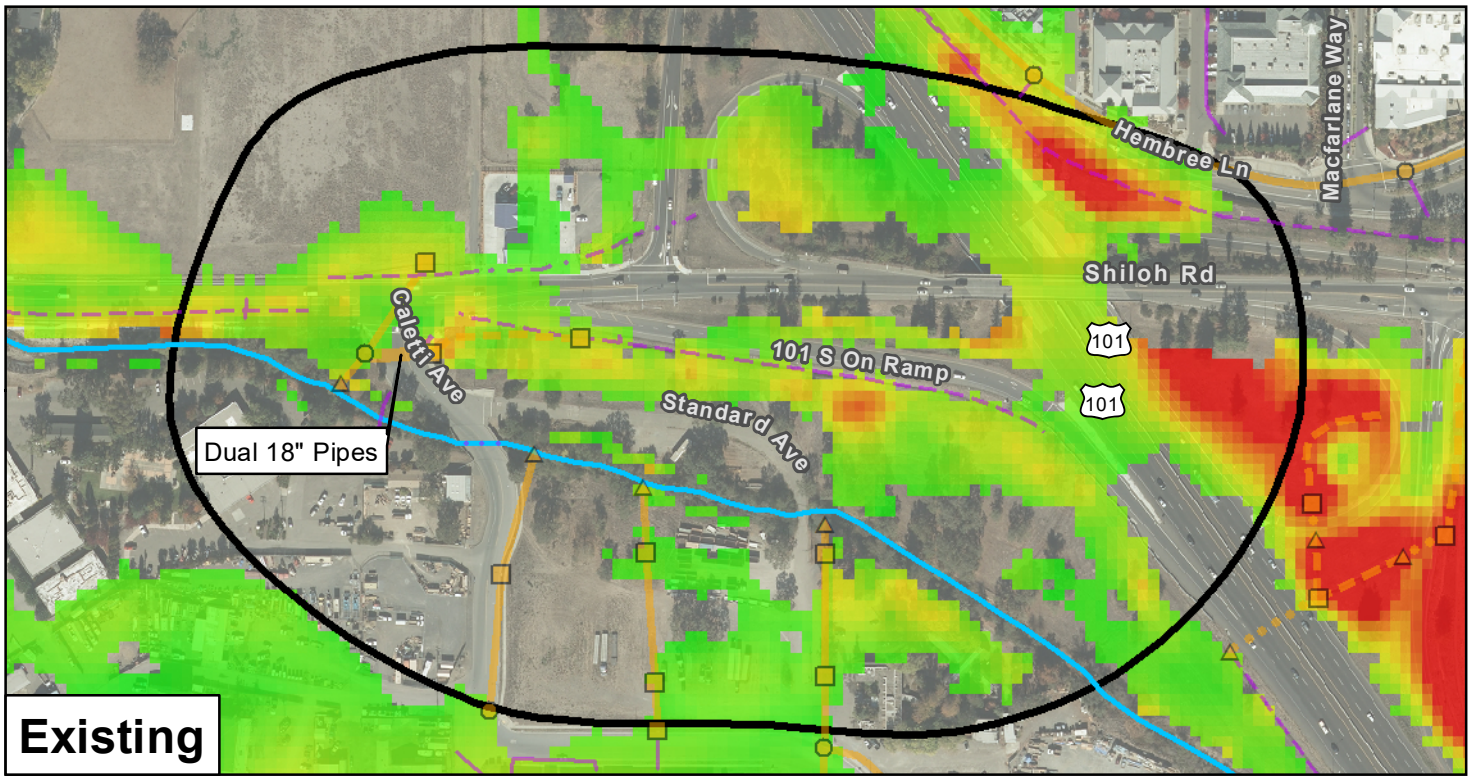
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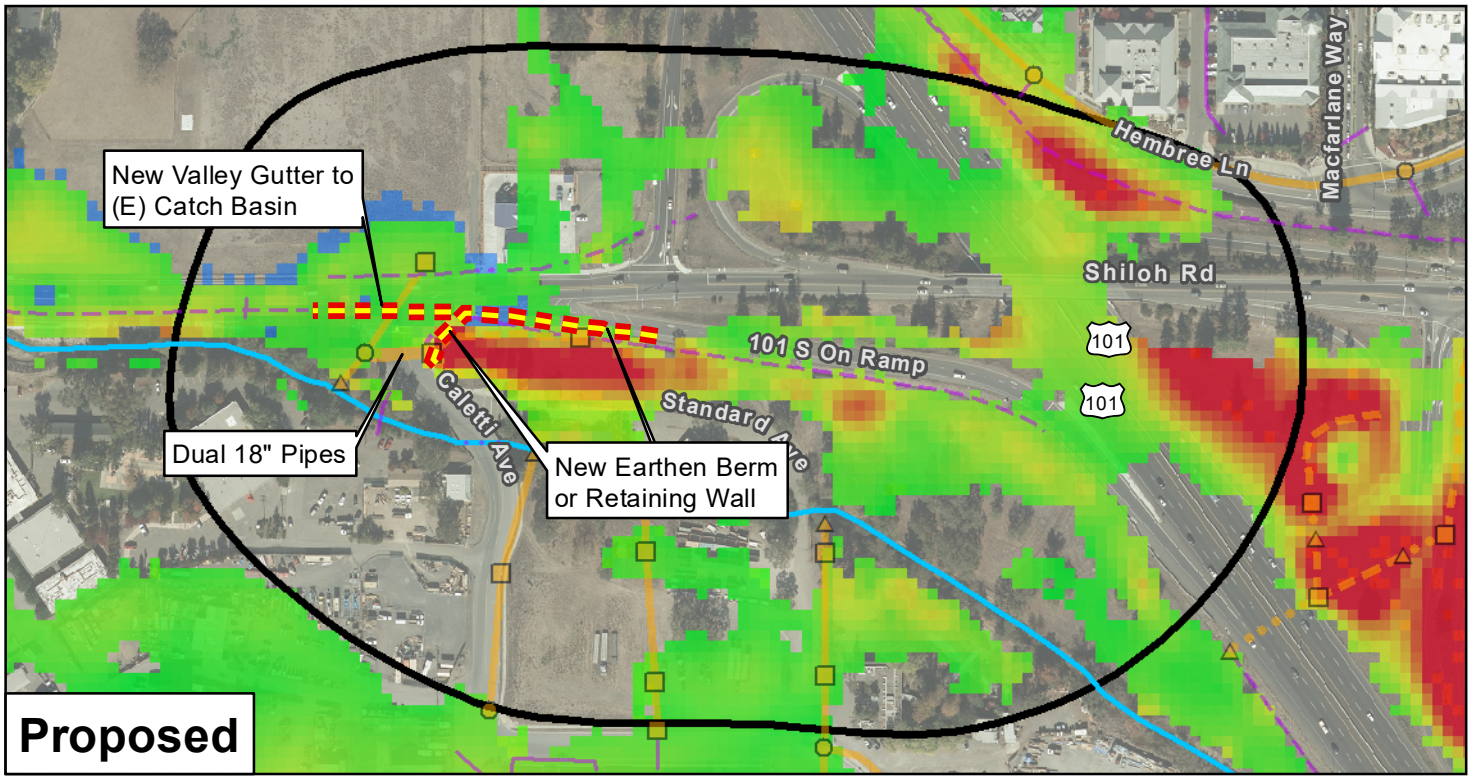
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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 150 300
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Flood and
Impacts of SDIP 11

Job Number 11159126
Revision 5
Date 12 Feb 2020

Figure SDIP 11

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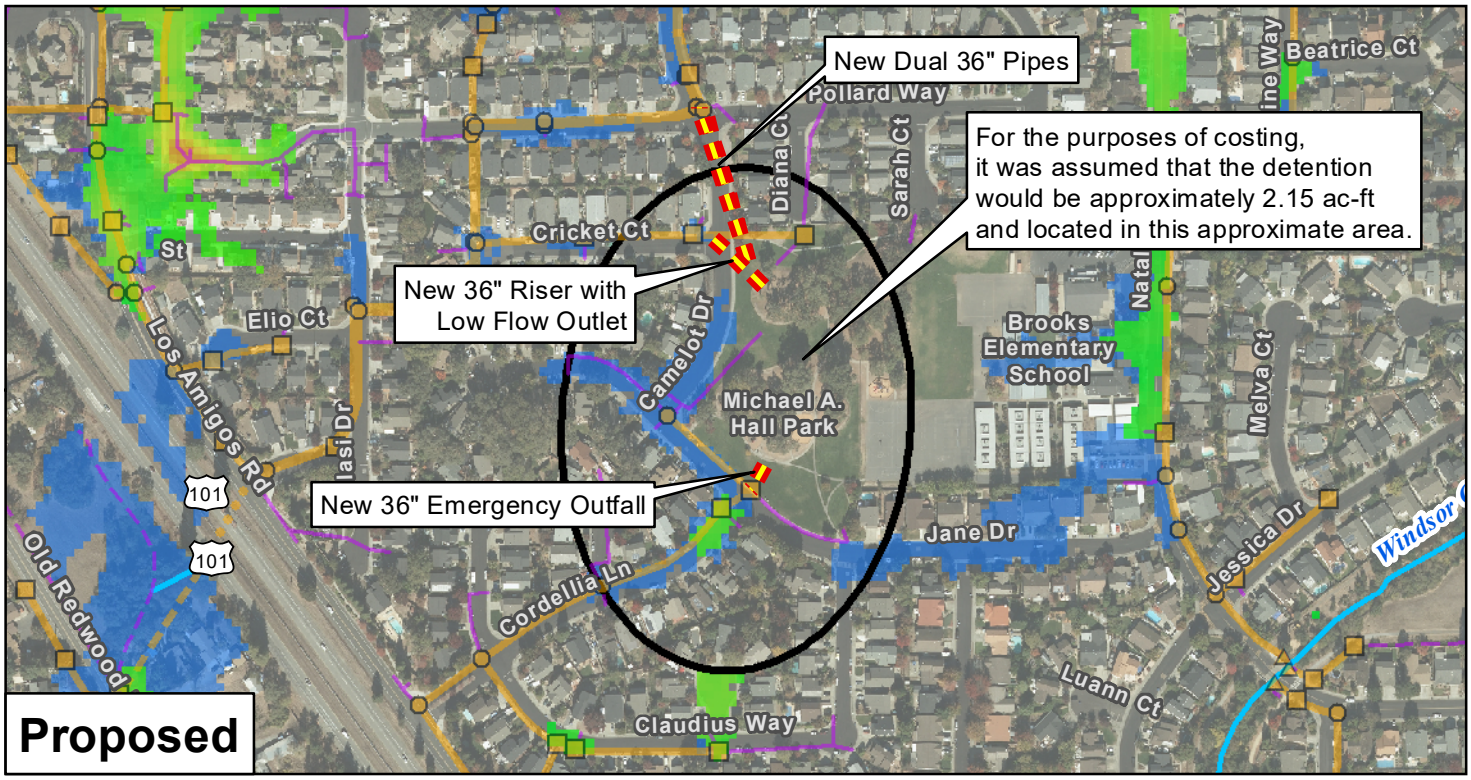
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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 200 400
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

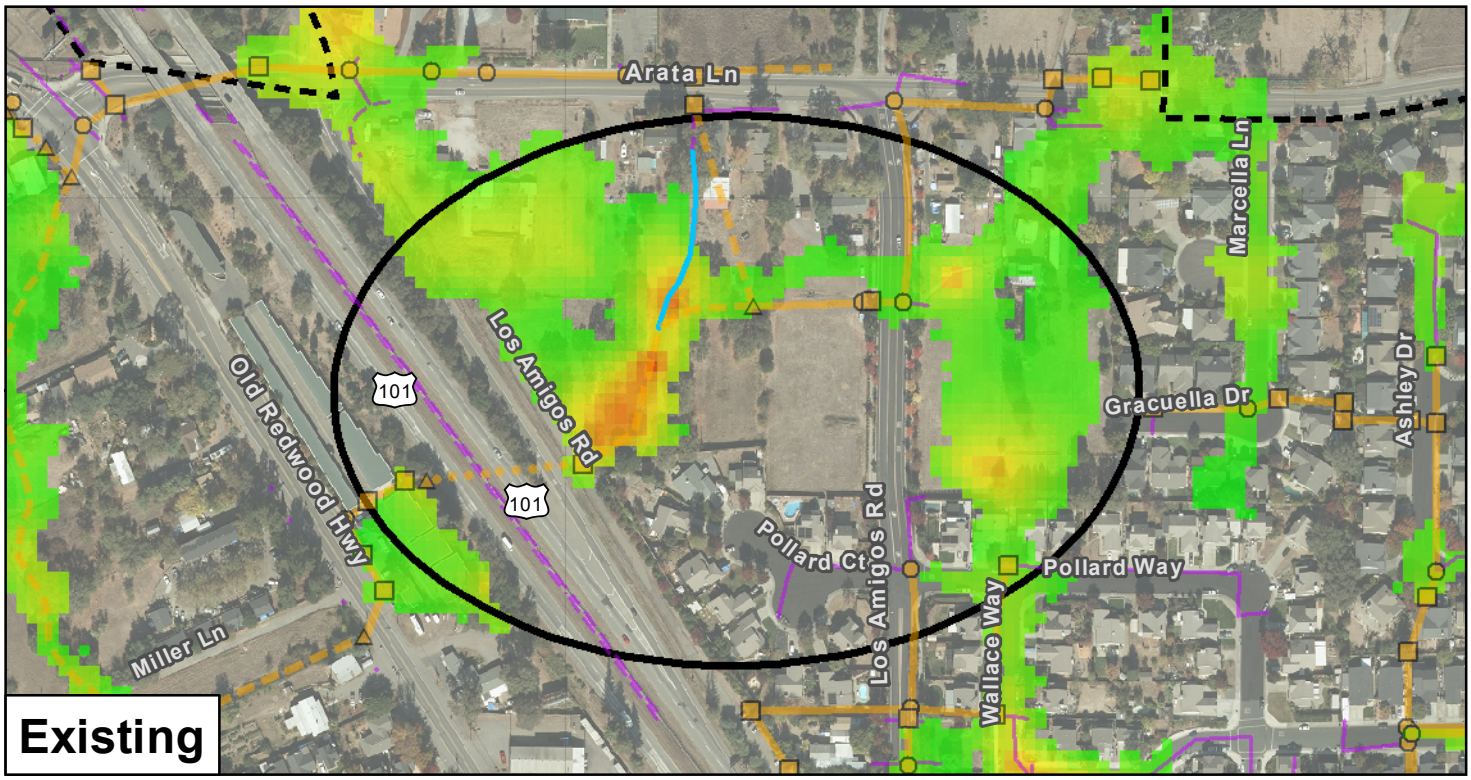
100 Year Flood and Impacts of SDIP 12

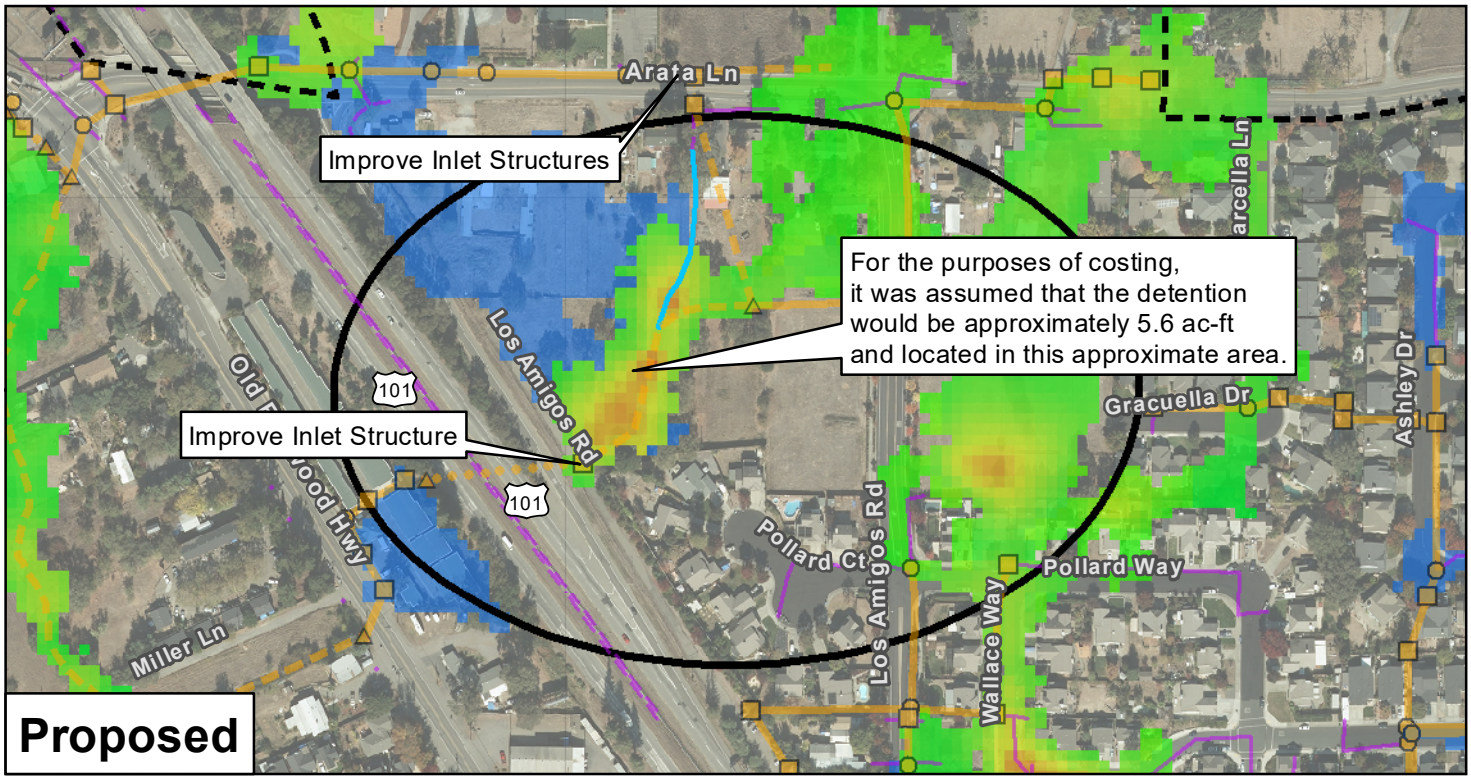
Job Number 11159126
Revision 2
Date 12 Feb 2020

Figure SDIP 12

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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 150 300
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Flood and
Impacts of SDIP 13

Job Number 11159126
Revision 2
Date 12 Feb 2020

Figure SDIP 13

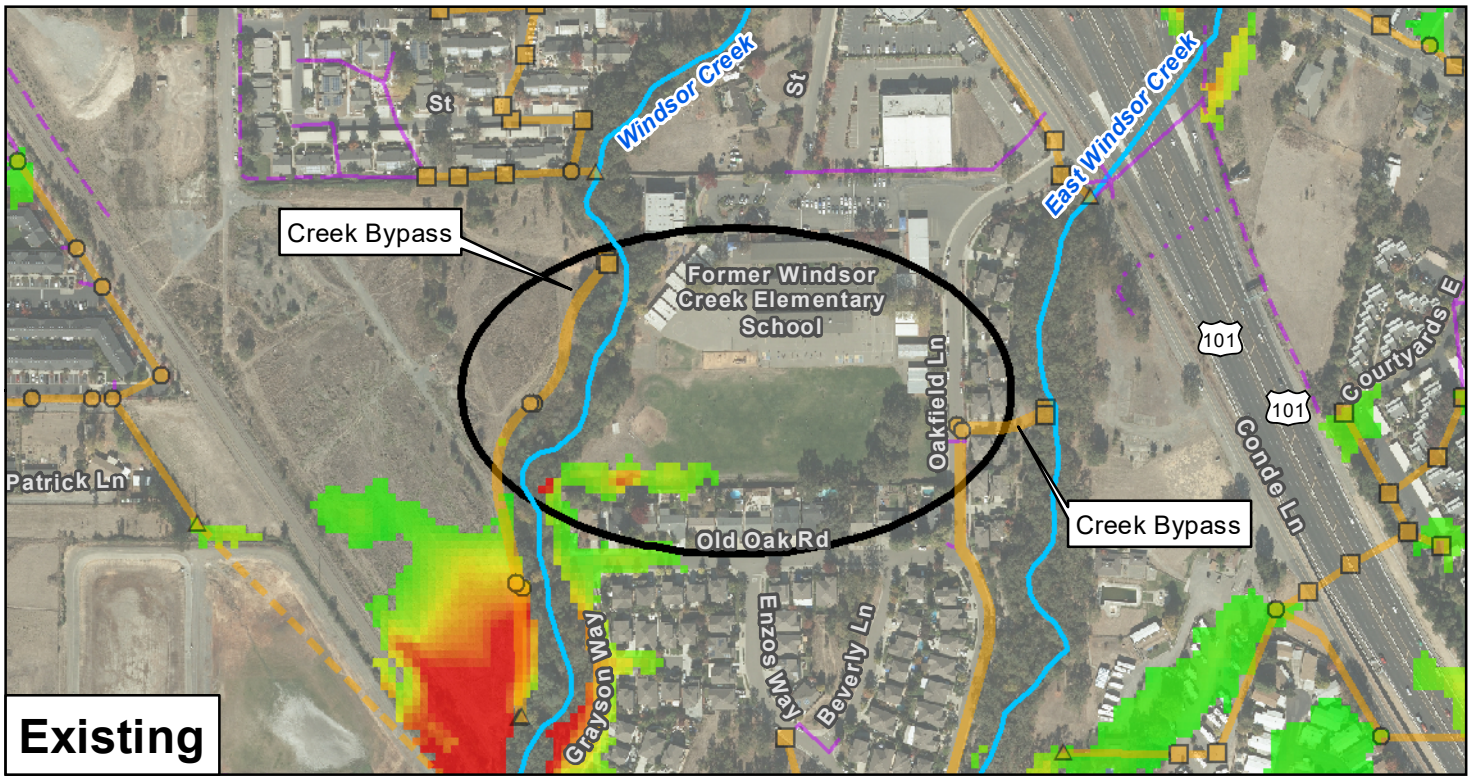
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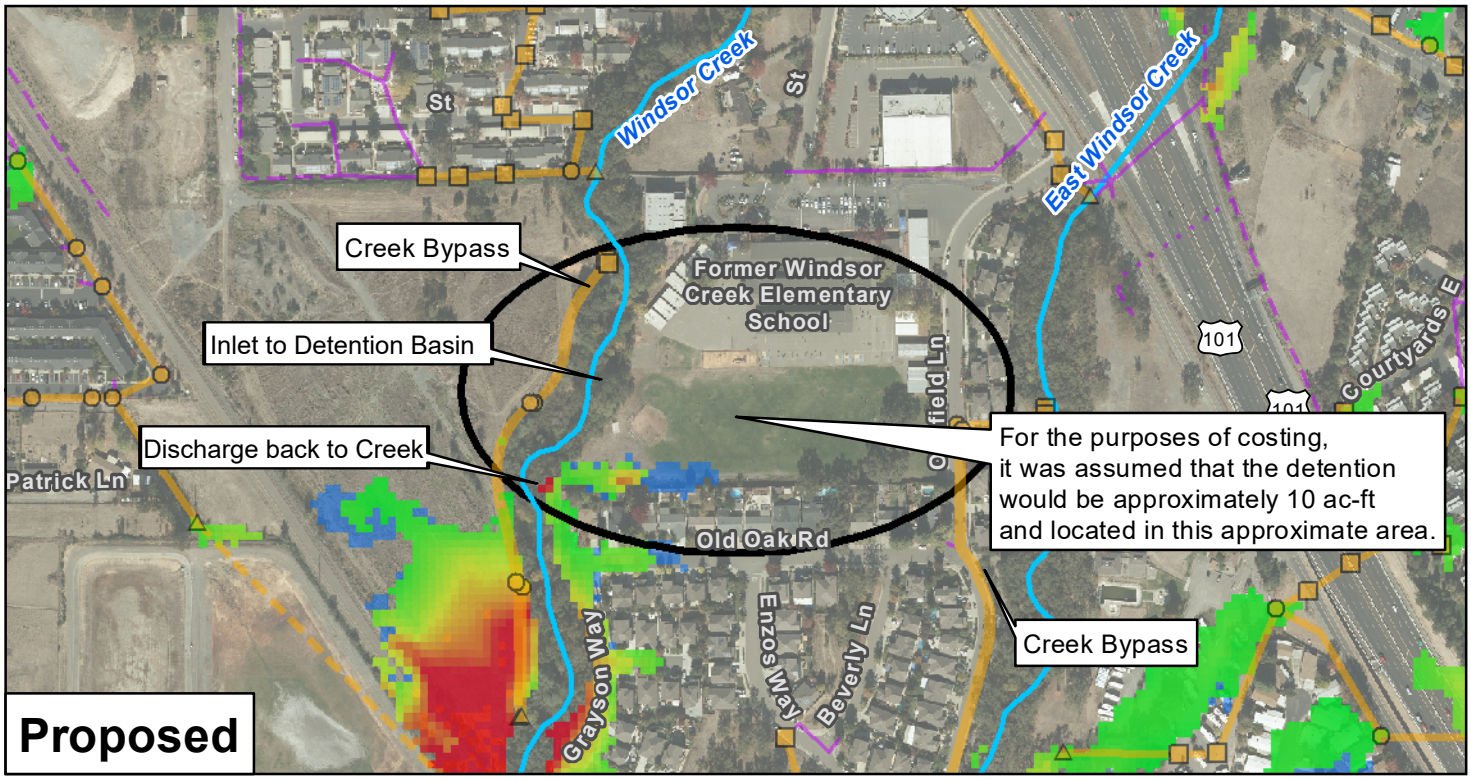
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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 200 400
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

100 Year Flood and Impacts of SDIP 14

Job Number 11159126
Revision 2
Date 12 Feb 2020

Figure SDIP 14

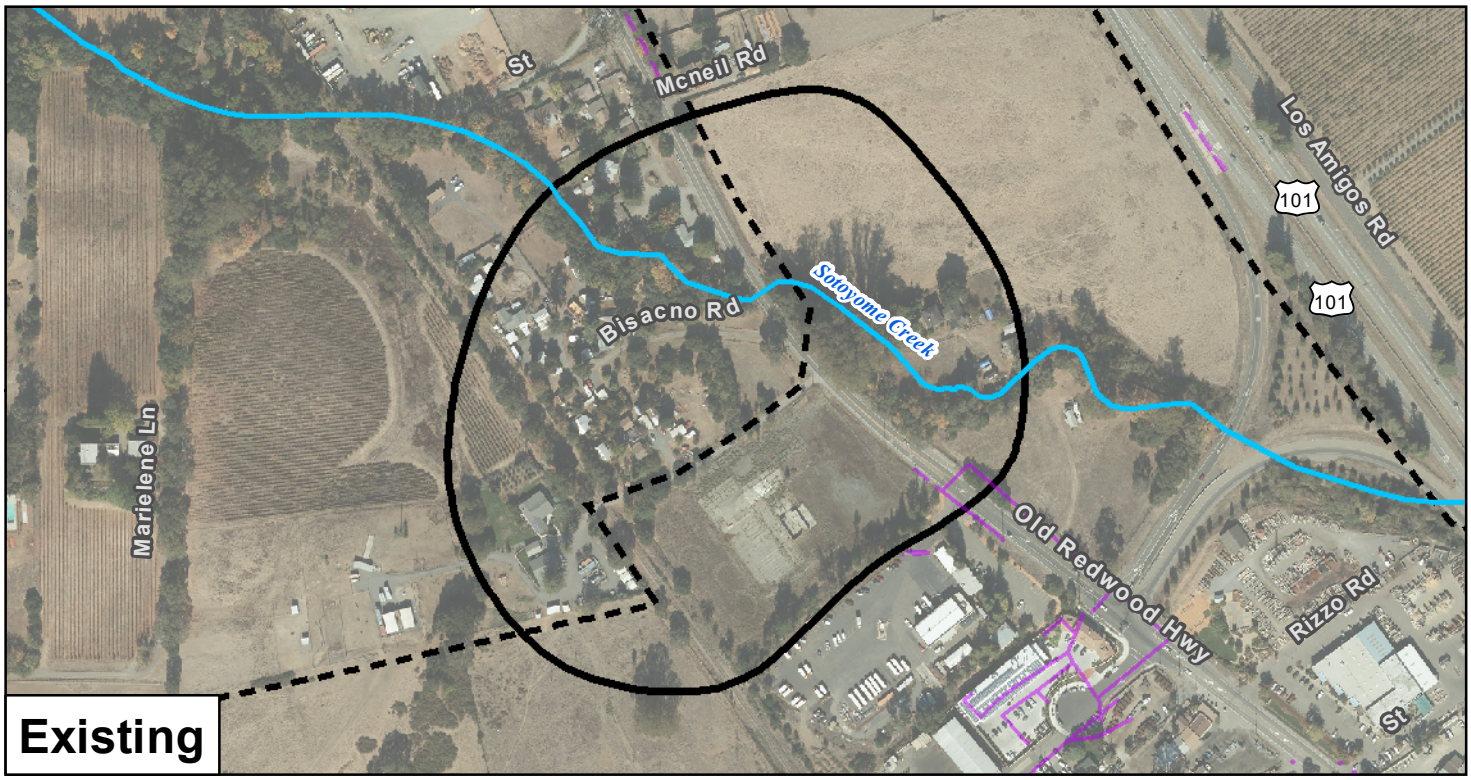
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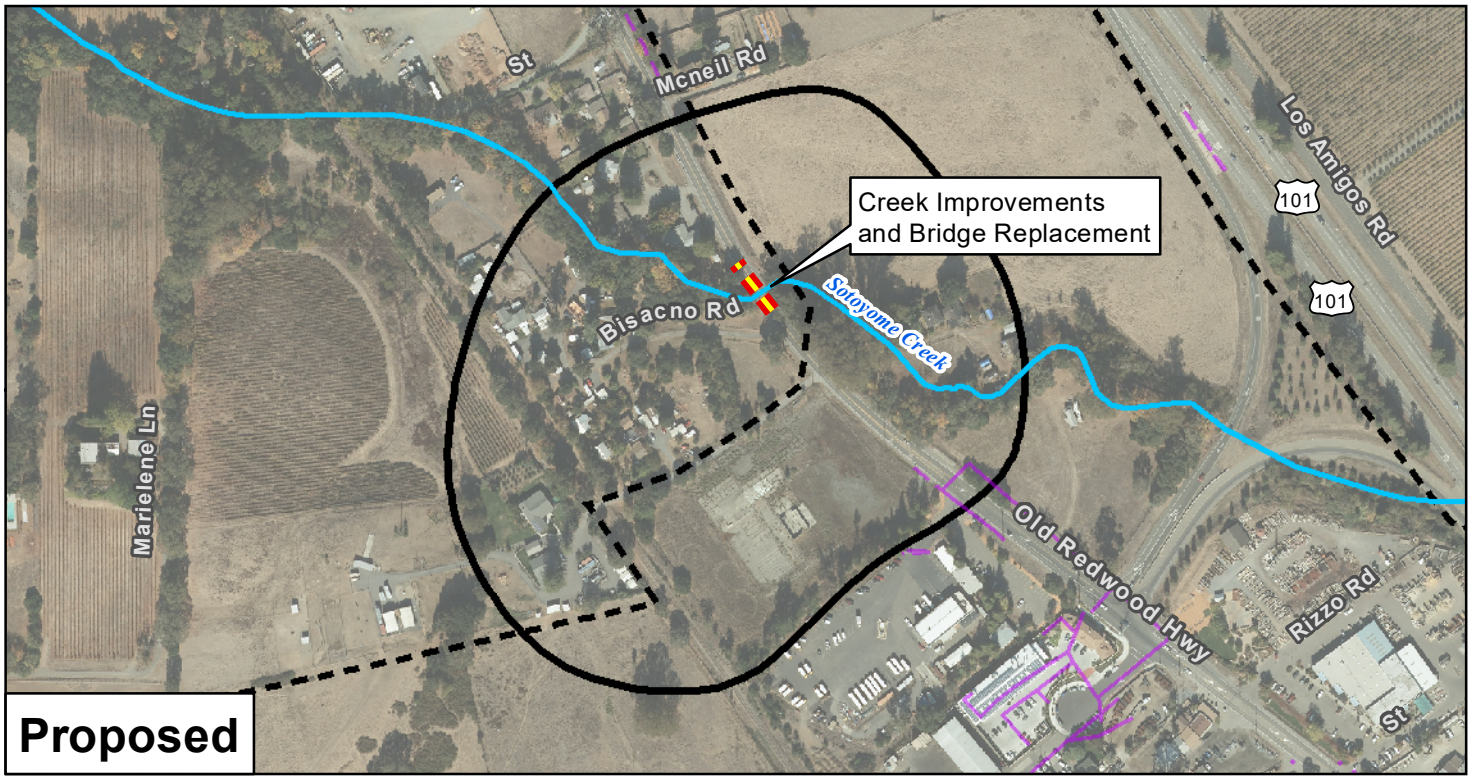
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Existing



Proposed

Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Value
> 2
> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 200 400
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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Town of Windsor
Storm Drainage Master Plan

100 Year Future Flood and Impacts of Future SDIP 1

Job Number 11159126
Revision 4
Date 12 Feb 2020

Figure F-SDIP 1

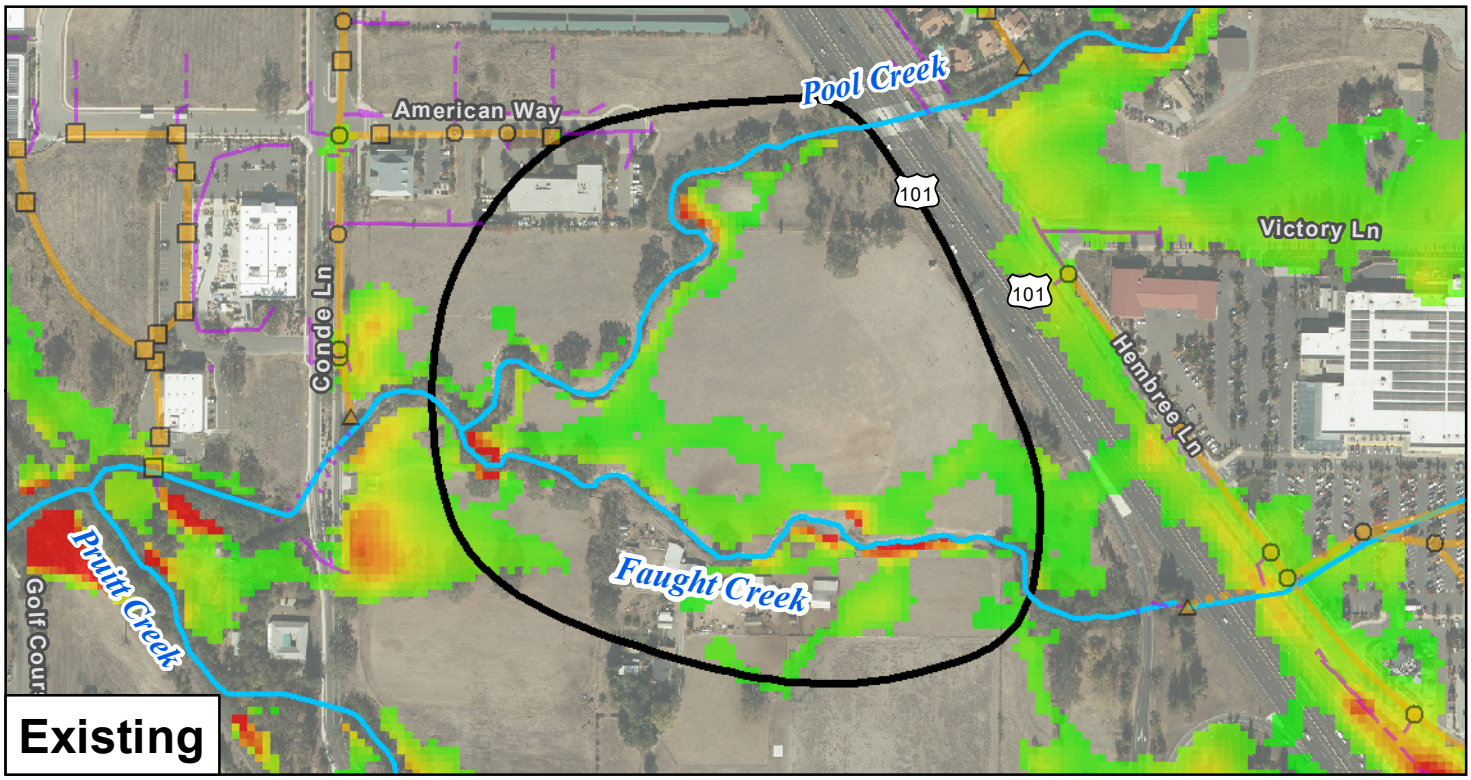
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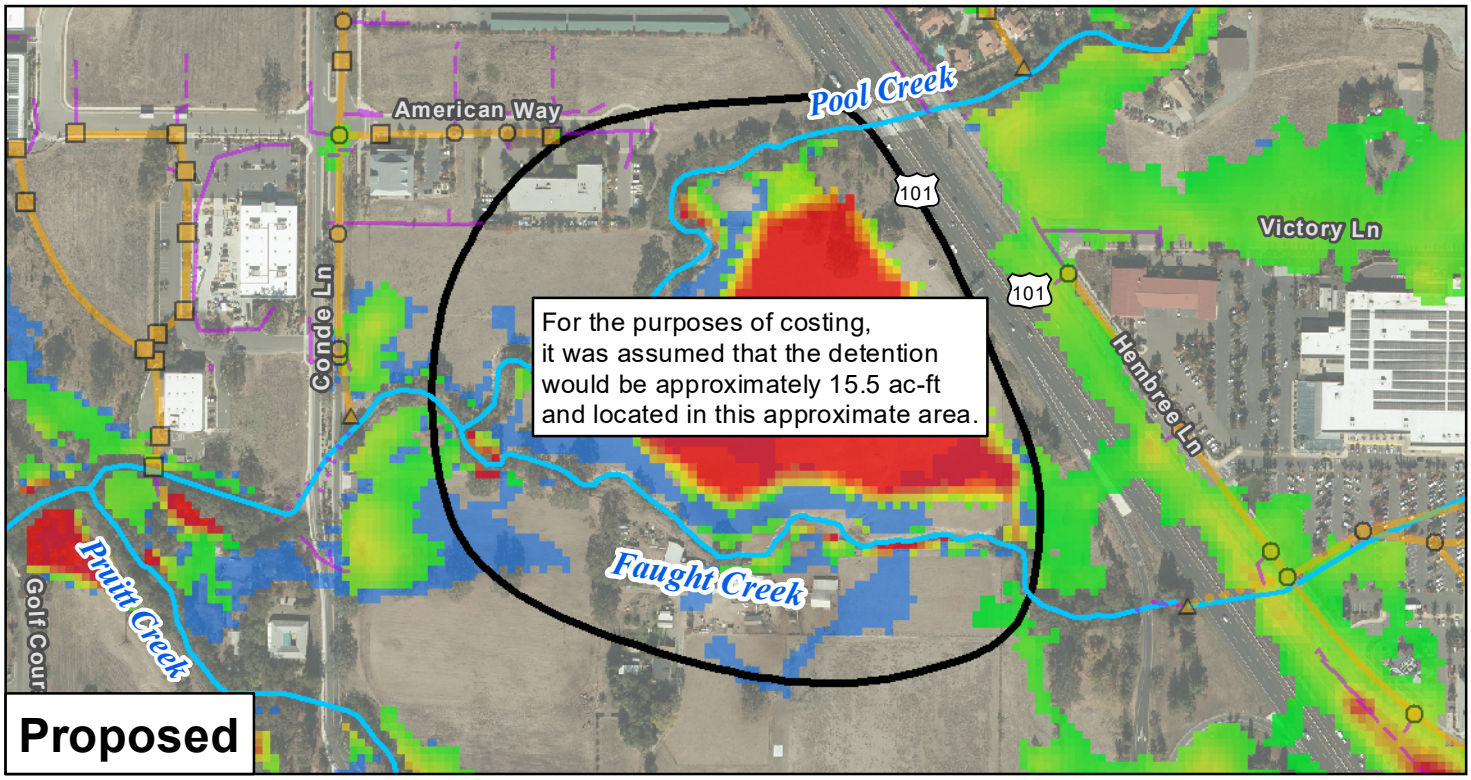
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Existing



Proposed

Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)
> 2
> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 200 400
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Future Flood and Impacts of Future SDIP 3

Job Number 11159126
Revision 5
Date 12 Feb 2020

Figure F-SDIP 3

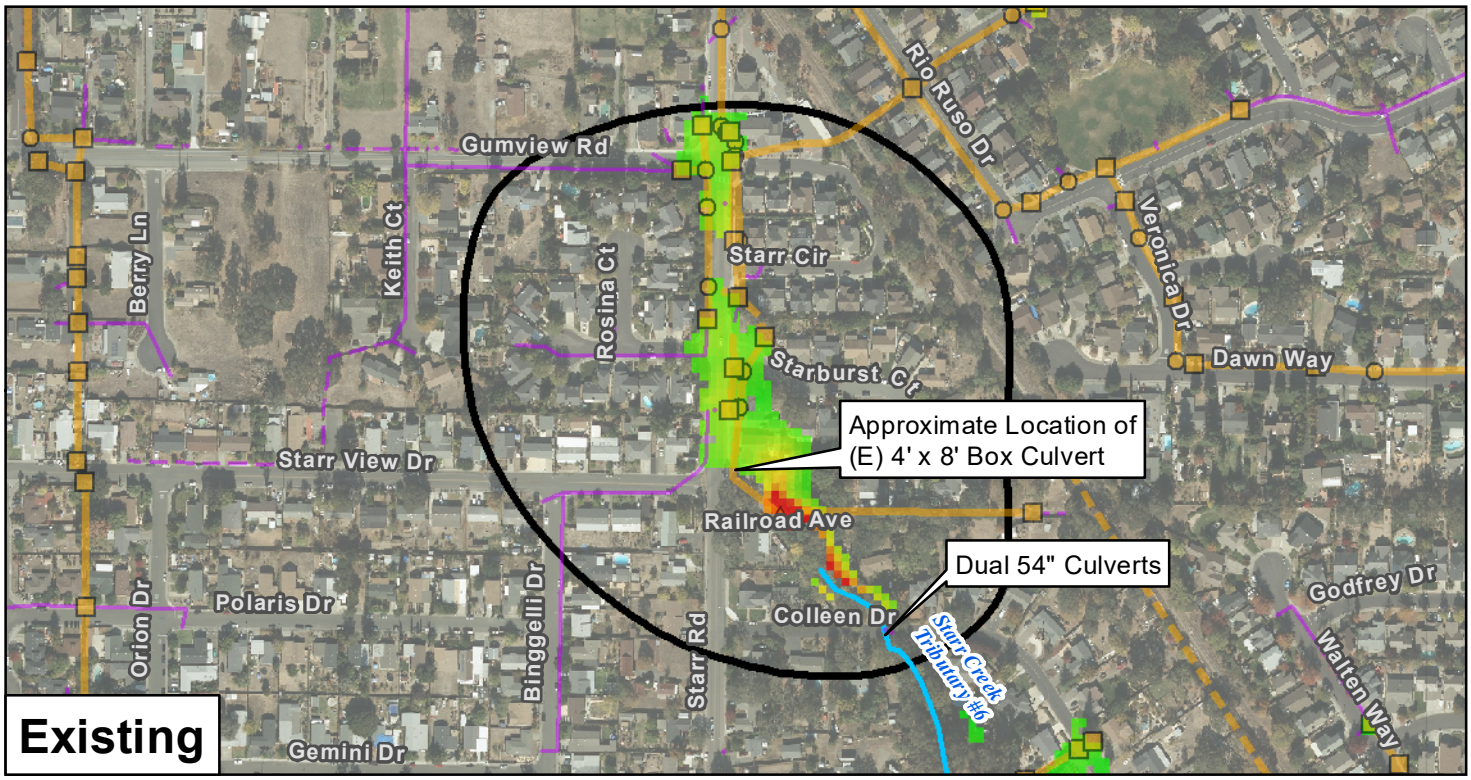
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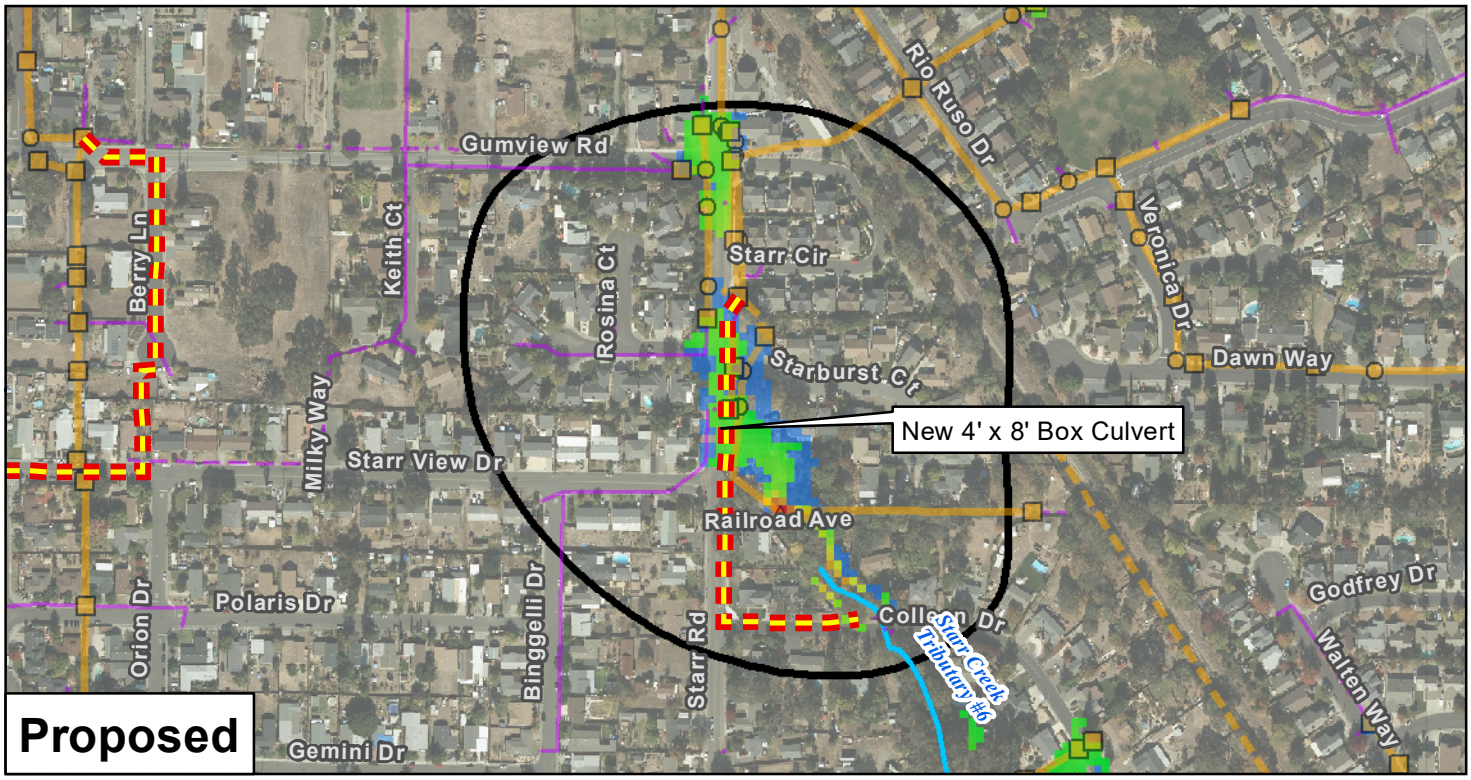
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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 200 400
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

100 Year Future Flood and Impacts of Future SDIP 4

Job Number 11159126
Revision 6
Date 12 Feb 2020

Figure F-SDIP 4

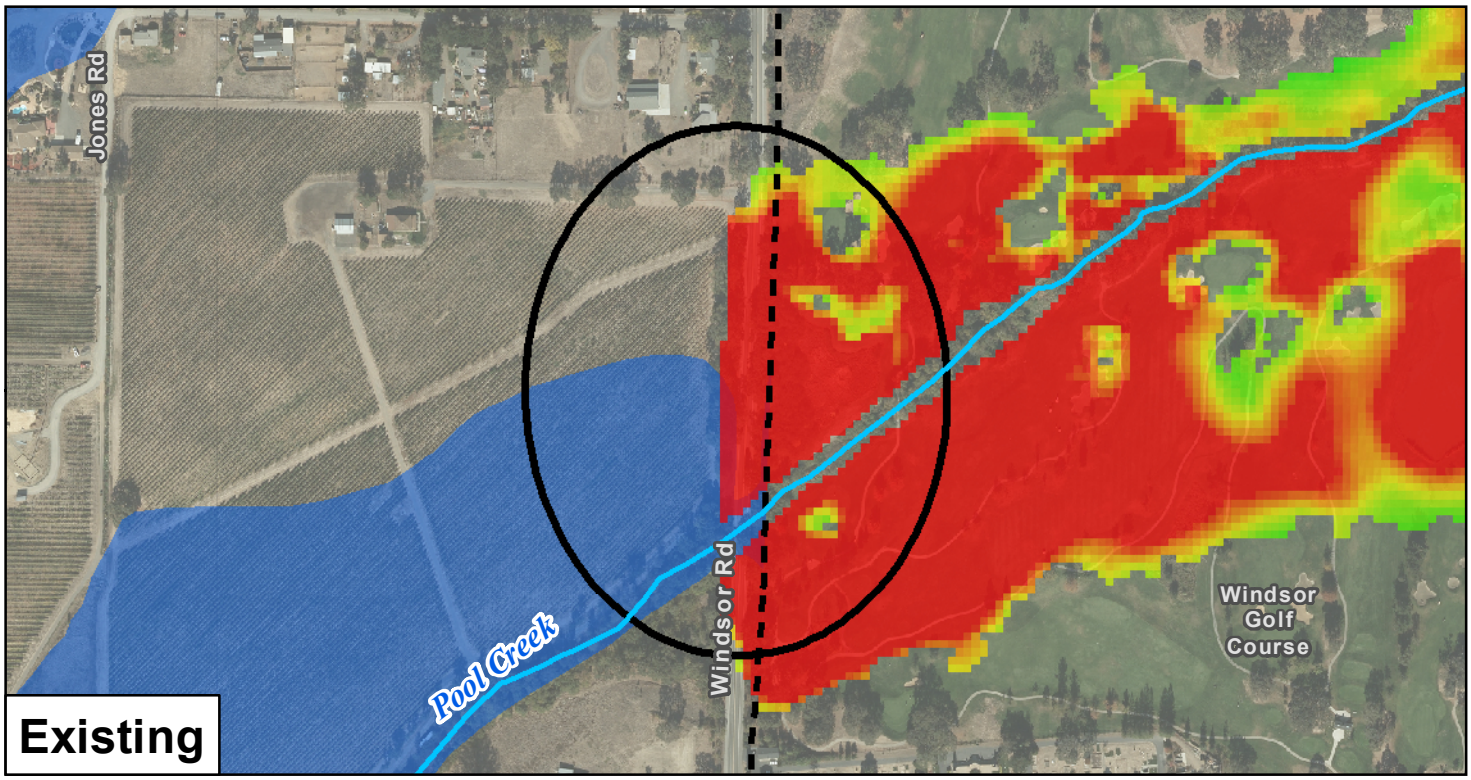
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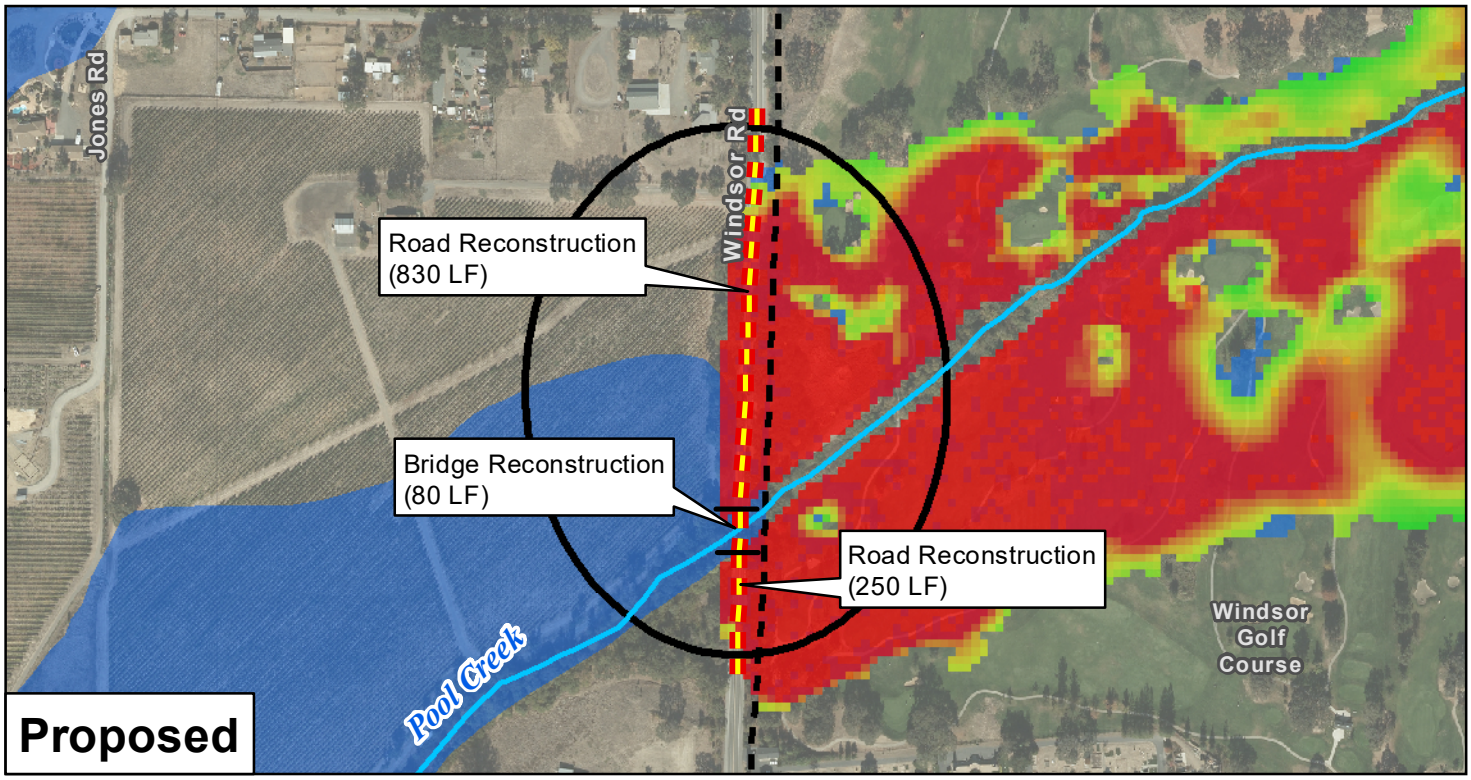
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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)
> 2
> 0

SDIP Project
FEMA 100 Year Flood Zone
(Outside Model Extents)

Paper Size 8.5" x 11" (ANSI A)
0 200 400
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Future Flood and Impacts of Future SDIP 5

Job Number 11159126
Revision 2
Date 13 Feb 2020

Figure F-SDIP 5

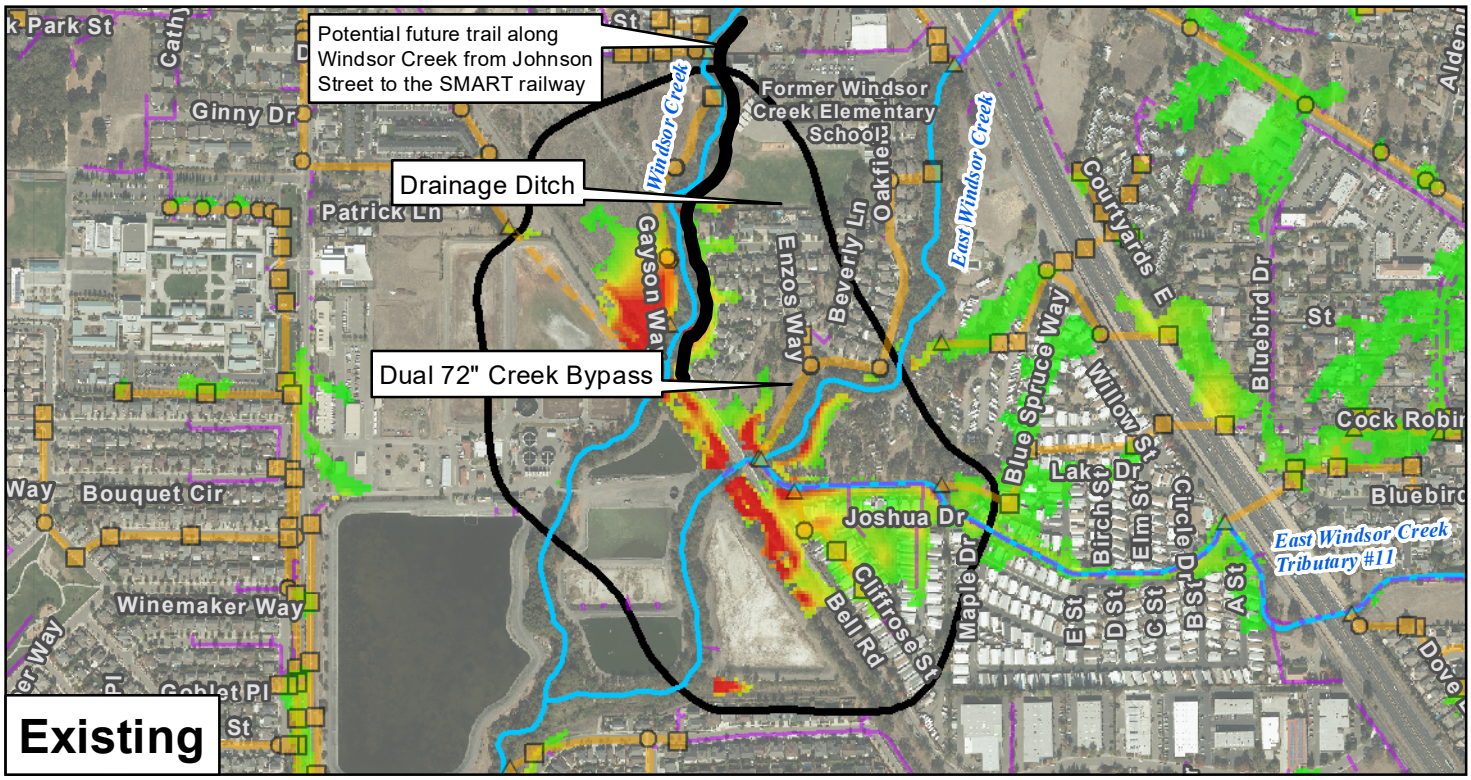
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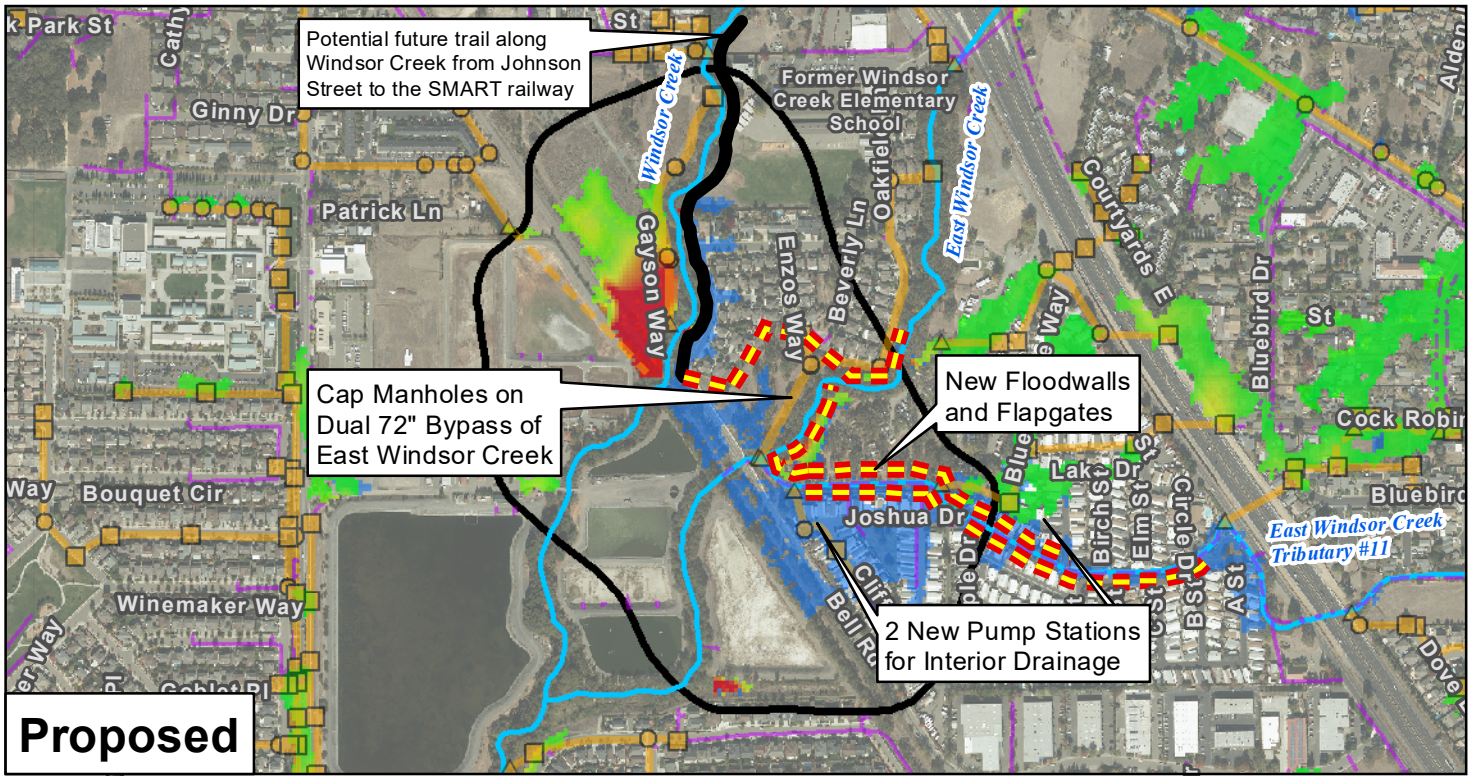
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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 200 400 600 800
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Future Flood and Impacts of Future SDIP 6

Job Number 11159126
Revision 7
Date 12 Feb 2020

Figure F-SDIP 6

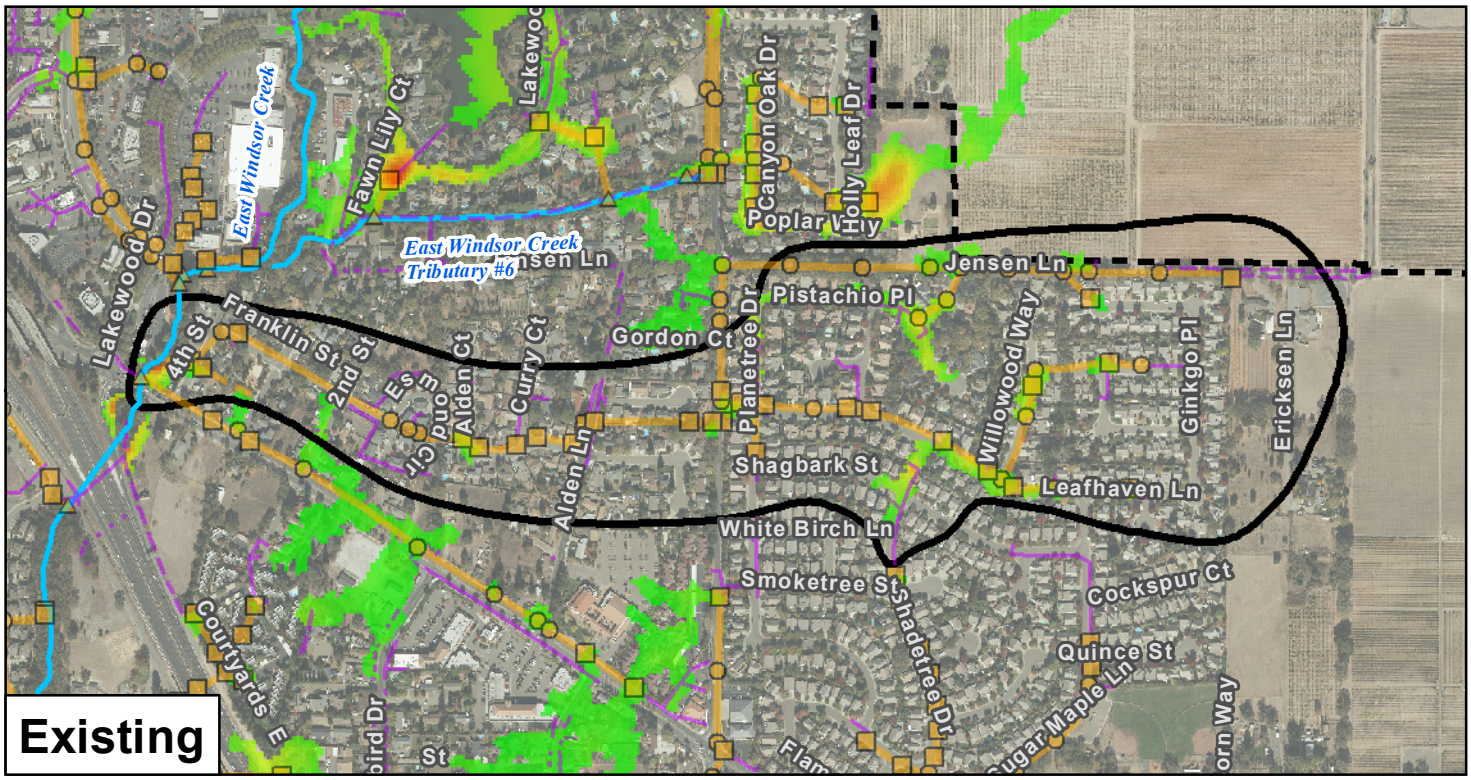
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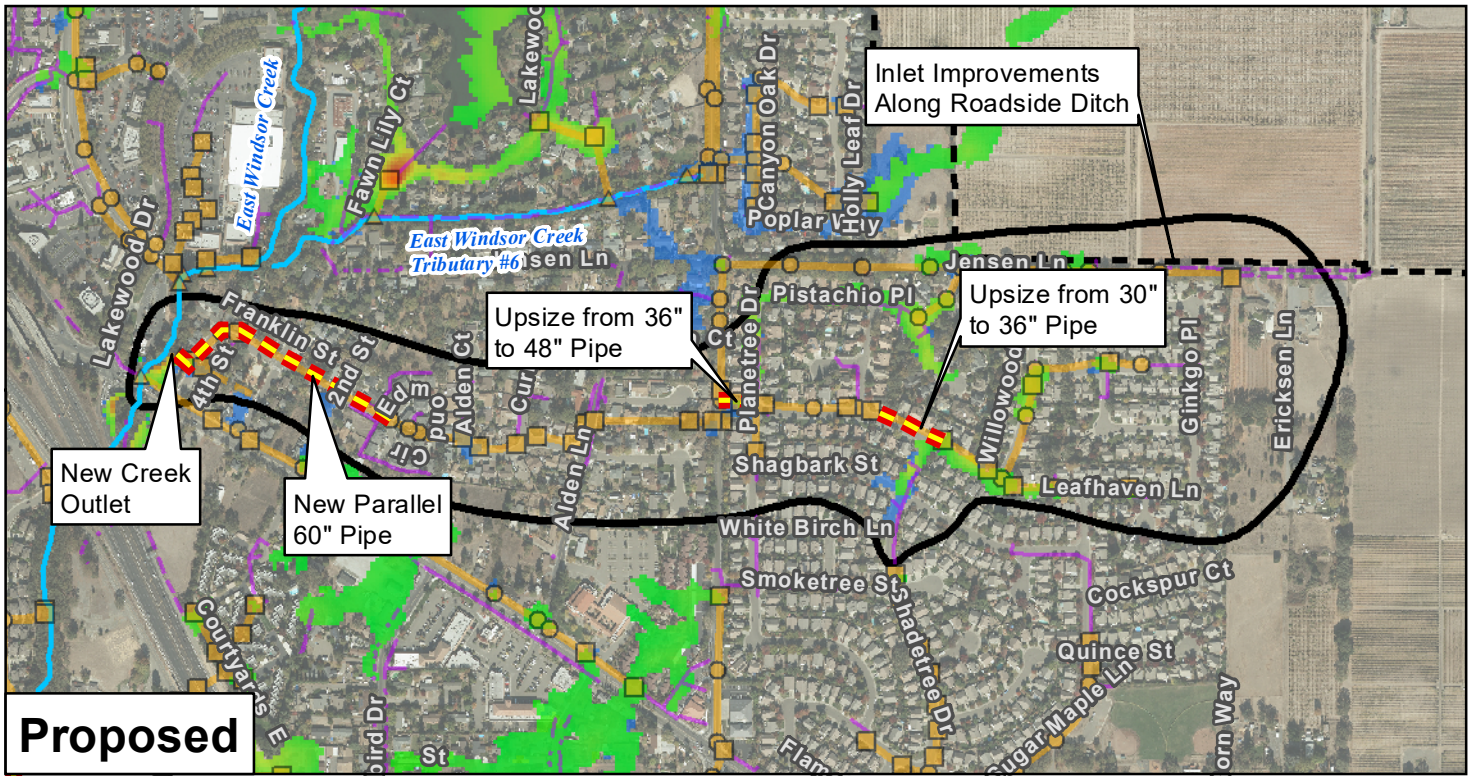
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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 200 400
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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GHD ESA TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Future Flood and Impacts of Future SDIP 7

Job Number 11159126
Revision 5
Date 12 Feb 2020

Figure F-SDIP 7

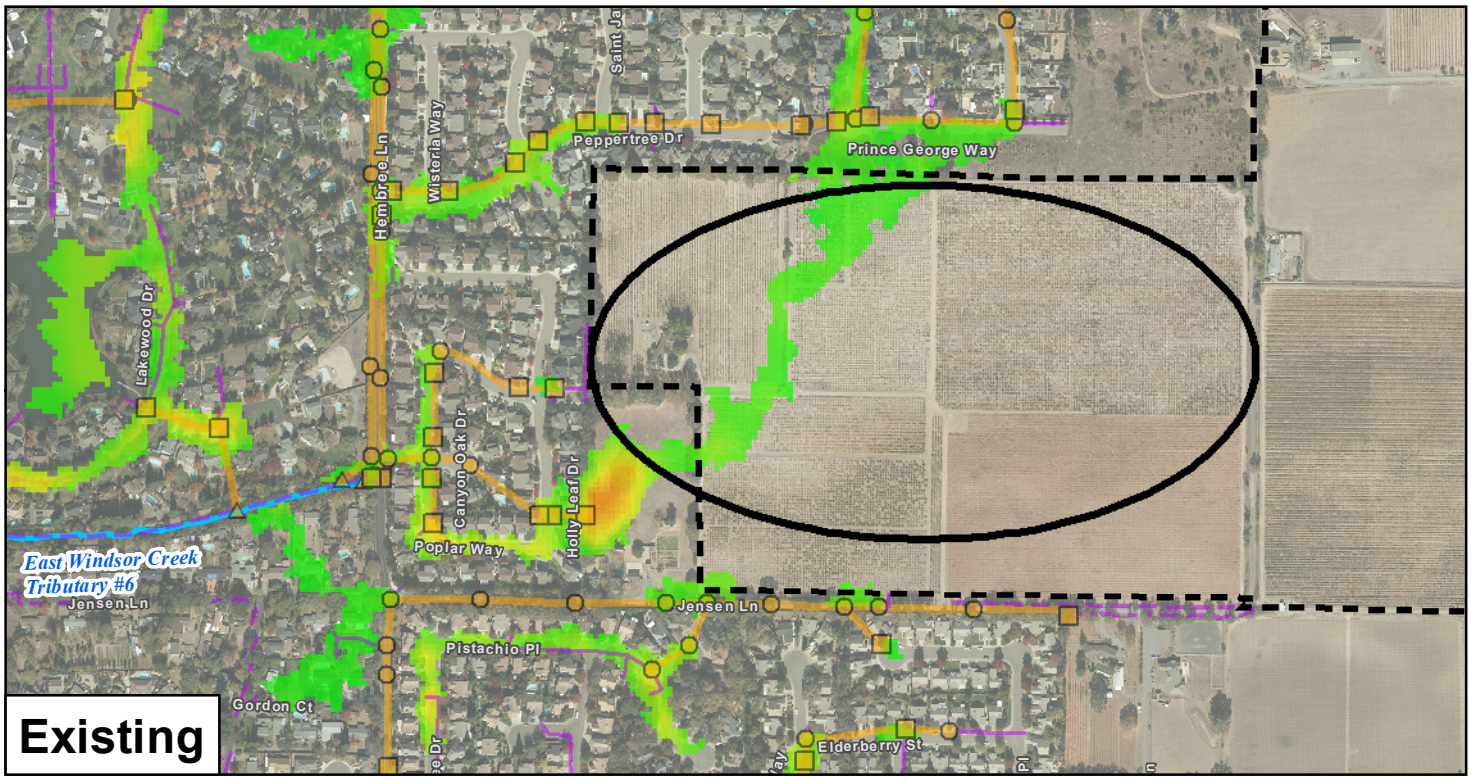
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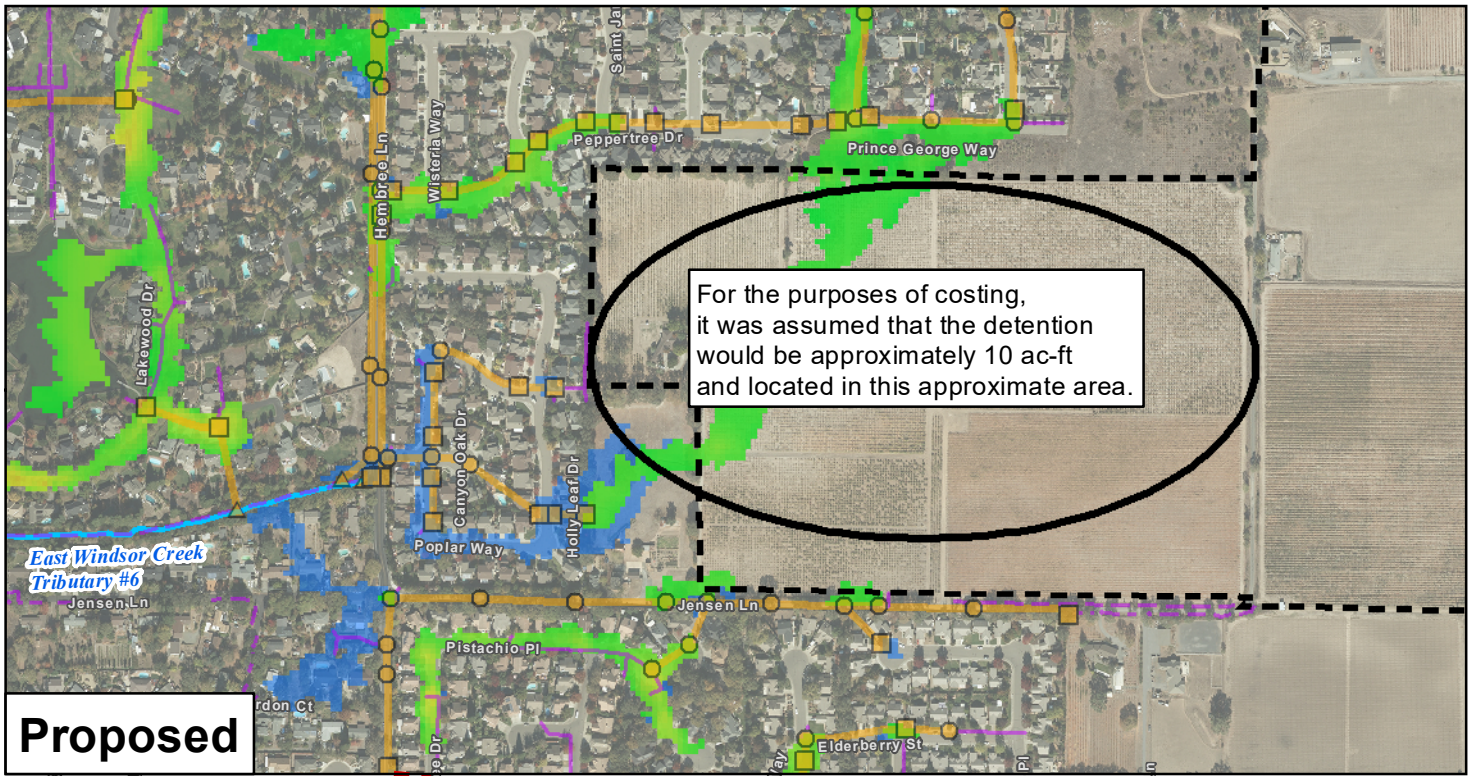
2235 Mercury Way Suite 150 Santa Rosa CA 95407 USA T 707 523 1010 F 707 527 8679 E santarosa@ghd.com W www.ghd.com

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Data source: Sonoma County GIS, Town Limits, Imagery, Roads, 2013; GHD, Storm Drain System, 2019; GHD, Modeling Results, Modeded Creeks, 2019. USGS, Creeks, 2014. Created by:afisher2

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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 200 400
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

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TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Future Flood and Impacts of Future SDIP 8

Job Number 11159126
Revision 1
Date 12 Feb 2020

Figure F-SDIP 8

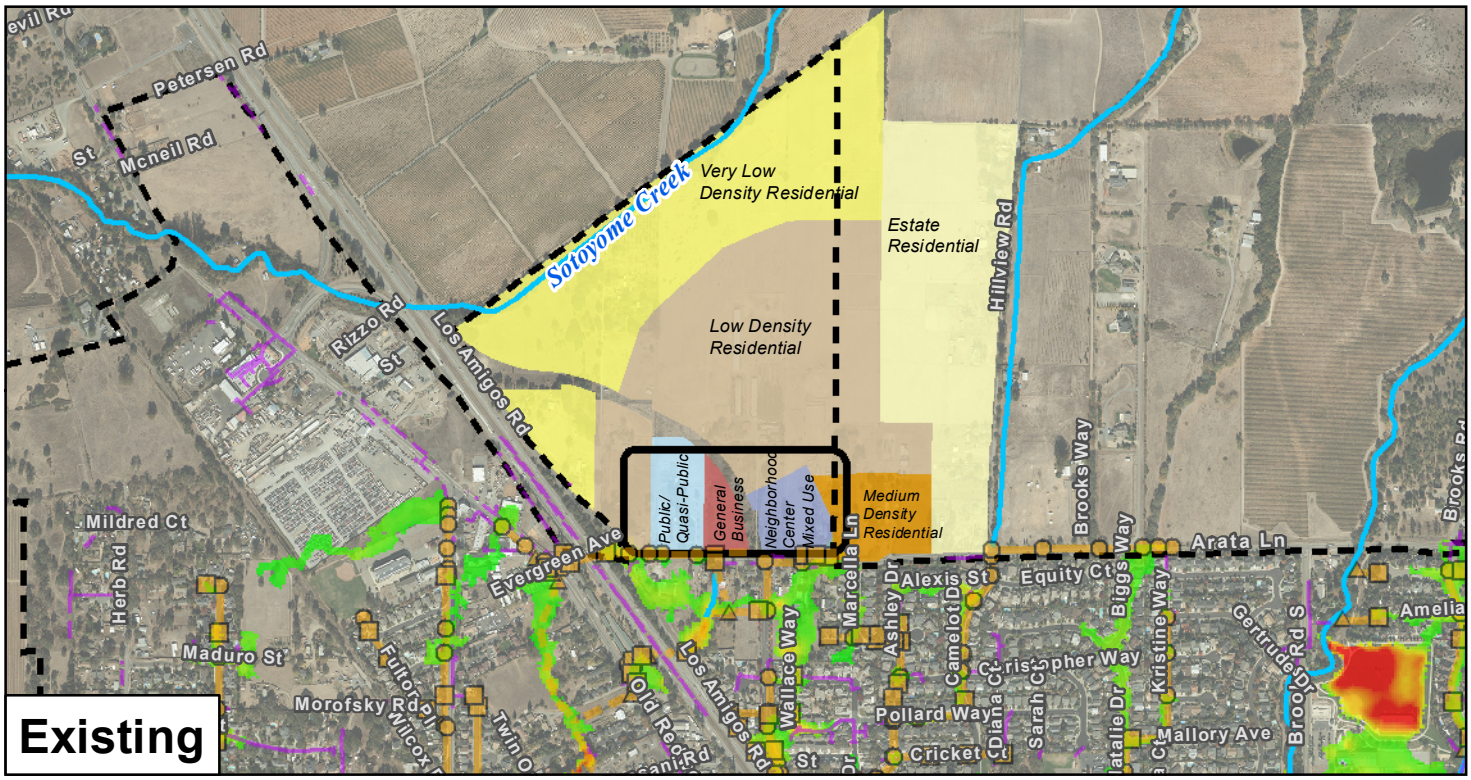
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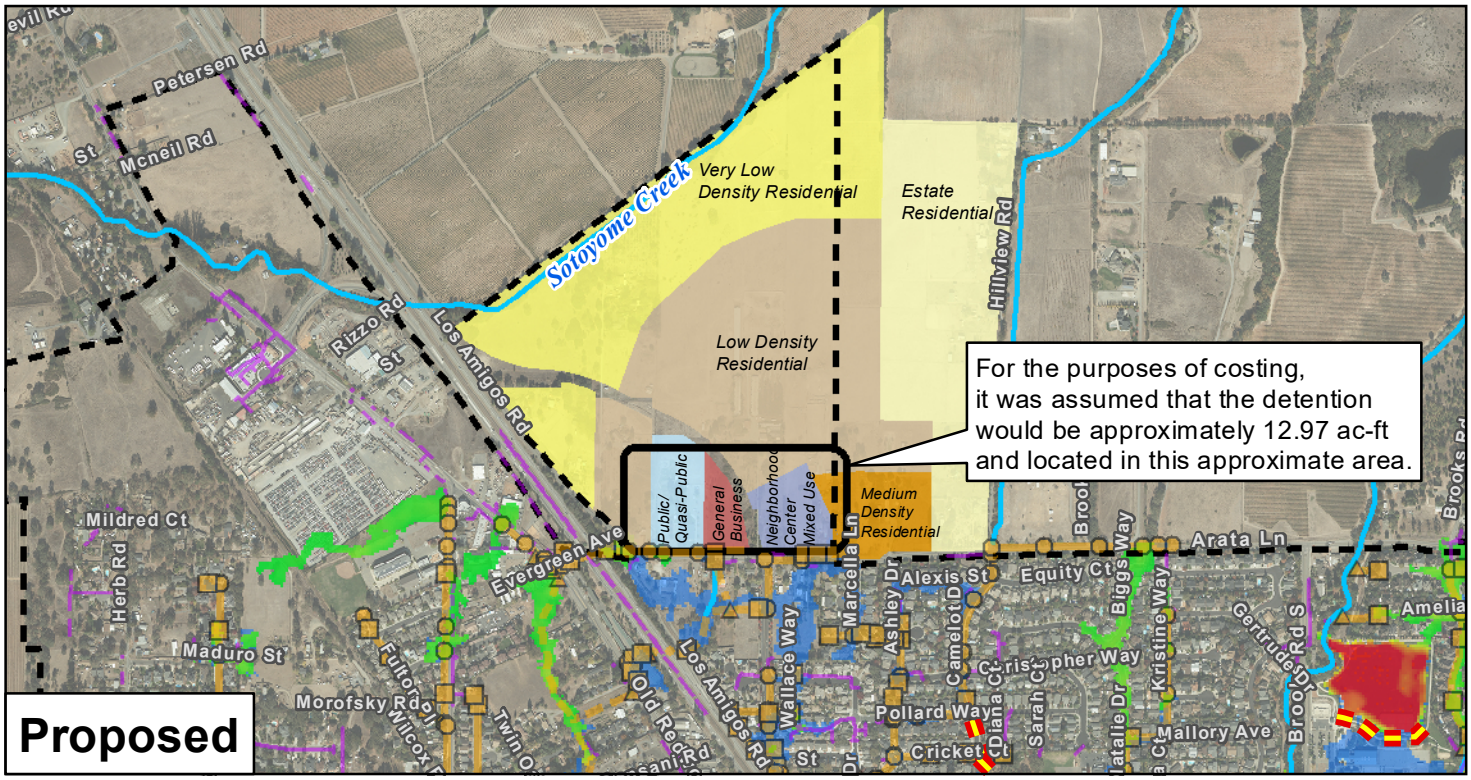
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Data source: Sonoma County GIS, Town Limits, Imagery, Roads, 2013; GHD, Storm Drain System, 2019; GHD, Modeling Results, Modeded Creeks, 2019. USGS, Creeks, 2014. Created by:afisher2

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Town Limits
Project Areas
Rivers and Creeks
Culverts, Modeled
Culverts, Not Modeled
Open Channels, Modeled
Open Channels, Not Modeled
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Discharge Points, Modeled
Manholes, Modeled
Inlets, Modeled

100 Year Flood

Depth (ft)

> 2

> 0

SDIP Project
Flooding Avoided

Paper Size 8.5" x 11" (ANSI A)
0 250 500
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

GHD

ESA

TOWN OF WINDSOR

Town of Windsor
Storm Drainage Master Plan

100 Year Flood and Impacts of Future SDIP 9

Job Number 11159126
Revision 2
Date 13 Feb 2020

Figure F-SDIP 9

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure F-SDIP 9 - Future SDIP 9.mxd

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Data source: Sonoma County GIS, Town Limits, Imagery, Roads, 2013; GHD, Storm Drain System, 2019; GHD, Modeling Results, Modeded Creeks, 2019. USGS, Creeks, 2014. Created by:afisher2

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8. RECOMMENDATIONS

One of the main goals of this SDMP is to provide potential SDIPs and opinions of probable project costs for the Town's use in planning for upcoming drainage mitigation projects. The Town should prioritize the SDIPs and determine which to pursue based on available funds. Currently, the Town's Drainage Mitigation Impact Fee Program is based on the 2017 Phase 1 SDMP Report, which this SDMP is intended to supersede. This chapter provides a summary of the reports findings and recommendations for next steps.

8.1 Final SDIP Model Results

The final model results for each of the SDIPs described in this chapter are presented in Chapter 7. It is important to note that the model results of the existing condition SDIPs are combined, and the model results of the future condition F-SDIPs are combined (and include the SDIPs as well). Individual project modeling is recommended for detailed engineering designs of the SDIPs and F-SDIPs when they are implemented.

8.2 SDIP Recommendations

Evaluation of model results identified nine baseline SDIPs and eight (future) F-SDIPs. These projects are summarized in the table below and are not presented in a prioritized order. Projects that were removed during Phase 2 are not included in this list; therefore SDIP IDs may skip numbers). For example, during preparation of the SDMP, the Town identified SDIP 8 and SDIP 11 as high priority projects.

Table 8-1 Storm Drainage Improvement Projects

SDIP ID #	SDIP Name	Cost
Existing Conditions (Baseline) SDIP Projects		
SDIP 1	Conveyance improvements along Biggs Way/Natalie Drive	$ 5,510,000
SDIP 5	Gumview Drive, Berry Lane, and Starr View Drive	$ 3,950,000
SDIP 6	Hiram Lewis Park Detention Basin	$ 880,000
SDIP 8	Old Redwood Highway at Dawn Way - Conveyance Improvements	$ 1,020,000
SDIP 9	Old Redwood Highway and Pleasant Avenue	$ 1,810,000
SDIP 11	Shiloh Road at Caletti Avenue	$ 247,000
SDIP 12	Hall Park Detention Basin	$ 1,900,000
SDIP 13	Starr Creek Tributary #5 – South of Arata Lane	$ 1,400,000
SDIP 14	East Windsor Creek Flood Control Project	$ 3,290,000
Total Cost of Existing (Baseline) SDIP Projects		$ 20,007,000
Future Conditions SDIP Projects		

SDIP ID #	SDIP Name	Cost
F-SDIP 1	Old Redwood Highway Bridge at Sotoyome Creek	$ 3,750,000
F-SDIP 3	Proposed Detention Basin between Pool Creek and Faught Creek	$ 3,430,000
F-SDIP 4	Starr Road and Colleen Drive	$ 3,880,000
F-SDIP 5	Pool Creek at Windsor Road	$ 7,680,000
F-SDIP 6 (formerly SDIP 2)	Windsor Creek and East Windsor Creek Confluence	$ 2,940,000
F-SDIP 7 (formerly SDIP 4)	Franklin Street and Leafhaven Conveyance Improvements	$ 3,770,000
F-SDIP 8	Detention at Jensen Lane Development	$ 3,880,000
F-SDIP 9	North of Arata Lane Drainage Project	$ 6,330,000
Total Cost of Future SDIP Projects		$ 35,660,000

The cost total is $20.01 million for existing condition projects, with approximately $6.6 to 7.9 million estimated in the five year budget for SDIPs 8, 11., 12, 13, and 14 (an average of $1.3 to 1.6 million per year). The remaining projects are assumed to be implemented over the following 10 to 20 years, which would result in an average annual budget allotment of $1.2 to 2.4 million (based in 2019 dollars). These costs should be adjusted to account for inflation, construction cost index, and other planning factors such as regulatory drivers and Town needs. Since there are project drivers from development needs for some projects (SDIP 13 and SDIP 15), the Town should consider timing projects to coincide with development so that existing and future need may be addressed simultaneously with a single project.

The total project cost for all future condition F-SDIP projects is $35.05 million. The timing for implementation of these projects is unknown, but is assumed to be distributed over a 10 year or greater time period to spread the cost of projects for long-term budgeting. Since there are project drivers from development needs for some projects (F-SDIP 1, F-SDIP 3, and F-SDIP 8), some F-SDIP projects may occur prior to the completion of the existing conditions SDIP projects.

The project cost for SDIP and F-SDIP projects attributed to development needs should be considered when preparing development agreements, where the cost for improvements, or portion thereof, may be covered by the development project. In the Estimate of Probable Cost (Appendix D), for each project where future development is driving the project (in whole or in part), the portion of the project cost which is driven by future need is provided. The future portion is determined by calculating the increase in runoff from development and determining what volume detention is needed to mitigate that increase alone using California Stormwater Quality Association (CASQA) Best Management Practices (BMPs) for sizing detention. That volume is then compared to the overall project volume to determine the proportion of the estimate of probable cost attributable to future development.

8.3 Recommended Next Steps

This SDMP can be updated as needed and its findings and recommendations are subject to change given a variety of factors for planning and funding. The list of SDIPs and F-SDIPs should

not exclude new projects based on future development impacts or the discovery of new flood conditions. Each of the SDIPs and F-SDIPs should be further developed in engineering detail prior to construction. Prioritization of projects should be based on addressing maintenance needs during storm events, reports from citizens of flooding, and needed capacity and/or flow retention improvements to support new development.

8.3.1 SDIP Development

The SDIPs and F-SDIPs and their associated costs presented in this report are for planning purposes and the presented costs are feasibility study level. All SDIPs and F-SDIPs should to be further developed, in engineering detail, prior to implementation.

Per the recommendation and preference of Sonoma Water, engineering design of all projects should include prioritizing stormwater detention to counteract conveyance capacity improvements that would otherwise convey peak storm flows to downstream parcels of the storm drainage system that may not be able to handle the flow increases. For the purposes of gaining area for stormwater detention, the Town should consider purchase ofprivate property nearby any project, where the opportunity exists, into the individual feasibility study phase of each design project. The scope and cost of this type of effort, including potential land purchases or easement acquisitions, have not been captured in this SDMP due to uncertainties in the potential outcome of efforts to acquire easements or purchase available land.

The Town should also consider the factors noted in the following section during future planning of its storm drainage conveyance system:

8.3.2 Recommended Future Enhancements to the SDMP Model

While a comprehensive and thorough hydrologic and hydraulic model was prepared for this SDMP, the model is expandable, and future updates to the current model can be beneficial. Recommended model updates include:

- Expansion of the model area, beyond the Town limits and the Town's Urban Growth Boundary, using the recent County LiDAR land surface elevation data.
- Addition of the uppermost reach of Gumview Creek (where nuisance flooding has been reported to the Town) to the model.
- Data collected by stream and rainfall gauges (installation of creek gauges is included in the Town's CIP for year 2019/2020) should be used to calibrate the model once an adequate data set is available. Refinement and update of the model may alter project descriptions for existing and future conditions SDIP projects and modify the associated project costs.
- Updated analysis and F-SDIP projects, as needed, which considers any updates to the Town's General Plan.
- Area specific surveys (as needed).
- Addition of smaller pipelines in known problem areas. These updates may be performed during the engineering design phase of individual SDIPs.

The data obtained from the creek gauges were not adequate to provide a fullcalibration of the model (a validation was performed based on the data at hand); however, the Town has included in it's CIP the installation of a creek gauge. Once more data is available for storms of varying magnitude, the model can be calibrated (second bullet). It is recommended that the model and this Storm Drainage Master Plan be updated with the release of future updates to the General Plan to maintain consistency between Town planning documents and to evaluate the impacts of planned development on the storm drainage network (third bullet). The last two recommendations need only be performed on an as needed basis.

8.3.3 Land Development Changes

The Town should update the H&H model, when appropriate, as development occurs, to use the model during development reviews. The SDMP model can be a useful tool to project potential downstream outcomes of development projects. As noted above, the model should also be updated, as necessary, to incorporate General Plan land use changes.

8.3.4 Regulatory Drivers and Environmental Review

Chapter 4 outlines various policy and regulatory issues that may affect the timing and budget for SDIP projects. The Town should review the list of SDIPs and F-SDIPs on a regular basis (i.e., every two years) and consider completing project feasibility or predesign studies in order to bring project descriptions and costs up to current conditions. For example, changes in FMDM requirements could result in design changes to larger conveyance or storage (detention) volumes. This would affect the project cost and project planning may need to investigate alignment alternatives and land needs that were not contemplated for the SDMP. Also, the impact on storm drainage system hydraulics from climate change may become more defined on a regional scale (i.e., regional acceptance of storm event intensification regarding peak rainfall magnitude and duration).

CEQA guidelines and resource agency permitting requirements also change over time, and depending on current requirements, the implementation and associated cost for one or more projects described in this SDMP may become more or less complex. As mentioned previously, it may be cost beneficial to combine projects which are planned in similar timeframes into conglomerated CEQA reports (such as EIRs).

8.3.5 Improvements Located within Private Property

Costs to construct storm drainage system improvements on private property may be affected substantially by the existence or lack of easements and rights-of-way held by the Town, Sonoma Water, and possibly the Army Corps of Engineers. Prior to designing and constructing projects of this type, the Town should gather the necessary information to fully understand all associated legal requirements pertaining to work occurring on private property, including the costs associated with obtaining easements and rights-of-way.

8.3.6 GIS Geodatabase Updates

The GIS geodatabase and other information prepared to support the H&H model should be reviewed and updated on a regular basis. This includes updates from planned changes in the storm drainage system and updates from completed SDIP or repair and rehabilitation projects.

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Appendices

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Appendix A Links to Manuals

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Links to Manuals

Rather than appending hard copies of entire manuals to this document, links to the on-line locations of some of the referenced documents are provided below. The reasons for this are two-fold. The referenced manuals are large documents and attaching them in full would use a significant amount of paper resource unnecessarily. Additionally, two of the referenced documents, the Phase I permit and the LID Manual, are dynamic documents. The LID Manual, especially, is a dynamic document with collateral material that is periodically modified. Therefore, the on-line version is the most recent version, and City of Santa Rosa staff request that users of the LID Manual refer to the website for the latest versions.

2019 Draft Flood Management Design Manual (FMDM)

https://www.sonomawater.org/fmdm

2017 LID Manual

https://www.srcity.org/DocumentCenter/View/14974/2017-Storm-Water-Technical-Design-Manual-Narrative

Phase I Permit

https://www.waterboards.ca.gov/northcoast/board_decisions/adopted_orders/pdf/2015/151008_0030_phaseIpermitrenewal.pdf

2005 SUSMP

http://www.ci.windsor.ca.us/DocumentCenter/View/3559

Climate Change Handbook for Regional Water Planning

http://www.water.ca.gov/climatechange/docs/Climate_Change_Handbook_Regional_Water_Planning.pdf

Appendix B Chapter 5 - Appendices

Chapter 5A - Subbasin Parameters

Chapter 5B - Hydrology Model Results

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Appendix 5A - Subbasin Parameters

Table 5A-1 below presents final model parameters used in development of the hydrology model for the Town of Windsor Storm Drain Master Plan.

Table 5A-1. Summary of Hydrology Model Subbasin Parameters

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_1	Gumview Creek	SD System [1]	103.4%	0.22	31.9	87.81	89.95
BASIN_2	Gumview Creek	SD System	102.1%	0.07	10.5	89.80	89.92
BASIN_3	Gumview Creek	SD System	101.9%	0.17	6.6	91.26	91.25
BASIN_4	Starr Trib T-6	SD System	102.9%	0.10	10.1	89.54	89.93
BASIN_5	Starr Trib T-6	SD System	102.9%	0.05	1.1	94.50	94.78
BASIN_6	Gumview Creek	SD System	100.8%	0.10	5.3	89.44	89.80
BASIN_7	Starr Trib T-6	SD System	102.9%	0.05	0.7	89.29	89.27
BASIN_8	Starr Creek	SD System	100.5%	0.13	7.9	93.25	92.82
BASIN_9	Starr Creek	SD System	100.5%	0.08	6.8	92.83	92.82
BASIN_10	Starr Creek	SD System	100.3%	0.09	2.9	92.72	92.72
BASIN_11	Gumview Creek	SD System	101.8%	0.20	16.8	89.76	88.85
BASIN_12	Starr Creek	SD System	101.1%	0.14	6.8	91.01	93.83
BASIN_13	Windsor Creek	SD System	99.3%	0.06	4.2	92.52	92.51
BASIN_14	Windsor Creek	SD System	99.7%	0.08	1.8	92.82	92.83
BASIN_15	Windsor Creek	SD System	98.7%	0.13	5.7	93.01	93.65
BASIN_16	Windsor Creek	SD System	100.0%	0.11	6.2	94.62	94.61
BASIN_17	Windsor Creek	SD System	100.0%	0.06	1.8	93.30	93.30
BASIN_18	Windsor Creek	SD System	100.9%	0.14	6.0	90.75	94.24
BASIN_19	Windsor Creek	SD System	100.0%	0.11	4.1	92.25	92.30
BASIN_20	Windsor Creek	SD System	98.2%	0.09	2.9	94.29	94.29
BASIN_21	Windsor Creek	SD System	98.6%	0.07	1.7	94.25	94.25
BASIN_22	Windsor Creek	SD System	98.1%	0.15	7.7	92.59	92.45
BASIN_23	Pool Creek	SD System	98.1%	0.06	6.3	92.64	92.65
BASIN_24	Windsor Creek	SD System	98.1%	0.18	5.7	92.44	92.43
BASIN_25	Windsor Creek	SD System	98.1%	0.17	7.2	92.79	92.79
BASIN_26	Windsor Creek	SD System	100.0%	0.19	12.6	93.35	93.77
BASIN_27	Starr Trib T-6	SD System	102.5%	0.12	4.6	91.94	91.93
BASIN_28	Starr Trib	SD System	101.0%	0.13	6.9	93.32	94.22
BASIN_29	Starr Creek	SD System	101.2%	0.07	2.0	90.88	90.87
BASIN_30	Starr Creek	SD System	102.4%	0.11	4.9	90.28	90.28
BASIN_31	Starr Creek	SD System	102.3%	0.13	3.9	91.90	91.89
BASIN_32	Starr Trib	SD System	102.3%	0.15	12.5	89.56	89.56
BASIN_33	Starr Trib	SD System	102.4%	0.09	2.8	90.17	90.16

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_34	Windsor Creek	SD System	102.3%	0.09	2.2	90.45	90.44
BASIN_35	Windsor Creek	SD System	101.5%	0.09	3.9	90.32	90.32
BASIN_36	Windsor Creek	SD System	101.4%	0.12	7.4	90.31	90.30
BASIN_37	Windsor Creek	Creek	101.2%	0.31	28.8	84.96	84.38
BASIN_38	Windsor Creek	Creek	101.6%	0.42	6.5	97.54	97.54
BASIN_39	Windsor Creek	SD System	100.5%	0.04	4.4	93.22	92.18
BASIN_40	E Windsor Creek	SD System	100.5%	0.13	8.9	95.99	95.66
BASIN_41	E Windsor Creek	SD System	100.5%	0.13	4.5	95.63	95.50
BASIN_42	E Windsor Trib X	SD System	100.0%	0.15	13.3	85.23	86.58
BASIN_43	E Windsor Trib 11	SD System	99.0%	0.12	10.1	90.89	90.89
BASIN_44	E Windsor Trib 11	SD System	98.6%	0.09	6.2	90.89	90.88
BASIN_45	E Windsor Trib 11	SD System	98.6%	0.09	3.5	89.51	89.50
BASIN_46	E Windsor Trib 11	SD System	98.9%	0.55	121.4	77.41	76.26
BASIN_47	E Windsor Trib 11	SD System	98.6%	0.34	28.0	81.41	80.07
BASIN_48	Pool Creek	SD System	98.0%	0.15	7.4	92.54	92.53
BASIN_49	Pool Creek	SD System	97.6%	0.11	3.5	91.40	92.16
BASIN_50	Pool Creek	SD System	97.1%	0.09	3.8	92.54	92.54
BASIN_51	Pool Creek	SD System	98.3%	0.12	9.4	76.15	87.42
BASIN_52	Faught Creek	SD System	97.1%	0.12	7.5	92.25	92.29
BASIN_53A	Faught Creek	Creek	100.0%	0.52	162.5	78.54	71.64
BASIN_53B	Faught Creek	Creek	100.0%	0.52	232.7	39.00	83.86
BASIN_54	Faught Creek	SD System	97.1%	0.11	7.0	90.79	90.88
BASIN_55	Faught Creek	SD System	96.3%	0.15	6.6	91.44	91.44
BASIN_56	Pool Creek	SD System	96.2%	0.10	2.7	94.09	96.16
BASIN_57	Pool Creek	SD System	96.2%	0.08	2.8	93.51	96.28
BASIN_58	Pool Creek	SD System	96.2%	0.20	8.6	95.83	95.47
BASIN_59	Pool Creek	SD System	96.9%	0.08	5.2	91.06	95.34
BASIN_60	Pool Creek	SD System	97.6%	0.17	8.6	84.13	95.43
BASIN_61	Pool Creek	SD System	97.1%	0.09	5.9	90.74	90.84
BASIN_62	Faught Creek	SD System	97.1%	0.09	8.7	86.62	86.60
BASIN_63	Faught Creek	SD System	97.1%	0.18	16.6	90.48	91.49
BASIN_64	Faught Creek	SD System	97.0%	0.12	7.6	89.13	89.11
BASIN_65	Faught Creek	SD System	95.3%	0.13	4.6	87.38	87.37
BASIN_66	E Windsor Creek	SD System	99.3%	0.19	8.7	84.84	87.48
BASIN_67	E Windsor Creek	SD System	100.1%	0.36	104.6	76.95	76.96
BASIN_68	E Windsor Creek	SD System	100.0%	0.20	11.5	87.83	87.96
BASIN_69	E Windsor Creek	SD System	100.0%	0.16	3.2	89.09	92.07
BASIN_70	E Windsor Trib X	SD System	100.8%	0.12	6.2	81.86	81.84
BASIN_71	E Windsor Trib X	SD System	101.1%	0.26	46.4	78.24	79.42

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_72	E Windsor Trib X [2]	SD System	100.4%	0.48	135.9	75.68	77.37
BASIN_73	E Windsor Trib X	SD System	100.0%	0.04	0.5	94.27	94.28
BASIN_74	E Windsor Trib X	SD System	100.0%	0.13	6.4	90.64	90.63
BASIN_75	E Windsor Trib X	SD System	101.4%	0.16	23.0	73.10	73.09
BASIN_76	E Windsor Trib X	SD System	101.4%	0.13	7.4	81.32	81.29
BASIN_77	E Windsor Trib X	SD System	101.4%	0.10	5.5	85.37	85.36
BASIN_78	E Windsor Creek	Creek	102.2%	0.38	128.4	70.54	70.54
BASIN_79	E Windsor Creek	SD System	102.5%	0.23	31.3	74.83	74.76
BASIN_80	E Windsor Open Ditch	SD System	103.3%	0.11	9.6	74.14	74.14
BASIN_81	E Windsor Open Ditch	SD System	102.6%	0.13	6.2	77.99	76.53
BASIN_82	E Windsor Open Ditch	SD System	103.1%	0.28	41.5	73.15	73.08
BASIN_83	E Windsor Open Ditch	Creek	101.9%	0.15	6.9	76.32	76.30
BASIN_84	E Windsor Creek	SD System	101.9%	0.19	9.7	84.45	84.43
BASIN_85	E Windsor Open Ditch	SD System	101.9%	0.13	11.4	90.67	90.66
BASIN_86	E Windsor Creek	SD System	101.0%	0.04	5.5	90.74	90.74
BASIN_87	E Windsor Creek	SD System	100.5%	0.10	4.0	82.93	82.92
BASIN_88	E Windsor Trib 11	SD System	99.0%	0.14	5.0	93.68	93.68
BASIN_89	Pool Creek	SD System	97.7%	0.15	10.3	96.28	96.01
BASIN_90	Pool Creek	SD System	97.9%	0.15	9.7	96.60	95.77
BASIN_91	Pool Creek	SD System	97.6%	0.07	12.9	96.57	95.85
BASIN_92	Pool Creek	SD System	98.1%	0.06	1.1	94.30	94.29
BASIN_93	Pool Creek	SD System	96.4%	0.12	6.7	94.74	94.73
BASIN_94	Pruitt Creek	Creek	95.2%	0.43	47.8	90.53	96.06
BASIN_95	Windsor Creek	SD System	98.6%	0.11	2.9	79.54	79.54
BASIN_96	Starr Trib	SD System	100.5%	0.18	8.0	85.64	90.24
BASIN_97	Starr Trib	Creek	100.6%	0.20	26.2	79.59	80.83
BASIN_98	Windsor Creek	SD System	100.0%	0.15	6.4	92.29	92.29
BASIN_99	E Windsor Creek	SD System	100.1%	0.12	8.4	83.59	85.66
BASIN_100	E Windsor Creek	SD System	101.5%	0.17	18.9	84.99	85.78
BASIN_101	E Windsor Creek	SD System	101.0%	0.26	26.8	87.03	88.47
BASIN_102	E Windsor Trib X	SD System	100.0%	0.15	20.2	84.82	86.13
BASIN_103	Pool Creek	SD System	98.1%	0.06	5.0	91.92	91.92
BASIN_104	Pool Creek	SD System	98.1%	0.11	14.6	91.49	91.49
BASIN_105	Pool Creek	SD System	98.1%	0.10	4.1	91.70	91.69
BASIN_106	Excluded [3]	N/A	98.2%	0.00	16.1	90.67	90.67
BASIN_107	Windsor Creek	SD System	101.0%	0.11	3.2	95.41	95.93
BASIN_108	Starr Trib	SD System	101.2%	0.12	3.5	93.11	93.21
BASIN_109	E Windsor Creek	SD System	99.4%	0.08	3.1	96.89	96.65
BASIN_110	E Windsor Trib 11	SD System	99.0%	0.12	9.3	90.06	90.05

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_111	E Windsor Creek	SD System	99.0%	0.14	5.7	93.86	94.15
BASIN_112	E Windsor Creek	Creek	101.6%	0.16	10.3	76.69	76.69
BASIN_113	Windsor Creek	SD System	101.9%	0.19	6.5	87.18	87.15
BASIN_114	Starr Trib T-6	Creek	101.5%	0.19	36.4	87.39	89.24
BASIN_115	Starr Trib T-6	SD System	102.6%	0.12	10.7	88.14	95.77
BASIN_116	Gumview Creek	SD System	101.9%	0.14	13.3	78.34	86.51
BASIN_117	Gumview Creek	SD System	102.1%	0.26	37.9	79.07	82.85
BASIN_118	E Windsor Trib X	SD System	101.6%	0.06	8.8	88.50	88.48
BASIN_119	E Windsor Trib X	SD System	101.4%	0.15	12.8	86.70	86.67
BASIN_120	E Windsor Trib X	SD System	100.0%	0.16	5.4	84.12	91.00
BASIN_121	Starr Trib T-6	SD System	102.9%	0.10	4.8	92.60	92.60
BASIN_122	Starr Creek	SD System	104.6%	0.46	187.3	71.79	71.79
BASIN_123	Starr Trib T-6	SD System	103.8%	0.42	51.4	85.28	89.93
BASIN_124	Starr Trib T-6	SD System	103.4%	0.09	2.9	96.84	96.99
BASIN_125	Starr Trib T-6	SD System	102.9%	0.05	1.2	97.61	97.63
BASIN_126	Starr Trib T-6	SD System	102.4%	0.10	4.5	88.59	93.35
BASIN_127	Starr Creek	SD System	102.4%	0.09	4.3	92.52	91.93
BASIN_128	E Windsor Open Ditch	SD System	101.9%	0.13	5.8	86.58	86.56
BASIN_129	E Windsor Open Ditch	SD System	101.9%	0.10	2.5	90.03	90.02
BASIN_130	E Windsor Open Ditch	SD System	101.9%	0.14	7.4	87.48	87.49
BASIN_131	E Windsor Creek	SD System	101.4%	0.14	8.0	74.15	74.15
BASIN_132	E Windsor Creek	SD System	101.4%	0.20	26.7	79.34	79.34
BASIN_133	Gumview Creek	SD System	103.3%	0.17	13.7	88.91	89.96
BASIN_134	Starr Trib T-6	SD System	102.8%	0.18	7.3	92.89	92.89
BASIN_135	Starr Creek	SD System	102.5%	0.08	5.2	89.72	89.72
BASIN_136	Starr Creek	SD System	101.0%	0.06	1.0	91.20	91.19
BASIN_137	Starr Creek	SD System	101.0%	0.17	6.9	93.17	93.72
BASIN_138	Starr Creek	SD System	101.0%	0.05	0.8	85.84	87.59
BASIN_139	Starr Creek	SD System	101.0%	0.12	3.0	91.36	91.35
BASIN_140	Starr Trib T-6	SD System	101.5%	0.06	6.5	89.77	89.26
BASIN_141	Starr Trib T-6	SD System	102.9%	0.13	4.7	91.36	94.48
BASIN_142	Starr Trib T-6	SD System	102.9%	0.09	4.7	96.83	96.76
BASIN_143	Starr Trib T-6	SD System	102.9%	0.12	3.3	93.40	92.94
BASIN_144	Windsor Creek	SD System	101.9%	0.17	9.2	90.18	90.17
BASIN_145	E Windsor Trib X	SD System	101.4%	0.12	6.6	87.50	87.48
BASIN_146	E Windsor Trib X	SD System	101.4%	0.14	7.1	87.63	87.60
BASIN_147	Starr Trib	SD System	101.0%	0.11	7.4	89.85	90.87
BASIN_148	E Windsor Creek	SD System	100.5%	0.09	2.1	94.61	95.34
BASIN_149	E Windsor Creek	Creek	100.4%	0.28	25.2	86.60	87.44

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_150	Windsor Creek	SD System	100.7%	0.09	2.1	94.48	94.92
BASIN_151	Windsor Creek	SD System	100.5%	0.08	3.5	96.24	96.66
BASIN_152	Windsor Creek	SD System	100.6%	0.08	5.9	94.62	96.23
BASIN_153	E Windsor Creek	SD System	98.9%	0.09	2.7	90.95	90.94
BASIN_154	E Windsor Creek	SD System	99.7%	0.11	5.9	90.79	90.78
BASIN_155	E Windsor Creek	SD System	99.4%	0.07	1.2	94.78	96.15
BASIN_156	E Windsor Creek	SD System	99.7%	0.12	6.4	91.31	91.30
BASIN_157	Starr Creek	SD System	100.0%	0.11	4.0	91.00	89.35
BASIN_158	Starr Creek	SD System	100.5%	0.09	2.0	92.61	92.60
BASIN_159	E Windsor Creek	SD System	99.0%	0.08	5.6	91.22	93.09
BASIN_160	Windsor Creek	Creek	99.7%	0.38	60.3	88.69	90.46
BASIN_161	Windsor Creek	SD System	98.1%	0.14	4.6	92.63	92.62
BASIN_162	Windsor Creek	SD System	98.6%	0.10	4.4	93.70	93.63
BASIN_163	Pool Creek	SD System	97.6%	0.09	3.7	93.10	95.80
BASIN_164	Pool Creek	SD System	97.7%	0.12	6.1	88.93	88.95
BASIN_165	E Windsor Trib 11	SD System	99.0%	0.10	5.7	91.25	91.25
BASIN_166	E Windsor Trib 11	SD System	99.0%	0.13	8.1	90.44	90.43
BASIN_167	E Windsor Trib 11	SD System	98.6%	0.16	9.8	91.78	91.78
BASIN_168	E Windsor Trib 11	SD System	98.9%	0.10	5.1	91.57	91.56
BASIN_169A	E Windsor Trib 11	SD System	100.0%	0.59	15.8	76.42	74.38
BASIN_169B	E Windsor Trib 11	SD System	100.0%	0.59	87.8	76.42	79.76
BASIN_170	Pool Creek	SD System	98.1%	0.09	4.2	92.57	92.57
BASIN_171	Pool Creek	SD System	98.1%	0.14	6.0	92.81	92.81
BASIN_172	Pool Creek	SD System	97.5%	0.10	19.3	84.64	93.73
BASIN_173	Pool Creek	SD System	97.1%	0.13	6.0	87.51	87.50
BASIN_174	Pool Creek	SD System	97.1%	0.13	4.8	90.68	92.14
BASIN_175	Pool Creek	SD System	97.2%	0.06	11.9	92.49	92.48
BASIN_176	Pool Creek	SD System	97.3%	0.12	3.3	90.78	95.56
BASIN_177	Pool Creek	SD System	97.5%	0.16	8.3	94.88	95.83
BASIN_178	Pool Creek	SD System	97.1%	0.10	4.9	91.22	91.65
BASIN_179	Faught Creek	SD System	96.4%	0.20	13.8	90.65	91.83
BASIN_180	Pool Creek	SD System	97.1%	0.07	3.9	87.82	90.20
BASIN_181	Faught Creek	SD System	97.1%	0.15	11.5	87.30	87.27
BASIN_182	Faught Creek	SD System	97.1%	0.13	5.9	85.55	85.53
BASIN_183	Airport Creek	SD System	96.2%	0.10	3.9	93.21	95.34
BASIN_184	Pool Creek	SD System	96.2%	0.11	13.3	93.91	95.02
BASIN_185	Pruitt Creek	SD System	95.7%	0.12	2.9	93.92	95.34
BASIN_186	Faught Creek	SD System	95.7%	0.12	5.2	97.45	97.44
BASIN_187	Pruitt Creek	SD System	95.2%	0.13	5.0	89.46	95.78

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_188	Faught Creek	SD System	95.4%	0.11	5.8	97.35	96.91
BASIN_189	Faught Creek	SD System	95.7%	0.14	7.7	96.71	95.96
BASIN_190	Pool Creek	SD System	96.2%	0.04	2.7	85.82	95.23
BASIN_191	Airport Creek	SD System	95.4%	0.12	7.2	96.55	95.51
BASIN_192	Airport Creek	SD System	94.5%	0.12	5.0	96.49	95.34
BASIN_193	Excluded	N/A	94.3%	0.00	4.3	94.65	95.34
BASIN_194	Airport Creek	SD System	95.2%	0.12	5.2	95.55	95.01
BASIN_195	Starr Creek	SD System	102.4%	0.10	3.6	91.90	91.90
BASIN_196	Starr Creek	SD System	102.3%	0.16	7.0	90.95	90.95
BASIN_197	Starr Creek	SD System	102.3%	0.18	12.1	90.59	90.58
BASIN_198	Starr Creek	SD System	102.4%	0.10	3.6	93.05	93.05
BASIN_199	Starr Creek	SD System	102.4%	0.10	3.3	92.58	92.57
BASIN_200	Windsor Creek	SD System	101.9%	0.14	8.0	89.40	89.38
BASIN_201	Windsor Creek	SD System	101.9%	0.16	10.7	88.82	88.80
BASIN_202	Windsor Creek	SD System	101.9%	0.14	6.6	89.35	89.34
BASIN_203	Windsor Creek	SD System	101.9%	0.16	5.8	87.97	87.95
BASIN_204	Windsor Creek	SD System	102.0%	0.09	4.7	90.87	90.86
BASIN_205	Windsor Creek	SD System	100.8%	0.15	13.4	93.10	92.68
BASIN_206	Starr Trib	SD System	102.4%	0.13	3.0	91.77	91.78
BASIN_207	Windsor Creek	SD System	101.1%	0.11	1.3	97.26	97.26
BASIN_208	Starr Creek	SD System	102.4%	0.10	5.9	93.85	93.85
BASIN_209	Pool Creek	SD System	98.5%	0.13	6.2	90.39	90.62
BASIN_210	Pool Creek	SD System	98.7%	0.25	11.0	89.86	93.42
BASIN_211	Windsor Creek	SD System	101.9%	0.12	4.7	90.20	90.19
BASIN_212	Starr Trib T-6	SD System	103.5%	0.39	24.5	94.90	95.80
BASIN_213	Starr Trib T-6	SD System	103.9%	0.46	73.7	82.97	91.43
BASIN_214	Starr Trib T-6	SD System	104.3%	0.15	9.4	94.44	96.28
BASIN_215	Starr Creek	SD System	102.4%	0.05	2.8	90.33	90.43
BASIN_216	Starr Trib T-6	SD System	102.9%	0.12	4.7	90.34	93.95
BASIN_217	E Windsor Open Ditch	SD System	101.9%	0.14	10.4	87.17	87.24
BASIN_218	E Windsor Open Ditch	SD System	101.9%	0.08	2.3	86.91	86.86
BASIN_219	E Windsor Open Ditch	SD System	101.9%	0.10	9.0	87.17	87.15
BASIN_220	E Windsor Creek	SD System	101.9%	0.12	5.5	91.64	91.62
BASIN_221	E Windsor Creek	SD System	101.9%	0.05	1.6	90.85	90.85
BASIN_222	E Windsor Creek	SD System	101.6%	0.14	19.7	80.39	80.38
BASIN_223	Gumview Creek	SD System	103.3%	0.13	6.4	89.20	89.19
BASIN_224	Gumview Creek	SD System	101.9%	0.05	2.1	92.36	92.33
BASIN_225	Gumview Creek	SD System	103.5%	0.48	123.7	82.58	84.05
BASIN_226	Starr Trib T-6	SD System	102.9%	0.22	25.7	88.38	91.45

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_227	Starr Trib T-6	SD System	102.9%	0.08	4.2	90.47	90.46
BASIN_228	Starr Trib T-6	SD System	102.3%	0.15	10.2	90.71	90.70
BASIN_229	Starr Creek	SD System	102.4%	0.17	15.7	91.04	96.37
BASIN_230	Starr Creek	SD System	101.6%	0.08	5.2	92.07	92.06
BASIN_231	Starr Creek	SD System	101.0%	0.06	1.3	91.35	91.34
BASIN_232	Starr Creek	SD System	101.9%	0.10	5.1	89.76	89.61
BASIN_233	Starr Trib T-6	SD System	102.9%	0.09	2.3	88.99	86.75
BASIN_234	Starr Creek	SD System	101.0%	0.08	4.1	91.37	94.04
BASIN_235	Starr Creek	SD System	101.0%	0.11	5.1	92.49	93.51
BASIN_236	Starr Trib	SD System	101.0%	0.09	2.5	92.51	94.21
BASIN_237	Starr Trib	SD System	101.0%	0.07	1.5	96.44	95.00
BASIN_238	Starr Trib	SD System	101.3%	0.21	9.3	93.69	94.70
BASIN_239	Windsor Creek	SD System	100.8%	0.26	22.5	93.25	93.31
BASIN_240	Windsor Creek	SD System	100.5%	0.05	1.4	97.16	97.04
BASIN_241	Windsor Creek	Creek	101.1%	0.41	14.6	97.19	97.27
BASIN_242	E Windsor Creek	SD System	100.5%	0.10	3.9	95.16	95.34
BASIN_243	E Windsor Trib X	SD System	101.9%	0.15	8.3	92.27	91.83
BASIN_244	E Windsor Trib X	SD System	101.2%	0.14	6.7	90.77	90.75
BASIN_245	E Windsor Trib X	SD System	100.0%	0.14	11.8	90.83	90.83
BASIN_246	E Windsor Trib X	SD System	100.0%	0.11	6.0	89.06	89.05
BASIN_247	Gumview Creek	SD System	101.9%	0.09	7.0	92.65	92.64
BASIN_248	Gumview Creek	SD System	102.9%	0.38	113.9	77.88	79.33
BASIN_249	Starr Trib	SD System	101.0%	0.09	6.5	91.38	94.34
BASIN_250	Starr Trib	SD System	101.0%	0.07	4.4	90.44	93.49
BASIN_251	Gumview Creek	SD System	101.5%	0.10	16.4	89.23	89.87
BASIN_252	Starr Trib	SD System	100.7%	0.04	4.2	75.03	75.03
BASIN_253	Windsor Creek	SD System	100.0%	0.13	6.6	93.13	93.73
BASIN_254	Windsor Creek	SD System	100.1%	0.13	5.6	91.48	93.75
BASIN_255	Windsor Creek	SD System	101.0%	0.10	3.5	96.07	96.13
BASIN_256	Windsor Creek	SD System	100.8%	0.08	2.8	94.92	95.97
BASIN_257	Windsor Creek	SD System	99.9%	0.12	5.0	94.54	93.95
BASIN_258	E Windsor Creek	SD System	100.7%	0.12	4.1	94.59	95.13
BASIN_259	E Windsor Creek	SD System	100.5%	0.12	3.8	96.09	95.97
BASIN_260	E Windsor Creek	SD System	100.5%	0.14	4.8	94.25	95.81
BASIN_261	E Windsor Creek	Creek	100.5%	0.10	14.3	94.55	95.99
BASIN_262	E Windsor Creek	SD System	99.7%	0.17	11.9	91.09	93.24
BASIN_263	E Windsor Creek	SD System	99.0%	0.18	10.5	87.90	92.64
BASIN_264	E Windsor Creek	SD System	99.0%	0.13	2.5	90.14	90.44
BASIN_265	E Windsor Creek	SD System	99.0%	0.09	2.9	92.32	93.07

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_266	E Windsor Creek	SD System	99.0%	0.06	3.3	92.34	92.34
BASIN_267	E Windsor Creek	SD System	99.0%	0.22	30.7	91.63	93.24
BASIN_268	Windsor Creek	SD System	99.8%	0.08	2.5	92.85	92.83
BASIN_269	Windsor Creek	SD System	100.9%	0.15	18.6	92.69	93.21
BASIN_270	Windsor Creek	SD System	101.0%	0.05	1.9	92.87	95.56
BASIN_271	E Windsor Trib X	SD System	100.0%	0.17	6.1	91.36	92.38
BASIN_272	E Windsor Trib X	SD System	100.0%	0.18	7.9	90.53	91.85
BASIN_273	E Windsor Trib X	SD System	100.0%	0.13	4.0	91.90	92.79
BASIN_274	E Windsor Creek	SD System	100.6%	0.16	1.2	89.44	91.32
BASIN_275	E Windsor Trib X	SD System	100.0%	0.11	0.6	91.28	93.12
BASIN_276	E Windsor Creek	SD System	100.0%	0.11	4.0	86.25	90.56
BASIN_277	E Windsor Creek	SD System	100.0%	0.16	7.0	90.86	91.57
BASIN_278	E Windsor Creek	SD System	99.9%	0.15	6.5	91.32	92.15
BASIN_279	E Windsor Creek	SD System	98.9%	0.05	2.0	89.92	91.04
BASIN_280	E Windsor Creek	SD System	99.3%	0.12	8.1	90.18	90.93
BASIN_281	E Windsor Creek	SD System	99.8%	0.06	1.9	90.74	91.59
BASIN_282	E Windsor Creek	SD System	100.0%	0.12	5.1	91.17	91.74
BASIN_283	E Windsor Creek	SD System	100.4%	0.10	3.9	93.70	94.83
BASIN_284	E Windsor Trib 11	SD System	98.9%	0.18	5.9	92.94	93.13
BASIN_285	E Windsor Trib 11	SD System	98.6%	0.13	14.1	85.78	86.27
BASIN_286	Starr Creek	SD System	100.5%	0.10	6.8	92.31	93.36
BASIN_287	Starr Creek	SD System	99.2%	0.09	4.2	91.82	92.53
BASIN_288	Starr Creek	SD System	100.1%	0.11	5.0	91.77	92.46
BASIN_289	Windsor Creek	SD System	100.0%	0.12	8.2	96.09	96.12
BASIN_290	Windsor Creek	SD System	100.0%	0.10	5.5	93.79	94.03
BASIN_291	Windsor Creek	SD System	100.2%	0.09	4.6	92.72	93.01
BASIN_292	Windsor Creek	SD System	100.0%	0.18	9.6	94.11	94.67
BASIN_293	Windsor Creek	SD System	100.0%	0.13	7.5	93.98	94.97
BASIN_294	Windsor Creek	SD System	99.5%	0.11	2.7	91.41	91.41
BASIN_295	Windsor Creek	SD System	98.8%	0.19	9.4	92.34	92.17
BASIN_296	Windsor Creek	SD System	100.3%	0.08	4.4	91.63	88.14
BASIN_297	Windsor Creek	SD System	98.1%	0.15	8.7	91.48	92.72
BASIN_298	Windsor Creek	SD System	98.6%	0.08	3.5	87.36	86.77
BASIN_299A	Windsor Creek	Creek	100.0%	0.88	94.1	76.43	75.25
BASIN_299B	Windsor Creek	Creek	100.0%	0.83	89.6	76.43	74.62
BASIN_299C	Windsor Creek	Creek	100.0%	0.86	79.6	76.43	76.05
BASIN_299D	Windsor Creek	Creek	100.0%	0.74	103.3	76.43	76.32
BASIN_299E	Windsor Creek	Creek	100.0%	0.74	31.2	76.43	78.01
BASIN_299F	Windsor Creek	Creek	100.0%	0.78	103.5	76.43	77.95

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_299G	Windsor Creek	Creek	100.0%	0.67	6.5	76.43	77.52
BASIN_299H	Windsor Creek	Creek	100.0%	0.67	21.8	76.43	79.57
BASIN_299I	Windsor Creek	Creek	100.0%	0.69	64.8	76.43	82.82
BASIN_299J	Windsor Creek	Creek	100.0%	0.68	161.7	76.43	82.07
BASIN_299K	Windsor Creek	Creek	100.0%	0.76	148.8	76.43	80.54
BASIN_299L	Windsor Creek	Creek	100.0%	0.84	182.3	76.43	83.11
BASIN_299M	Windsor Creek	Creek	100.0%	0.88	189.9	76.43	76.47
BASIN_299N	Windsor Creek	Creek	100.0%	0.88	188.2	76.43	70.42
BASIN_299O	Windsor Creek	Creek	100.0%	0.56	62.1	76.43	72.93
BASIN_299P	Windsor Creek	Creek	100.0%	0.53	160.8	76.43	72.62
BASIN_299Q	Windsor Creek	Creek	100.0%	0.51	116.0	76.43	75.77
BASIN_299R	Windsor Creek	Creek	100.0%	0.63	161.6	76.43	78.03
BASIN_299S	Windsor Creek	Creek	100.0%	0.43	100.3	76.43	68.03
BASIN_299T	Windsor Creek	Creek	100.0%	0.34	119.7	76.43	73.43
BASIN_299U	Windsor Creek	Creek	100.0%	0.21	60.0	76.43	73.33
BASIN_300	Starr Trib T-6	Creek	102.7%	0.05	1.1	88.00	87.73
BASIN_301	Starr Creek	Creek	101.3%	0.13	6.7	87.11	88.67
BASIN_302	Starr Creek	Creek	100.8%	0.17	21.6	87.20	89.56
BASIN_303	E Windsor Creek	Creek	101.9%	0.18	8.4	83.82	80.96
BASIN_304	E Windsor Trib 11	SD System	99.0%	0.06	6.1	90.55	91.29
BASIN_305	E Windsor Trib 11	Creek	99.0%	0.13	5.7	85.33	89.50
BASIN_306A	Pool Creek	Creek	100.0%	0.88	121.9	68.62	73.41
BASIN_306B	Pool Creek	Creek	100.0%	0.98	189.7	68.62	65.07
BASIN_306C	Pool Creek	Creek	100.0%	0.98	157.2	68.62	60.52
BASIN_306D	Pool Creek	Creek	100.0%	0.64	146.2	68.62	74.47
BASIN_306E	Pool Creek	Creek	100.0%	0.58	143.2	68.62	71.58
BASIN_306F	Pool Creek	Creek	100.0%	1.08	154.1	68.62	72.06
BASIN_306G	Pool Creek	Creek	100.0%	1.14	41.8	68.62	67.86
BASIN_306H	Pool Creek	Creek	100.0%	1.14	133.0	68.62	64.68
BASIN_306I	Pool Creek	Creek	100.0%	0.89	47.8	68.62	66.17
BASIN_306J	Pool Creek	Creek	100.0%	0.76	46.9	68.62	56.60
BASIN_306K	Pool Creek	Creek	100.0%	0.68	69.6	68.62	61.90
BASIN_306L	Pool Creek	Creek	100.0%	0.57	116.2	68.62	63.89
BASIN_306M	Pool Creek	Creek	100.0%	0.42	135.2	68.62	72.02
BASIN_306N	Pool Creek	Creek	100.0%	0.88	116.7	68.62	65.96
BASIN_306O	Pool Creek	Creek	100.0%	0.46	168.0	68.62	71.73
BASIN_306P	Pool Creek	Creek	100.0%	0.24	198.6	68.62	74.26
BASIN_307	Pool Creek	Creek	97.8%	0.37	60.0	83.59	84.58
BASIN_308A	Pruitt Creek	Creek	100.0%	1.03	193.3	72.38	71.21

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_308B	Pruitt Creek	Creek	100.0%	1.03	159.4	72.38	67.02
BASIN_308C	Pruitt Creek	Creek	100.0%	0.94	61.8	72.38	68.37
BASIN_308D	Pruitt Creek	Creek	100.0%	0.84	177.7	72.38	67.28
BASIN_308E	Pruitt Creek	Creek	100.0%	0.78	164.3	72.38	57.10
BASIN_308F	Pruitt Creek	Creek	100.0%	0.78	188.8	72.38	74.01
BASIN_308G	Pruitt Creek	Creek	100.0%	0.64	22.1	72.38	61.46
BASIN_308H	Pruitt Creek	Creek	100.0%	0.68	145.2	72.38	62.99
BASIN_308I	Pruitt Creek	Creek	100.0%	0.58	86.5	72.38	59.23
BASIN_308J	Pruitt Creek	Creek	100.0%	0.54	71.0	72.38	71.25
BASIN_308K	Pruitt Creek	Creek	100.0%	0.44	190.9	72.38	75.34
BASIN_308L	Pruitt Creek	Creek	100.0%	0.41	145.1	72.38	74.50
BASIN_308M	Pruitt Creek	Creek	100.0%	0.38	100.2	72.38	78.46
BASIN_308N	Pruitt Creek	Creek	100.0%	0.38	231.1	72.38	81.98
BASIN_308O	Pruitt Creek	Creek	100.0%	0.28	34.7	72.38	82.86
BASIN_308P	Pruitt Creek	Creek	100.0%	0.24	122.3	72.38	89.46
BASIN_308Q	Pruitt Creek	Creek	100.0%	0.18	122.4	72.38	84.89
BASIN_309	Windsor Creek	Creek	98.8%	0.46	170.1	79.40	79.23
BASIN_310	Starr Creek	Creek	99.6%	0.42	187.3	78.63	78.63
BASIN_311	Pool Creek	Creek	98.1%	0.60	253.4	82.70	82.70
BASIN_312	Airport Creek	SD System	94.1%	0.30	28.7	89.63	95.32
BASIN_313A	Windsor Creek	Creek	100.0%	0.24	335.7	79.15	80.67
BASIN_313B	Windsor Creek	Creek	100.0%	0.36	297.9	79.15	79.65
BASIN_313C	Windsor Creek	Creek	100.0%	0.56	425.4	79.15	81.11
BASIN_313D	Windsor Creek	Creek	100.0%	0.88	435.2	79.15	73.36
BASIN_313E	Windsor Creek	Creek	100.0%	0.88	524.5	79.16	81.14
BASIN_314	Windsor Creek	SD System	100.0%	0.12	2.9	94.23	94.67
BASIN_315	E Windsor Creek	SD System	98.2%	0.08	0.5	91.82	93.05
BASIN_316	Windsor Creek	SD System	100.0%	0.11	1.9	91.82	91.86
BASIN_317	E Windsor Creek	Creek	99.0%	0.13	4.4	92.59	93.74
BASIN_318	E Windsor Creek	Creek	99.0%	0.17	18.0	88.69	88.31
BASIN_319	E Windsor Trib 11	Creek	98.9%	0.29	51.4	93.03	93.75
BASIN_320	E Windsor Trib 11	SD System	99.0%	0.07	1.7	91.10	92.51
BASIN_321	E Windsor Creek	SD System	99.0%	0.06	0.4	97.70	97.70
BASIN_322	E Windsor Creek	SD System	99.0%	0.10	1.4	94.07	93.91
BASIN_323	E Windsor Creek	SD System	99.0%	0.07	1.0	94.18	94.50
BASIN_324	E Windsor Creek	SD System	99.0%	0.13	4.6	93.52	93.75
BASIN_325	E Windsor Creek	SD System	99.0%	0.06	1.0	96.26	96.75
BASIN_326	E Windsor Trib 11	SD System	99.0%	0.17	6.4	90.06	91.00
BASIN_327	Pool Creek	SD System	97.6%	0.10	2.4	92.70	93.72

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_328	E Windsor Trib 11	SD System	99.0%	0.07	1.3	92.52	93.52
BASIN_329	Pool Creek	SD System	97.6%	0.11	4.9	97.08	95.34
BASIN_330	E Windsor Trib 11	SD System	99.0%	0.15	6.7	91.21	92.68
BASIN_331	E Windsor Trib 11	SD System	98.8%	0.14	6.9	91.65	92.03
BASIN_332	Pool Creek	SD System	97.2%	0.11	5.2	87.78	91.27
BASIN_333	Pool Creek	SD System	98.2%	0.13	6.8	91.65	92.27
BASIN_334	E Windsor Trib 11	SD System	99.0%	0.09	4.9	91.97	93.14
BASIN_335	Pool Creek	SD System	97.9%	0.17	8.4	93.11	93.19
BASIN_336	Pool Creek	SD System	97.1%	0.14	5.4	91.55	92.13
BASIN_337	E Windsor Trib 11	SD System	98.6%	0.21	9.2	80.54	89.32
BASIN_338	E Windsor Trib 11	SD System	98.6%	0.07	2.2	92.35	93.57
BASIN_339	Windsor Creek	SD System	98.4%	0.13	7.6	93.40	94.41
BASIN_340	Pool Creek	SD System	98.1%	0.05	2.3	90.73	91.38
BASIN_341	Pool Creek	SD System	98.1%	0.08	5.2	91.93	92.68
BASIN_342	Pool Creek	SD System	98.0%	0.09	6.2	91.88	92.63
BASIN_343	Pool Creek	SD System	98.0%	0.05	2.8	92.62	92.78
BASIN_344	Pool Creek	SD System	97.7%	0.07	1.6	91.74	92.35
BASIN_345	Pool Creek	SD System	97.7%	0.14	4.5	94.29	94.76
BASIN_346	Pool Creek	SD System	97.4%	0.13	6.6	94.00	94.14
BASIN_347	Pool Creek	SD System	96.6%	0.11	2.2	92.26	91.40
BASIN_348	Pool Creek	SD System	98.1%	0.09	4.4	95.73	94.25
BASIN_349	Pool Creek	SD System	98.0%	0.14	7.5	86.55	86.65
BASIN_350	Pool Creek	SD System	97.6%	0.13	9.9	83.23	95.50
BASIN_351	Pool Creek	SD System	97.6%	0.12	5.1	97.01	96.38
BASIN_352	Pool Creek	SD System	97.6%	0.07	2.5	95.67	95.34
BASIN_353	Pool Creek	SD System	97.6%	0.14	6.4	95.56	96.45
BASIN_354	Pool Creek	SD System	97.6%	0.10	5.6	91.43	92.36
BASIN_355	Pool Creek	SD System	97.6%	0.07	4.6	91.43	91.91
BASIN_356	Pool Creek	SD System	97.2%	0.14	9.1	91.12	91.49
BASIN_357	Pool Creek	SD System	97.7%	0.05	1.0	92.58	93.59
BASIN_358	Pool Creek	SD System	97.1%	0.07	1.4	87.49	86.26
BASIN_359	Pool Creek	SD System	97.1%	0.10	2.0	87.68	89.96
BASIN_360	Faught Creek	SD System	97.1%	0.11	6.4	86.04	86.85
BASIN_361	Faught Creek	SD System	97.1%	0.15	3.8	86.47	87.54
BASIN_362	Faught Creek	SD System	97.1%	0.08	5.0	87.01	87.80
BASIN_363	Faught Creek	SD System	96.3%	0.05	3.2	87.10	88.46
BASIN_364	Faught Creek	SD System	95.2%	0.16	11.6	80.40	80.47
BASIN_365	Faught Creek	SD System	96.1%	0.13	5.9	85.25	92.61
BASIN_366	Pruitt Creek	Creek	95.9%	0.33	65.7	90.84	94.85

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_367	Airport Creek	SD System	95.9%	0.17	11.5	95.66	95.54
BASIN_368	Airport Creek	SD System	96.2%	0.13	4.1	93.34	95.34
BASIN_369	Pool Creek	SD System	96.2%	0.15	9.8	90.84	95.59
BASIN_370	Faught Creek	SD System	95.4%	0.12	5.5	95.89	95.82
BASIN_371	Faught Creek	SD System	95.2%	0.15	13.1	90.40	94.24
BASIN_372	Faught Creek	SD System	95.7%	0.13	2.2	97.48	96.97
BASIN_373	Faught Creek	SD System	95.2%	0.24	18.4	85.80	94.11
BASIN_374	Faught Creek	SD System	95.2%	0.19	16.2	78.87	77.34
BASIN_375	Faught Creek	SD System	97.0%	0.27	20.5	74.72	74.45
BASIN_376	Faught Creek	SD System	95.2%	0.06	3.1	90.70	92.66
BASIN_377	Starr Creek	Creek	101.4%	0.24	25.2	86.48	92.80
BASIN_378	Windsor Creek	Creek	98.9%	0.35	84.0	81.74	81.74
BASIN_379	E Windsor Creek	SD System	101.9%	0.22	9.6	87.40	88.08
BASIN_380	E Windsor Creek	SD System	101.9%	0.17	3.0	88.76	90.31
BASIN_381	E Windsor Creek	SD System	101.9%	0.05	1.8	89.26	90.52
BASIN_382	Windsor Creek	SD System	100.5%	0.12	10.4	90.38	90.99
BASIN_383	Windsor Creek	SD System	100.7%	0.16	9.9	89.83	90.66
BASIN_384	Starr Trib	SD System	102.2%	0.15	9.0	91.91	92.36
BASIN_385	Starr Trib	SD System	102.4%	0.09	3.9	91.82	92.53
BASIN_386	Starr Trib T-6	SD System	102.8%	0.15	4.1	89.28	89.73
BASIN_387	Starr Trib T-6	SD System	102.9%	0.08	1.6	90.18	91.40
BASIN_388	Starr Trib T-6	SD System	102.9%	0.11	7.1	92.35	93.80
BASIN_389	Starr Trib T-6	SD System	102.9%	0.17	15.6	88.83	95.64
BASIN_390A	Airport Creek	Creek	100.0%	1.66	154.2	84.89	81.31
BASIN_390B	Airport Creek	Creek	100.0%	1.46	178.4	84.89	84.53
BASIN_390C	Airport Creek	Creek	100.0%	1.46	25.8	84.89	86.72
BASIN_390D	Airport Creek	Creek	100.0%	1.38	137.0	84.89	92.73
BASIN_390E	Airport Creek	Creek	100.0%	1.23	173.9	84.89	83.94
BASIN_390F	Airport Creek	Creek	100.0%	0.86	133.4	84.89	88.84
BASIN_390G	Airport Creek	Creek	100.0%	0.86	169.2	84.89	89.74
BASIN_390H	Airport Creek	Creek	100.0%	0.46	228.5	84.89	84.07
BASIN_390I	Airport Creek	Creek	100.0%	0.46	201.4	84.89	81.08
BASIN_390J	Airport Creek	Creek	100.0%	0.23	99.5	84.89	77.44
BASIN_391	Windsor Creek	Creek	99.5%	0.09	5.0	83.35	83.35
BASIN_392	Airport Creek	Creek	94.6%	0.17	11.1	95.66	95.28
BASIN_393	Airport Creek	SD System	93.9%	0.55	43.3	83.20	83.88
BASIN_394	Airport Creek	SD System	94.0%	0.30	27.2	88.62	91.80
BASIN_395	Airport Creek	Creek	94.3%	0.10	5.7	89.46	93.06
BASIN_396	Pool Creek	SD System	97.1%	0.10	4.5	89.48	90.34

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_397	Starr Trib T-6	SD System	104.1%	0.12	6.0	93.28	96.32
BASIN_398	Starr Trib T-6	SD System	102.9%	0.14	3.8	93.70	94.10
BASIN_399	Starr Trib T-6	SD System	102.9%	0.13	5.6	92.24	95.90
BASIN_400	Starr Trib T-6	SD System	102.9%	0.08	1.6	89.58	90.53
BASIN_401	Starr Creek	SD System	102.4%	0.06	0.4	97.34	97.34
BASIN_402	Starr Creek	SD System	102.4%	0.07	4.4	91.13	90.30
BASIN_403	Starr Creek	SD System	104.6%	0.46	128.9	75.34	75.34
BASIN_404	Windsor Creek	Creek	101.9%	0.12	19.6	77.47	75.33
BASIN_405	Gumview Creek	SD System	103.3%	0.07	1.3	92.81	93.84
BASIN_406	Gumview Creek	SD System	102.9%	0.16	10.7	90.58	91.24
BASIN_407	Starr Trib T-6	SD System	101.4%	0.05	2.6	88.09	90.68
BASIN_408	Starr Trib T-6	Creek	101.4%	0.14	20.3	89.87	91.48
BASIN_409	Gumview Creek	SD System	101.9%	0.13	11.0	90.78	91.45
BASIN_410	Starr Trib T-6	SD System	102.9%	0.08	1.8	90.32	91.58
BASIN_411	Starr Creek	SD System	102.4%	0.06	1.6	91.62	92.22
BASIN_412	Starr Creek	SD System	101.0%	0.06	3.8	90.44	92.35
BASIN_413	Starr Creek	SD System	102.5%	0.27	9.2	89.12	88.29
BASIN_414	Starr Trib	SD System	102.3%	0.12	6.0	89.79	90.64
BASIN_415	Starr Trib	SD System	102.4%	0.12	6.8	91.09	91.83
BASIN_416	Windsor Creek	SD System	101.9%	0.07	2.2	87.21	88.07
BASIN_417	E Windsor Creek	SD System	101.9%	0.07	3.2	86.84	86.31
BASIN_418	E Windsor Creek	SD System	100.5%	0.05	1.8	96.36	95.61
BASIN_419	Windsor Creek	SD System	100.5%	0.09	4.5	90.62	91.83
BASIN_420	E Windsor Creek	Creek	99.2%	0.11	12.4	91.24	96.08
BASIN_421	Windsor Creek	Creek	99.5%	0.14	11.6	91.26	93.82
BASIN_422	Windsor Creek	SD System	101.0%	0.11	4.4	94.66	94.70
BASIN_423	Windsor Creek	SD System	100.0%	0.12	7.8	91.44	91.14
BASIN_424	E Windsor Open Ditch	SD System	101.9%	0.11	9.1	88.71	89.56
BASIN_425	E Windsor Creek	SD System	101.5%	0.09	2.4	87.06	88.38
BASIN_426	E Windsor Creek	SD System	101.6%	0.10	8.2	87.70	88.72
BASIN_427	E Windsor Trib X	SD System	101.4%	0.11	6.2	81.67	82.11
BASIN_428	E Windsor Trib X	SD System	101.4%	0.13	3.6	86.54	88.44
BASIN_429	E Windsor Trib X	SD System	100.0%	0.10	7.1	87.22	89.27
BASIN_430	E Windsor Trib X	SD System	100.2%	0.14	6.5	87.95	88.92
BASIN_431	E Windsor Trib X	SD System	100.9%	0.13	7.5	89.48	90.49
BASIN_432	E Windsor Trib X	SD System	101.8%	0.07	5.5	89.52	90.56
BASIN_433	E Windsor Trib X	SD System	100.0%	0.08	3.8	90.02	91.19
BASIN_434	E Windsor Creek	SD System	100.0%	0.08	5.7	83.80	84.39
BASIN_435	E Windsor Creek	SD System	100.0%	0.09	1.8	92.44	93.41

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_436	E Windsor Creek	SD System	99.3%	0.12	5.4	90.05	91.18
BASIN_437	E Windsor Creek	SD System	99.0%	0.11	2.6	93.63	96.40
BASIN_438	E Windsor Creek	SD System	100.0%	0.07	1.1	91.46	91.95
BASIN_439	E Windsor Creek	SD System	100.0%	0.07	2.8	91.98	92.78
BASIN_440	Starr Creek	SD System	100.5%	0.06	1.3	91.84	90.85
BASIN_441	Windsor Creek	SD System	100.1%	0.06	1.3	94.81	93.68
BASIN_442	Windsor Creek	SD System	100.5%	0.11	2.5	92.67	93.57
BASIN_443	Excluded	N/A	99.8%	0.00	35.2	94.36	94.36
BASIN_444	Excluded	N/A	99.2%	0.00	9.3	82.59	82.59
BASIN_445	E Windsor Creek	Creek	98.9%	0.28	15.4	84.79	84.60
BASIN_446	E Windsor Trib 11	SD System	99.0%	0.08	1.8	88.24	89.82
BASIN_447	E Windsor Trib 11	SD System	99.0%	0.05	1.0	92.60	93.64
BASIN_448	Pool Creek	SD System	98.0%	0.09	2.4	94.96	96.07
BASIN_449	E Windsor Trib 11	SD System	99.0%	0.06	2.4	91.13	91.62
BASIN_450	Windsor Creek	SD System	98.6%	0.06	2.4	92.90	94.09
BASIN_451	Windsor Creek	SD System	98.6%	0.10	4.0	93.53	93.89
BASIN_452	Windsor Creek	SD System	98.6%	0.08	2.2	94.02	94.51
BASIN_453	Windsor Creek	SD System	98.3%	0.04	5.6	92.88	93.59
BASIN_454	Windsor Creek	SD System	98.3%	0.08	2.6	94.03	94.61
BASIN_455	Pool Creek	SD System	98.1%	0.08	2.3	91.51	92.08
BASIN_456	Pool Creek	Creek	96.7%	1.30	206.1	82.30	83.05
BASIN_457	Pool Creek	SD System	96.2%	0.06	1.6	93.31	96.13
BASIN_458	Pool Creek	SD System	96.2%	0.03	0.4	95.74	96.99
BASIN_459	Pool Creek	SD System	96.2%	0.11	5.0	95.94	96.47
BASIN_460	Pool Creek	SD System	97.6%	0.16	7.0	97.25	95.54
BASIN_461	Faught Creek	Creek	95.8%	0.21	16.8	83.15	95.68
BASIN_462	Pool Creek	SD System	97.2%	0.11	3.5	91.95	92.73
BASIN_463	Pool Creek	SD System	96.2%	0.15	7.7	91.76	91.61
BASIN_464	Airport Creek	SD System	95.8%	0.07	9.9	91.57	95.23
BASIN_465	Excluded	N/A	95.4%	0.00	19.5	90.86	90.86
BASIN_466	Airport Creek	SD System	94.9%	0.10	4.4	97.19	95.34
BASIN_467	Pool Creek	SD System	97.5%	0.09	4.8	82.87	88.81
BASIN_468	Pool Creek	SD System	97.1%	0.08	3.6	89.72	90.90
BASIN_469	Pool Creek	SD System	97.1%	0.11	8.1	89.12	90.30
BASIN_470	Pool Creek	Creek	97.1%	0.27	29.6	87.27	90.69
BASIN_471	Faught Creek	SD System	96.9%	0.10	3.9	90.05	90.72
BASIN_472	Faught Creek	SD System	96.8%	0.18	19.1	87.11	93.93
BASIN_473	Faught Creek	SD System	95.5%	0.11	4.2	86.64	87.83
BASIN_474	Faught Creek	SD System	95.2%	0.10	1.4	85.68	84.73

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_475	Faught Creek	SD System	95.2%	0.09	3.8	86.20	86.14
BASIN_476	Faught Creek	SD System	95.2%	0.11	4.4	89.43	90.29
BASIN_477	Faught Creek	SD System	95.2%	0.14	10.3	89.35	90.16
BASIN_478	Faught Creek	SD System	95.2%	0.12	6.2	85.67	85.17
BASIN_479	Faught Creek	SD System	95.2%	0.09	1.1	94.25	95.30
BASIN_480	Faught Creek	SD System	95.4%	0.06	3.4	97.64	96.04
BASIN_481	Pruitt Creek	SD System	95.7%	0.09	4.6	97.42	97.42
BASIN_482	Pruitt Creek	SD System	95.4%	0.15	3.5	95.49	97.15
BASIN_483	Pruitt Creek	SD System	95.2%	0.08	0.9	91.59	96.38
BASIN_484	Pruitt Creek	SD System	95.7%	0.06	1.4	88.11	94.68
BASIN_485	Pruitt Creek	SD System	95.7%	0.06	2.8	88.76	95.21
BASIN_486	Pruitt Creek	SD System	95.7%	0.11	6.8	95.89	95.34
BASIN_487	Airport Creek	Creek	95.6%	0.28	13.1	96.40	95.34
BASIN_488	Starr Trib T-6	SD System	102.9%	0.04	0.8	94.70	95.73
BASIN_489A	Gumview Creek	Creek	100.0%	0.50	148.3	73.74	75.30
BASIN_489B	Gumview Creek	Creek	100.0%	0.50	201.4	73.75	73.43
BASIN_490	Starr Creek	SD System	102.4%	0.06	2.7	90.52	91.36
BASIN_491	Faught Creek	Creek	97.1%	0.14	6.2	87.75	88.12
BASIN_492	Faught Creek	SD System	97.1%	0.15	9.1	90.77	91.66
BASIN_493	Faught Creek	Creek	97.1%	0.06	1.6	92.21	92.81
BASIN_494A	Faught Creek	SD System	100.0%	0.39	14.6	74.25	68.32
BASIN_494B	Faught Creek	SD System	100.0%	0.24	41.2	74.25	74.22
BASIN_495	E Windsor Creek	SD System	100.5%	0.07	3.5	89.35	90.18
BASIN_496	E Windsor Creek	SD System	101.9%	0.08	8.1	89.99	91.14
BASIN_497	Windsor Creek	SD System	98.5%	0.10	4.7	84.99	84.99
BASIN_498	Windsor Creek	SD System	98.6%	0.02	0.6	93.57	93.98
BASIN_499	Windsor Creek	SD System	98.6%	0.03	0.5	94.01	94.87
BASIN_500	E Windsor Creek	SD System	101.4%	0.10	4.8	85.39	86.20
BASIN_501	Starr Creek	SD System	102.4%	0.07	3.7	86.62	91.48
BASIN_502	Windsor Creek	SD System	101.9%	0.01	0.7	83.77	84.21
BASIN_503	Windsor Creek	SD System	101.9%	0.03	1.0	84.35	85.26
BASIN_504	Gumview Creek	SD System	103.3%	0.04	0.7	90.96	91.93
BASIN_505	E Windsor Trib X	Creek	100.0%	0.23	21.5	88.95	89.53
BASIN_506	Windsor Creek	SD System	99.0%	0.02	0.3	93.08	93.80
BASIN_507	Pool Creek	SD System	97.6%	0.05	2.3	90.22	95.34
BASIN_508	Pool Creek	SD System	97.1%	0.06	3.6	91.57	92.21
BASIN_509	Pruitt Creek	SD System	95.7%	0.04	2.7	91.99	95.34
BASIN_510	Pruitt Creek	SD System	95.7%	0.12	4.4	96.00	95.35
BASIN_511	Faught Creek	SD System	95.2%	0.12	1.9	85.05	94.76

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_512	Faught Creek	SD System	95.7%	0.04	1.5	97.27	96.04
BASIN_513	Faught Creek	SD System	96.2%	0.09	6.3	95.69	95.28
BASIN_514	Pool Creek	Creek	96.9%	0.23	11.9	89.72	96.29
BASIN_515	Airport Creek	SD System	94.3%	0.06	1.9	97.80	95.36
BASIN_516	Pool Creek	SD System	98.6%	0.11	9.3	89.88	91.16
BASIN_517	E Windsor Trib 11	SD System	98.6%	0.13	9.6	91.03	92.32
BASIN_518	Gumview Creek	SD System	103.3%	0.04	10.3	90.32	91.32
BASIN_519	Starr Trib T-6	SD System	102.9%	0.04	0.7	95.36	96.25
BASIN_520	Starr Creek	SD System	102.4%	0.04	1.6	89.69	90.71
BASIN_521	Starr Trib T-6	SD System	102.9%	0.05	0.7	89.41	89.52
BASIN_522	Starr Trib T-6	SD System	102.9%	0.05	0.4	93.44	94.66
BASIN_523	Starr Creek	SD System	101.5%	0.06	1.6	90.13	91.35
BASIN_524	E Windsor Trib X	SD System	100.0%	0.08	1.9	85.89	86.42
BASIN_525	Starr Trib	SD System	101.0%	0.07	1.7	90.61	94.50
BASIN_526	Starr Trib	Creek	101.3%	0.05	2.2	89.60	93.55
BASIN_527	E Windsor Creek	SD System	100.5%	0.07	0.9	96.37	96.06
BASIN_528	E Windsor Creek	SD System	100.5%	0.06	0.5	96.79	96.45
BASIN_529	E Windsor Creek	SD System	100.5%	0.02	0.4	96.35	97.07
BASIN_530	E Windsor Creek	SD System	100.3%	0.07	1.0	94.02	95.72
BASIN_531	E Windsor Creek	SD System	99.0%	0.07	2.9	90.96	94.44
BASIN_532	Windsor Creek	SD System	99.3%	0.08	1.2	92.91	95.57
BASIN_533	Windsor Creek	SD System	98.6%	0.05	1.6	94.84	94.78
BASIN_534	E Windsor Open Ditch	Creek	101.9%	0.06	1.7	85.40	84.32
BASIN_535	Windsor Creek	SD System	100.5%	0.03	0.4	96.05	95.94
BASIN_536	Windsor Creek	SD System	100.4%	0.10	5.2	97.60	97.60
BASIN_537	Excluded	N/A	99.0%	0.00	5.3	83.39	83.39
BASIN_538	Pool Creek	SD System	98.6%	0.07	2.5	93.11	93.76
BASIN_539	Pool Creek	SD System	98.0%	0.06	1.8	91.12	91.11
BASIN_540	Pool Creek	SD System	98.1%	0.06	1.5	92.21	92.69
BASIN_541	Pool Creek	SD System	98.1%	0.14	6.6	90.79	91.43
BASIN_542	Pool Creek	SD System	97.6%	0.05	1.3	92.49	93.48
BASIN_543	E Windsor Creek	SD System	101.9%	0.14	8.6	83.27	83.27
BASIN_544	Starr Creek	SD System	102.4%	0.07	3.4	91.11	92.44
BASIN_545	Starr Creek	SD System	102.4%	0.07	1.3	92.28	93.20
BASIN_546	Starr Trib T-6	SD System	103.6%	0.31	43.4	84.16	89.52
BASIN_547	Starr Trib T-6	Creek	101.4%	0.15	14.1	90.83	91.64
BASIN_548	Starr Creek	SD System	99.0%	0.05	4.4	91.99	91.42
BASIN_549	Pool Creek	SD System	96.2%	0.03	2.1	95.74	96.47
BASIN_550	Starr Creek	Creek	100.3%	0.37	89.6	85.45	85.25

Basin_ID	Watershed	Discharges To	Rainfall Scalar (%)	Lag Time (hr)	Area (acres)	Current CN	Future CN
BASIN_551	Excluded	N/A	95.3%	0.00	16.6	88.19	88.19
BASIN_552	Gumview Creek	Creek	101.9%	0.30	69.7	80.14	80.67
BASIN_553	Starr Creek	Creek	101.4%	0.15	6.6	90.43	92.70
BASIN_554	Windsor Creek	SD System	100.1%	0.04	4.4	92.56	93.78
BASIN_555	Pool Creek	SD System	97.5%	0.22	5.9	94.32	95.63
BASIN_556	Pool Creek	SD System	97.3%	0.11	2.8	95.91	95.68
BASIN_557	Pool Creek	Creek	100.0%	0.18	4.3	84.44	95.41

NOTES:

1. SD System refers to the storm drain system
2. E Windsor Trib X in the model is East Windsor Creek Tributary #6
3. “Excluded” indicates a subbasin that is hydraulically disconnected from the watershed.

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Appendix 5B – Hydrology Model Results

Table 5B-1 below presents final hydrology model results used in the Town of Windsor Storm Drain Master Plan in the form of peak runoff (cfs) for the 10-, 25-, and 100-year return period storms for both baseline and future conditions.

Table 5B-1. MIKE URBAN Hydrology Model Results

	Baseline Hydrology			Future Conditions Hydrology		
BASIN_ID	**10 yr Peak Q (cfs)**	**25 yr Peak Q (cfs)**	**100 yr Peak Q (cfs)**	**10 yr Peak Q (cfs)**	**25 yr Peak Q (cfs)**	**100 yr Peak Q (cfs)**
BASIN_1	47.7	57.5	71.0	49.4	59.2	72.6
BASIN_2	25.6	30.7	38.5	25.6	30.7	38.5
BASIN_3	11.7	13.9	17.1	11.7	13.9	17.1
BASIN_4	22.1	26.5	33.1	22.2	26.6	33.1
BASIN_5	3.1	3.7	4.7	3.2	3.8	4.7
BASIN_6	11.1	13.4	16.7	11.3	13.6	16.9
BASIN_7	2.0	2.4	3.0	2.0	2.4	3.0
BASIN_8	15.6	18.6	22.8	15.7	18.6	22.8
BASIN_9	16.4	19.5	24.2	16.4	19.5	24.2
BASIN_10	6.7	7.9	9.8	6.7	7.9	9.8
BASIN_11	26.8	32.1	39.4	26.3	31.7	39.0
BASIN_12	13.0	15.6	19.2	13.6	16.1	19.6
BASIN_13	11.1	13.1	16.4	11.1	13.1	16.4
BASIN_14	4.3	5.1	6.3	4.3	5.1	6.3
BASIN_15	11.5	13.7	16.8	11.7	13.8	16.9
BASIN_16	13.6	16.1	19.7	13.6	16.1	19.7
BASIN_17	4.9	5.8	7.3	4.9	5.8	7.3
BASIN_18	11.4	13.6	16.7	11.8	14.0	17.1
BASIN_19	8.9	10.6	13.0	8.9	10.6	13.0
BASIN_20	6.9	8.2	10.1	6.9	8.2	10.1
BASIN_21	4.3	5.1	6.4	4.3	5.1	6.4
BASIN_22	14.7	17.5	21.4	14.5	17.3	21.2
BASIN_23	17.1	20.3	25.4	17.1	20.3	25.4
BASIN_24	9.9	11.7	14.3	9.9	11.7	14.3
BASIN_25	12.9	15.4	18.7	12.9	15.4	18.7
BASIN_26	21.8	25.9	31.6	22.1	26.2	31.8
BASIN_27	9.3	11.1	13.6	9.3	11.1	13.7
BASIN_28	14.2	16.9	20.7	14.4	17.0	20.9
BASIN_29	5.0	6.0	7.6	5.0	6.0	7.6
BASIN_30	10.2	12.2	15.1	10.2	12.2	15.1
BASIN_31	7.8	9.3	11.4	7.8	9.3	11.4
BASIN_32	22.4	26.8	33.0	22.4	26.8	33.0
BASIN_33	6.3	7.5	9.4	6.3	7.5	9.4
BASIN_34	4.9	5.9	7.3	4.9	5.9	7.3
BASIN_35	8.6	10.3	12.8	8.6	10.3	12.8
BASIN_36	14.7	17.6	21.8	14.7	17.6	21.9
BASIN_37	34.5	42.1	52.5	33.8	41.4	51.8
BASIN_38	8.0	9.4	11.3	8.0	9.4	11.3
BASIN_39	13.0	15.4	19.4	12.8	15.3	19.2

	Baseline Hydrology			Future Conditions Hydrology		
BASIN_ID	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_40	18.6	22.0	26.8	18.6	22.0	26.8
BASIN_41	9.2	10.8	13.2	9.2	10.8	13.2
BASIN_42	21.8	26.6	33.3	22.7	27.5	34.2
BASIN_43	20.3	24.2	29.9	20.3	24.2	29.9
BASIN_44	14.4	17.2	21.4	14.4	17.2	21.4
BASIN_45	7.9	9.5	11.8	7.8	9.4	11.7
BASIN_46	88.9	112.0	144.7	86.5	109.4	142.0
BASIN_47	29.2	36.2	45.8	28.5	35.5	45.1
BASIN_48	14.2	16.8	20.6	14.2	16.8	20.6
BASIN_49	7.4	8.8	10.9	7.5	8.9	11.0
BASIN_50	8.9	10.6	13.1	8.9	10.6	13.1
BASIN_51	13.5	17.1	22.3	17.7	21.4	26.7
BASIN_52	15.4	18.3	22.5	15.4	18.3	22.5
BASIN_53A	127.0	158.6	203.4	102.6	132.6	175.9
BASIN_53B	8.9	14.5	38.6	206.4	252.4	316.9
BASIN_54	14.7	17.5	21.7	14.7	17.5	21.7
BASIN_55	12.3	14.7	18.1	12.3	14.7	18.1
BASIN_56	6.1	7.2	8.9	6.2	7.3	9.0
BASIN_57	7.2	8.5	10.6	7.3	8.7	10.7
BASIN_58	14.8	17.5	21.1	14.7	17.3	21.0
BASIN_59	12.5	15.0	18.7	13.2	15.5	19.2
BASIN_60	13.2	16.1	20.3	15.8	18.7	22.7
BASIN_61	13.4	16.0	20.0	13.5	16.1	20.0
BASIN_62	18.8	22.7	28.7	18.8	22.8	28.7
BASIN_63	27.6	33.1	40.7	28.1	33.5	41.1
BASIN_64	14.9	17.9	22.2	14.9	17.9	22.2
BASIN_65	8.3	10.0	12.5	8.3	10.0	12.5
BASIN_66	12.9	15.7	19.6	13.4	16.2	20.1
BASIN_67	94.6	119.4	153.9	94.8	119.6	154.1
BASIN_68	17.8	21.5	26.6	17.8	21.5	26.6
BASIN_69	5.6	6.7	8.3	5.8	7.0	8.5
BASIN_70	10.7	13.2	16.9	10.7	13.2	16.9
BASIN_71	50.2	63.1	80.9	51.7	64.7	82.5
BASIN_72	103.5	131.1	170.0	106.8	134.6	173.8
BASIN_73	1.5	1.8	2.3	1.5	1.8	2.3
BASIN_74	12.7	15.2	18.8	12.7	15.2	18.8
BASIN_75	26.4	34.0	44.8	26.5	34.0	44.9
BASIN_76	11.9	14.8	18.9	12.0	14.8	18.9
BASIN_77	10.7	13.0	16.4	10.7	13.0	16.4
BASIN_78	93.2	121.2	161.1	93.5	121.5	161.5
BASIN_79	32.8	41.7	54.3	32.9	41.8	54.4
BASIN_80	13.7	17.6	23.3	13.8	17.6	23.3
BASIN_81	9.0	11.3	14.7	8.8	11.1	14.4
BASIN_82	37.6	48.4	63.6	37.7	48.5	63.7
BASIN_83	9.0	11.3	14.8	9.0	11.4	14.8
BASIN_84	14.2	17.3	21.7	14.2	17.3	21.8
BASIN_85	22.4	26.7	32.9	22.4	26.7	32.9
BASIN_86	15.6	18.6	23.6	15.6	18.7	23.6

	Baseline Hydrology			Future Conditions Hydrology		
BASIN_ID	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_87	7.5	9.2	11.7	7.5	9.2	11.7
BASIN_88	9.9	11.7	14.3	9.9	11.7	14.3
BASIN_89	20.3	24.0	29.2	20.3	24.0	29.2
BASIN_90	19.3	22.7	27.6	19.2	22.6	27.5
BASIN_91	34.7	40.8	50.6	34.4	40.6	50.4
BASIN_92	3.0	3.5	4.4	3.0	3.5	4.4
BASIN_93	14.3	16.9	20.7	14.3	16.9	20.7
BASIN_94	54.1	64.5	78.9	57.4	67.6	81.7
BASIN_95	5.0	6.2	8.0	5.0	6.2	8.0
BASIN_96	12.5	15.1	18.9	13.4	16.1	19.7
BASIN_97	33.8	42.1	53.6	34.7	43.0	54.6
BASIN_98	11.8	14.1	17.3	11.8	14.1	17.3
BASIN_99	15.0	18.4	23.3	15.7	19.0	23.9
BASIN_100	29.3	35.7	44.7	29.9	36.4	45.3
BASIN_101	36.2	43.9	54.3	37.0	44.6	54.9
BASIN_102	32.9	40.2	50.3	33.7	40.9	51.0
BASIN_103	13.4	15.9	20.0	13.4	15.9	20.0
BASIN_104	30.7	36.6	45.3	30.7	36.7	45.3
BASIN_105	9.0	10.7	13.3	9.0	10.7	13.3
BASIN_106	50.5	60.2	76.8	50.6	60.2	76.9
BASIN_107	7.0	8.3	10.1	7.1	8.3	10.2
BASIN_108	7.3	8.8	10.7	7.3	8.8	10.7
BASIN_109	7.7	9.1	11.2	7.7	9.1	11.2
BASIN_110	18.3	22.0	27.2	18.3	22.0	27.2
BASIN_111	11.2	13.3	16.3	11.2	13.3	16.3
BASIN_112	13.5	17.0	22.0	13.5	17.0	22.0
BASIN_113	10.2	12.3	15.3	10.2	12.3	15.3
BASIN_114	56.0	67.8	84.0	58.1	69.8	86.0
BASIN_115	20.8	25.1	31.3	23.1	27.3	33.4
BASIN_116	19.2	24.1	31.2	23.8	28.7	35.8
BASIN_117	42.7	53.4	68.1	47.3	58.1	72.9
BASIN_118	21.5	26.0	32.9	21.5	26.0	32.9
BASIN_119	21.9	26.5	32.9	21.9	26.5	33.0
BASIN_120	8.5	10.4	13.1	9.7	11.6	14.2
BASIN_121	10.7	12.7	15.7	10.7	12.7	15.7
BASIN_122	128.7	166.3	220.2	129.0	166.7	220.6
BASIN_123	53.0	64.6	80.6	58.3	69.8	85.6
BASIN_124	7.2	8.5	10.5	7.2	8.5	10.5
BASIN_125	3.5	4.1	5.0	3.5	4.1	5.0
BASIN_126	9.7	11.6	14.5	10.3	12.2	15.0
BASIN_127	10.2	12.1	14.9	10.0	11.9	14.8
BASIN_128	10.7	13.0	16.2	10.7	13.0	16.2
BASIN_129	5.4	6.5	8.1	5.4	6.5	8.1
BASIN_130	13.1	15.9	19.8	13.1	15.9	19.8
BASIN_131	10.3	13.1	17.3	10.3	13.2	17.3
BASIN_132	34.0	42.6	54.4	34.1	42.6	54.5
BASIN_133	22.9	27.5	34.0	23.3	27.9	34.3
BASIN_134	12.9	15.4	18.7	12.9	15.4	18.7

	Baseline Hydrology			Future Conditions Hydrology		
BASIN_ID	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_135	11.9	14.3	17.8	11.9	14.3	17.8
BASIN_136	2.6	3.2	4.0	2.6	3.2	4.0
BASIN_137	12.6	14.9	18.2	12.7	15.1	18.4
BASIN_138	1.9	2.3	2.9	1.9	2.4	3.0
BASIN_139	6.0	7.2	8.9	6.0	7.2	8.9
BASIN_140	16.9	20.2	25.5	16.6	20.0	25.3
BASIN_141	9.4	11.2	13.8	9.7	11.5	14.1
BASIN_142	11.3	13.3	16.4	11.3	13.3	16.4
BASIN_143	6.9	8.2	10.0	6.9	8.2	10.0
BASIN_144	15.7	18.8	23.1	15.7	18.8	23.1
BASIN_145	12.6	15.2	19.0	12.4	15.0	18.8
BASIN_146	13.0	15.6	19.4	13.0	15.6	19.4
BASIN_147	15.1	18.2	22.5	15.4	18.4	22.8
BASIN_148	4.9	5.8	7.2	4.9	5.8	7.2
BASIN_149	33.0	39.9	49.4	33.0	40.0	49.4
BASIN_150	4.9	5.9	7.2	5.0	5.9	7.3
BASIN_151	8.7	10.2	12.6	8.7	10.3	12.6
BASIN_152	14.6	17.3	21.4	14.8	17.4	21.5
BASIN_153	6.0	7.1	8.9	6.0	7.1	8.9
BASIN_154	12.3	14.6	18.1	12.3	14.6	18.1
BASIN_155	3.2	3.8	4.7	3.2	3.8	4.7
BASIN_156	12.9	15.4	19.0	12.9	15.4	19.0
BASIN_157	8.4	10.0	12.4	8.2	9.8	12.2
BASIN_158	4.8	5.7	7.0	4.8	5.7	7.0
BASIN_159	13.1	15.6	19.5	13.5	16.0	19.8
BASIN_160	70.0	84.2	103.5	71.3	85.4	104.6
BASIN_161	8.9	10.6	13.0	8.9	10.6	13.0
BASIN_162	10.0	11.9	14.7	10.0	11.9	14.7
BASIN_163	8.7	10.3	12.8	9.0	10.6	13.0
BASIN_164	12.2	14.7	18.2	12.2	14.7	18.2
BASIN_165	12.5	14.9	18.5	12.5	14.9	18.5
BASIN_166	15.8	19.0	23.5	15.9	19.0	23.5
BASIN_167	18.0	21.5	26.3	18.0	21.5	26.3
BASIN_168	11.2	13.3	16.5	11.2	13.3	16.5
BASIN_169A	10.7	13.5	17.6	10.0	12.8	16.8
BASIN_169B	59.3	75.0	97.6	66.6	82.6	105.5
BASIN_170	9.9	11.8	14.6	10.0	11.8	14.6
BASIN_171	11.7	13.9	17.0	11.7	13.9	17.0
BASIN_172	38.6	47.0	59.6	44.7	52.9	65.3
BASIN_173	11.2	13.5	16.8	11.2	13.5	16.8
BASIN_174	9.2	11.0	13.6	9.4	11.2	13.7
BASIN_175	31.4	37.3	46.8	31.4	37.3	46.8
BASIN_176	6.6	7.9	9.7	7.0	8.3	10.1
BASIN_177	15.7	18.6	22.6	15.8	18.7	22.7
BASIN_178	10.9	13.0	16.2	11.1	13.2	16.3
BASIN_179	22.5	26.9	32.9	22.9	27.3	33.3
BASIN_180	9.5	11.5	14.5	9.9	11.8	14.8
BASIN_181	20.1	24.4	30.3	20.1	24.4	30.3

	Baseline Hydrology			Future Conditions Hydrology		
BASIN_ID	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_182	10.6	12.9	16.2	10.6	12.9	16.2
BASIN_183	8.5	10.2	12.5	8.7	10.3	12.7
BASIN_184	29.6	35.0	43.1	29.8	35.3	43.3
BASIN_185	6.1	7.3	8.9	6.2	7.3	9.0
BASIN_186	11.1	13.1	16.0	11.1	13.1	16.0
BASIN_187	9.7	11.7	14.5	10.6	12.5	15.3
BASIN_188	12.8	15.1	18.4	12.8	15.1	18.4
BASIN_189	15.9	18.8	22.8	15.8	18.6	22.7
BASIN_190	7.0	8.5	11.0	8.0	9.5	11.9
BASIN_191	15.6	18.4	22.5	15.5	18.3	22.4
BASIN_192	10.7	12.6	15.4	10.6	12.5	15.3
BASIN_193	14.2	16.7	21.2	14.2	16.7	21.2
BASIN_194	11.1	13.0	15.9	10.9	12.9	15.8
BASIN_195	7.9	9.4	11.6	7.9	9.4	11.6
BASIN_196	12.4	14.8	18.2	12.4	14.8	18.2
BASIN_197	20.7	24.8	30.3	20.7	24.8	30.4
BASIN_198	8.3	9.8	12.1	8.3	9.8	12.1
BASIN_199	7.5	8.9	10.9	7.5	8.9	10.9
BASIN_200	14.8	17.8	22.0	14.8	17.8	22.0
BASIN_201	18.6	22.3	27.5	18.6	22.3	27.6
BASIN_202	12.2	14.7	18.2	12.2	14.7	18.2
BASIN_203	9.9	11.9	14.7	9.9	11.9	14.7
BASIN_204	10.6	12.7	15.8	10.6	12.7	15.8
BASIN_205	25.1	29.8	36.4	25.1	29.8	36.4
BASIN_206	5.9	7.1	8.7	5.9	7.1	8.7
BASIN_207	3.0	3.6	4.4	3.0	3.6	4.4
BASIN_208	13.5	16.0	19.7	13.5	16.0	19.7
BASIN_209	11.9	14.2	17.6	12.0	14.4	17.7
BASIN_210	15.9	19.0	23.3	16.6	19.7	23.9
BASIN_211	9.4	11.2	13.9	9.4	11.2	13.9
BASIN_212	30.8	36.3	44.0	31.0	36.6	44.2
BASIN_213	69.5	85.4	107.5	81.3	97.0	118.7
BASIN_214	18.2	21.6	26.3	18.5	21.9	26.6
BASIN_215	7.6	9.0	11.4	7.6	9.0	11.4
BASIN_216	9.4	11.3	13.9	9.9	11.8	14.4
BASIN_217	18.4	22.2	27.7	18.4	22.2	27.7
BASIN_218	5.2	6.3	7.9	5.2	6.3	7.9
BASIN_219	18.6	22.6	28.4	18.6	22.6	28.4
BASIN_220	11.3	13.5	16.7	11.4	13.5	16.7
BASIN_221	4.5	5.4	6.8	4.5	5.4	6.8
BASIN_222	29.7	37.0	47.3	29.8	37.0	47.4
BASIN_223	12.1	14.5	18.0	12.1	14.5	18.0
BASIN_224	5.8	7.0	8.8	5.8	7.0	8.8
BASIN_225	113.8	139.8	175.9	116.6	142.6	178.7
BASIN_226	37.9	45.7	56.4	39.8	47.6	58.1
BASIN_227	9.6	11.5	14.4	9.6	11.5	14.4
BASIN_228	19.0	22.7	27.9	19.0	22.7	27.9
BASIN_229	27.5	32.9	40.3	29.2	34.4	41.7

BASIN_ID	Baseline Hydrology			Future Conditions Hydrology		
	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_230	12.3	14.7	18.2	12.3	14.7	18.2
BASIN_231	3.6	4.3	5.4	3.6	4.3	5.4
BASIN_232	10.9	13.0	16.2	10.9	13.0	16.2
BASIN_233	5.0	6.1	7.6	4.9	5.9	7.4
BASIN_234	9.6	11.5	14.3	10.0	11.8	14.6
BASIN_235	11.1	13.1	16.2	11.3	13.4	16.5
BASIN_236	5.7	6.8	8.4	5.8	6.8	8.4
BASIN_237	4.0	4.8	5.9	4.0	4.7	5.9
BASIN_238	15.4	18.3	22.2	15.6	18.5	22.4
BASIN_239	33.2	39.4	47.9	33.2	39.4	47.9
BASIN_240	3.9	4.6	5.8	3.9	4.6	5.8
BASIN_241	18.2	21.5	25.9	18.2	21.5	25.9
BASIN_242	8.9	10.6	13.0	8.9	10.6	13.0
BASIN_243	15.3	18.2	22.3	15.3	18.2	22.3
BASIN_244	12.7	15.2	18.8	12.7	15.2	18.8
BASIN_245	22.2	26.6	32.7	22.2	26.6	32.7
BASIN_246	12.0	14.5	18.0	12.0	14.5	18.0
BASIN_247	16.6	19.7	24.4	16.6	19.7	24.4
BASIN_248	103.4	129.8	166.6	106.5	133.0	169.9
BASIN_249	14.8	17.6	21.9	15.3	18.2	22.5
BASIN_250	10.9	13.1	16.5	11.4	13.6	16.9
BASIN_251	34.5	41.5	51.8	35.1	42.1	52.3
BASIN_252	8.3	10.5	14.2	8.3	10.5	14.2
BASIN_253	13.4	15.9	19.5	13.6	16.1	19.7
BASIN_254	11.0	13.2	16.2	11.5	13.6	16.6
BASIN_255	8.0	9.4	11.6	8.0	9.4	11.6
BASIN_256	7.0	8.2	10.2	7.0	8.3	10.2
BASIN_257	10.8	12.8	15.7	10.7	12.7	15.6
BASIN_258	8.6	10.2	12.5	8.6	10.2	12.5
BASIN_259	8.2	9.6	11.8	8.2	9.6	11.8
BASIN_260	9.7	11.5	14.0	9.9	11.7	14.2
BASIN_261	32.7	38.7	47.5	33.0	39.0	47.8
BASIN_262	20.6	24.6	30.2	21.2	25.2	30.7
BASIN_263	17.1	20.6	25.5	18.5	22.0	26.8
BASIN_264	4.7	5.7	7.0	4.7	5.7	7.0
BASIN_265	6.6	7.9	9.8	6.7	8.0	9.9
BASIN_266	8.7	10.4	13.0	8.7	10.4	13.0
BASIN_267	48.5	57.8	70.5	49.2	58.4	71.0
BASIN_268	6.3	7.5	9.3	6.3	7.5	9.3
BASIN_269	35.3	41.9	51.2	35.3	41.9	51.2
BASIN_270	5.3	6.3	7.9	5.5	6.5	8.1
BASIN_271	10.7	12.7	15.6	10.8	12.9	15.8
BASIN_272	13.5	16.1	19.8	13.7	16.4	20.0
BASIN_273	8.1	9.6	11.9	8.2	9.7	11.9
BASIN_274	2.0	2.5	3.0	2.1	2.5	3.1
BASIN_275	1.3	1.6	1.9	1.3	1.6	2.0
BASIN_276	7.8	9.5	12.0	8.5	10.2	12.6
BASIN_277	12.5	14.9	18.4	12.7	15.1	18.5

	Baseline Hydrology			Future Conditions Hydrology		
BASIN_ID	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_278	12.0	14.4	17.7	12.2	14.5	17.8
BASIN_279	5.4	6.5	8.2	5.5	6.5	8.2
BASIN_280	16.2	19.5	24.1	16.5	19.7	24.3
BASIN_281	4.9	5.9	7.3	5.0	5.9	7.4
BASIN_282	10.3	12.4	15.3	10.5	12.5	15.4
BASIN_283	8.6	10.2	12.5	8.7	10.2	12.6
BASIN_284	10.4	12.3	15.0	10.4	12.3	15.0
BASIN_285	25.5	31.0	38.8	25.5	31.0	38.8
BASIN_286	15.3	18.3	22.6	15.5	18.5	22.8
BASIN_287	9.6	11.4	14.1	9.7	11.5	14.2
BASIN_288	10.5	12.5	15.5	10.5	12.5	15.5
BASIN_289	17.7	20.9	25.5	17.7	20.9	25.5
BASIN_290	12.1	14.4	17.7	12.1	14.4	17.7
BASIN_291	10.9	13.0	16.1	10.9	13.0	16.1
BASIN_292	16.7	19.8	24.2	16.9	20.0	24.3
BASIN_293	15.3	18.2	22.2	15.5	18.3	22.3
BASIN_294	5.7	6.9	8.5	5.7	6.9	8.5
BASIN_295	15.8	18.9	23.0	15.8	18.9	23.0
BASIN_296	10.6	12.6	15.8	10.0	12.0	15.1
BASIN_297	16.1	19.2	23.6	16.5	19.6	24.0
BASIN_298	7.8	9.4	11.9	7.8	9.5	11.9
BASIN_299A	52.8	66.5	86.3	51.3	64.9	84.7
BASIN_299B	51.7	65.1	84.6	50.2	63.5	83.0
BASIN_299C	45.1	56.9	73.9	45.2	57.0	74.0
BASIN_299D	62.9	79.3	103.1	63.0	79.4	103.2
BASIN_299E	19.0	23.9	31.1	20.2	25.2	32.5
BASIN_299F	61.4	77.5	100.7	65.3	81.6	105.0
BASIN_299G	4.1	5.2	6.8	4.4	5.5	7.1
BASIN_299H	13.9	17.5	22.8	15.6	19.3	24.6
BASIN_299I	40.7	51.4	66.9	49.3	60.3	76.0
BASIN_299J	102.3	129.3	168.0	120.8	148.5	187.9
BASIN_299K	89.4	112.8	146.6	103.0	127.0	161.3
BASIN_299L	104.5	131.7	171.1	126.5	154.6	194.7
BASIN_299M	106.5	134.2	174.3	106.8	134.4	174.6
BASIN_299N	105.5	132.9	172.7	86.3	112.2	150.4
BASIN_299O	43.1	54.6	70.9	39.3	50.4	66.5
BASIN_299P	114.6	145.1	188.7	104.4	134.2	177.0
BASIN_299Q	84.3	106.7	138.8	84.4	106.9	138.9
BASIN_299R	106.0	134.0	174.2	112.7	141.0	181.6
BASIN_299S	79.3	100.5	130.6	60.2	79.7	108.1
BASIN_299T	106.5	135.0	175.3	97.1	124.9	164.6
BASIN_299U	67.4	85.4	110.7	61.5	79.1	104.0
BASIN_300	3.0	3.6	4.6	3.0	3.6	4.6
BASIN_301	12.4	15.1	18.8	12.9	15.5	19.2
BASIN_302	35.0	42.4	52.7	37.0	44.3	54.5
BASIN_303	12.5	15.3	19.2	11.7	14.5	18.4
BASIN_304	16.5	19.6	24.7	16.5	19.6	24.7
BASIN_305	10.2	12.5	15.7	11.1	13.3	16.5

	Baseline Hydrology			Future Conditions Hydrology		
BASIN_ID	**10 yr Peak Q (cfs)**	**25 yr Peak Q (cfs)**	**100 yr Peak Q (cfs)**	**10 yr Peak Q (cfs)**	**25 yr Peak Q (cfs)**	**100 yr Peak Q (cfs)**
BASIN_306A	53.7	70.3	94.7	62.3	79.6	105.0
BASIN_306B	79.5	103.9	140.0	67.5	90.5	125.0
BASIN_306C	65.9	86.0	116.0	46.0	63.7	90.6
BASIN_306D	74.9	98.2	132.5	89.6	114.3	150.1
BASIN_306E	76.9	101.0	136.3	86.1	111.1	147.3
BASIN_306F	61.8	80.6	108.6	69.2	88.7	117.5
BASIN_306G	16.4	21.3	28.7	15.8	20.7	28.0
BASIN_306H	52.0	67.8	91.3	44.2	59.1	81.5
BASIN_306I	20.9	27.4	36.9	18.6	24.8	34.0
BASIN_306J	22.1	29.0	39.1	12.2	17.7	26.2
BASIN_306K	34.6	45.4	61.3	25.5	35.1	49.7
BASIN_306L	62.9	82.7	111.6	51.1	69.4	96.7
BASIN_306M	85.2	112.2	151.2	95.3	123.2	163.3
BASIN_306N	51.4	67.3	90.7	45.6	60.8	83.5
BASIN_306O	101.1	133.0	179.5	113.1	146.2	193.9
BASIN_306P	165.5	217.6	292.7	197.5	252.6	330.5
BASIN_307	63.9	78.2	97.9	65.4	79.7	99.3
BASIN_308A	88.5	113.7	150.6	85.7	110.6	147.2
BASIN_308B	73.0	93.7	124.2	60.5	80.0	109.0
BASIN_308C	29.5	37.9	50.3	25.5	33.5	45.4
BASIN_308D	89.4	115.0	152.5	74.1	98.1	133.9
BASIN_308E	85.5	110.1	146.1	42.3	61.2	90.6
BASIN_308F	98.3	126.5	167.9	105.4	134.3	176.1
BASIN_308G	12.6	16.3	21.6	7.9	11.0	15.7
BASIN_308H	80.6	103.9	137.9	55.9	76.4	107.2
BASIN_308I	51.8	66.9	88.8	29.0	41.2	59.9
BASIN_308J	44.1	57.0	75.6	42.7	55.4	73.9
BASIN_308K	131.1	169.6	224.9	145.0	184.6	241.1
BASIN_308L	103.3	133.6	177.1	114.2	145.4	189.8
BASIN_308M	74.1	95.9	127.1	89.5	112.4	144.6
BASIN_308N	170.9	221.1	293.0	229.1	282.8	357.6
BASIN_308O	29.9	38.7	51.2	41.0	50.4	63.4
BASIN_308P	113.5	146.8	194.2	175.3	210.8	259.5
BASIN_308Q	129.4	167.3	221.2	184.9	225.5	281.4
BASIN_309	144.3	180.2	230.5	144.5	180.5	230.8
BASIN_310	167.1	208.8	266.9	167.4	209.1	267.3
BASIN_311	209.7	257.4	324.1	210.0	257.7	324.4
BASIN_312	38.1	45.7	55.9	40.7	48.1	58.2
BASIN_313A	385.7	482.1	616.4	406.8	504.0	638.8
BASIN_313B	280.6	350.9	449.5	288.7	359.3	458.1
BASIN_313C	321.9	401.8	515.3	339.9	420.4	534.5
BASIN_313D	266.5	331.0	424.0	222.2	284.1	374.6
BASIN_313E	321.2	399.0	511.1	339.3	417.7	530.4
BASIN_314	6.0	7.1	8.7	6.0	7.1	8.7
BASIN_315	1.3	1.6	1.9	1.3	1.6	1.9
BASIN_316	4.1	4.9	6.1	4.1	4.9	6.1
BASIN_317	9.0	10.7	13.1	9.1	10.8	13.2
BASIN_318	30.3	36.4	45.0	29.8	36.0	44.5

	Baseline Hydrology			Future Conditions Hydrology		
BASIN_ID	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_319	72.4	86.0	104.5	73.2	86.8	105.2
BASIN_320	4.1	4.9	6.2	4.2	5.0	6.3
BASIN_321	1.1	1.3	1.6	1.1	1.3	1.6
BASIN_322	3.2	3.8	4.7	3.2	3.8	4.7
BASIN_323	2.7	3.2	4.0	2.7	3.2	4.0
BASIN_324	9.4	11.2	13.7	9.4	11.2	13.7
BASIN_325	2.6	3.0	3.8	2.6	3.1	3.8
BASIN_326	11.0	13.2	16.2	11.2	13.4	16.4
BASIN_327	5.4	6.4	7.8	5.4	6.4	7.9
BASIN_328	3.2	3.9	4.8	3.3	3.9	4.9
BASIN_329	10.9	12.9	15.7	10.7	12.7	15.6
BASIN_330	12.5	14.9	18.3	12.8	15.3	18.6
BASIN_331	13.3	15.8	19.4	13.3	15.8	19.4
BASIN_332	10.5	12.7	15.9	11.1	13.2	16.4
BASIN_333	13.6	16.2	19.9	13.6	16.2	19.9
BASIN_334	11.4	13.6	16.9	11.6	13.8	17.0
BASIN_335	15.1	18.0	22.0	15.1	18.0	22.0
BASIN_336	10.2	12.2	15.0	10.2	12.2	15.0
BASIN_337	12.0	14.9	18.9	14.2	17.1	21.0
BASIN_338	5.4	6.5	8.1	5.5	6.6	8.2
BASIN_339	15.2	18.0	22.1	15.4	18.2	22.3
BASIN_340	6.1	7.3	9.3	6.1	7.3	9.3
BASIN_341	12.4	14.7	18.4	12.5	14.9	18.5
BASIN_342	14.2	17.0	21.0	14.4	17.1	21.2
BASIN_343	7.7	9.2	11.5	7.7	9.2	11.5
BASIN_344	4.2	5.0	6.3	4.2	5.0	6.3
BASIN_345	9.1	10.8	13.2	9.2	10.9	13.2
BASIN_346	13.3	15.8	19.3	13.3	15.8	19.3
BASIN_347	4.8	5.7	7.1	4.7	5.7	7.0
BASIN_348	10.4	12.3	15.1	10.2	12.1	14.9
BASIN_349	13.4	16.2	20.2	13.4	16.2	20.2
BASIN_350	16.8	20.6	26.1	20.5	24.3	29.6
BASIN_351	11.1	13.1	16.0	11.1	13.0	15.9
BASIN_352	6.5	7.7	9.5	6.5	7.7	9.5
BASIN_353	13.0	15.4	18.7	13.0	15.4	18.7
BASIN_354	12.3	14.7	18.2	12.5	14.8	18.4
BASIN_355	11.4	13.6	17.1	11.6	13.8	17.2
BASIN_356	17.1	20.4	25.1	17.1	20.4	25.1
BASIN_357	2.8	3.4	4.2	2.9	3.4	4.2
BASIN_358	3.3	4.0	5.1	3.2	4.0	5.0
BASIN_359	4.1	5.0	6.3	4.3	5.1	6.4
BASIN_360	12.1	14.7	18.5	12.4	15.0	18.8
BASIN_361	6.5	7.8	9.8	6.7	8.1	10.0
BASIN_362	10.8	13.1	16.6	11.1	13.3	16.8
BASIN_363	8.2	9.9	12.7	8.4	10.1	12.9
BASIN_364	16.5	20.6	26.3	16.6	20.6	26.3
BASIN_365	10.4	12.7	16.0	11.9	14.2	17.4
BASIN_366	85.2	101.8	124.4	89.6	105.9	128.2

	Baseline Hydrology			Future Conditions Hydrology		
BASIN_ID	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_367	21.5	25.3	30.7	21.5	25.3	30.7
BASIN_368	8.3	9.9	12.1	8.5	10.1	12.3
BASIN_369	18.0	21.6	26.5	19.1	22.6	27.4
BASIN_370	11.8	13.9	17.0	11.8	13.9	17.0
BASIN_371	23.6	28.3	34.9	24.9	29.6	36.1
BASIN_372	4.6	5.4	6.6	4.6	5.4	6.6
BASIN_373	25.1	30.6	38.0	28.6	33.9	41.1
BASIN_374	20.8	26.0	33.2	19.7	24.8	32.0
BASIN_375	19.9	25.4	33.0	19.3	24.7	32.3
BASIN_376	7.8	9.4	11.8	8.1	9.6	11.9
BASIN_377	34.8	42.3	52.5	39.1	46.4	56.5
BASIN_378	88.3	109.0	137.4	88.5	109.1	137.6
BASIN_379	14.1	17.0	21.1	14.3	17.3	21.3
BASIN_380	5.2	6.3	7.7	5.3	6.3	7.8
BASIN_381	4.7	5.7	7.2	4.9	5.8	7.3
BASIN_382	20.9	25.1	31.1	21.3	25.4	31.4
BASIN_383	17.5	21.0	25.9	17.8	21.3	26.1
BASIN_384	17.0	20.2	24.8	17.0	20.2	24.8
BASIN_385	8.9	10.6	13.1	9.0	10.7	13.2
BASIN_386	7.5	8.9	11.1	7.6	9.1	11.2
BASIN_387	3.7	4.5	5.6	3.8	4.6	5.7
BASIN_388	15.1	18.0	22.2	15.5	18.4	22.6
BASIN_389	26.3	31.7	39.1	28.8	34.0	41.2
BASIN_390A	82.5	99.5	123.6	74.9	91.8	116.0
BASIN_390B	101.0	121.9	151.7	101.1	122.0	151.8
BASIN_390C	14.6	17.6	21.9	15.3	18.3	22.6
BASIN_390D	79.5	96.0	119.5	91.9	108.0	130.9
BASIN_390E	106.2	128.3	159.9	104.0	126.0	157.7
BASIN_390F	95.8	116.0	145.0	103.8	123.9	152.7
BASIN_390G	121.5	147.2	184.0	133.9	159.3	195.7
BASIN_390H	220.3	268.6	336.0	215.7	264.0	331.5
BASIN_390I	194.2	236.7	296.2	177.1	219.4	278.8
BASIN_390J	134.7	164.3	205.1	110.5	139.4	179.8
BASIN_391	10.0	12.3	15.7	10.0	12.3	15.8
BASIN_392	20.5	24.2	29.3	20.3	24.0	29.2
BASIN_393	37.3	45.8	57.6	38.2	46.7	58.6
BASIN_394	35.7	43.0	52.8	37.5	44.6	54.3
BASIN_395	12.1	14.5	18.1	12.8	15.2	18.8
BASIN_396	9.7	11.7	14.5	9.9	11.8	14.7
BASIN_397	12.4	14.7	18.1	12.8	15.1	18.4
BASIN_398	7.5	8.8	10.8	7.5	8.9	10.8
BASIN_399	11.1	13.2	16.2	11.6	13.7	16.6
BASIN_400	3.7	4.4	5.5	3.7	4.4	5.6
BASIN_401	1.2	1.4	1.8	1.2	1.4	1.8
BASIN_402	10.7	12.8	16.0	10.6	12.6	15.9
BASIN_403	97.9	124.7	162.5	98.2	124.9	162.8
BASIN_404	29.2	36.8	48.0	27.6	35.1	46.2
BASIN_405	3.3	4.0	4.9	3.4	4.0	4.9

	Baseline Hydrology			Future Conditions Hydrology		
BASIN_ID	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_406	19.3	23.1	28.3	19.3	23.1	28.3
BASIN_407	6.6	8.0	10.2	7.0	8.3	10.5
BASIN_408	37.9	45.4	56.0	38.5	45.9	56.5
BASIN_409	21.4	25.5	31.4	21.4	25.5	31.5
BASIN_410	4.2	5.0	6.3	4.3	5.1	6.4
BASIN_411	4.1	4.9	6.1	4.1	4.9	6.1
BASIN_412	9.7	11.7	14.7	10.0	11.9	14.9
BASIN_413	12.7	15.2	18.7	12.5	15.0	18.5
BASIN_414	11.8	14.1	17.4	11.9	14.3	17.6
BASIN_415	14.0	16.8	20.7	14.2	17.0	20.9
BASIN_416	5.2	6.3	8.0	5.3	6.4	8.1
BASIN_417	7.3	8.9	11.2	7.2	8.7	11.1
BASIN_418	5.2	6.1	7.6	5.2	6.1	7.6
BASIN_419	10.2	12.1	15.1	10.3	12.3	15.2
BASIN_420	25.5	30.5	37.7	27.1	31.9	39.0
BASIN_421	21.8	26.1	32.1	22.7	26.9	32.8
BASIN_422	9.7	11.4	14.1	9.7	11.4	14.1
BASIN_423	15.8	18.9	23.3	15.8	18.9	23.3
BASIN_424	18.9	22.7	28.3	19.2	23.0	28.6
BASIN_425	5.1	6.1	7.8	5.2	6.3	7.9
BASIN_426	16.8	20.3	25.4	17.2	20.6	25.7
BASIN_427	10.7	13.2	16.8	10.7	13.2	16.8
BASIN_428	6.7	8.1	10.1	6.8	8.2	10.2
BASIN_429	14.7	17.8	22.4	15.3	18.3	22.9
BASIN_430	11.7	14.1	17.5	11.9	14.3	17.7
BASIN_431	14.1	17.0	21.0	14.3	17.2	21.3
BASIN_432	13.6	16.2	20.4	13.8	16.4	20.6
BASIN_433	8.9	10.6	13.3	9.0	10.8	13.5
BASIN_434	12.2	14.9	19.1	12.2	14.9	19.1
BASIN_435	4.0	4.8	5.9	4.1	4.8	5.9
BASIN_436	10.9	13.1	16.3	11.1	13.3	16.5
BASIN_437	5.7	6.7	8.3	5.8	6.8	8.3
BASIN_438	2.7	3.2	4.1	2.8	3.3	4.1
BASIN_439	7.2	8.5	10.7	7.3	8.6	10.7
BASIN_440	3.3	3.9	4.9	3.2	3.9	4.9
BASIN_441	3.6	4.3	5.3	3.6	4.2	5.3
BASIN_442	5.4	6.4	7.9	5.5	6.5	7.9
BASIN_443	114.7	135.7	171.9	114.7	135.7	171.9
BASIN_444	25.4	31.1	40.7	25.4	31.1	40.7
BASIN_445	19.2	23.4	29.2	19.2	23.4	29.2
BASIN_446	4.1	4.9	6.1	4.2	5.0	6.3
BASIN_447	2.8	3.4	4.2	2.9	3.4	4.2
BASIN_448	5.7	6.7	8.3	5.7	6.8	8.3
BASIN_449	6.3	7.5	9.5	6.4	7.6	9.6
BASIN_450	6.7	7.9	9.9	6.7	8.0	10.0
BASIN_451	9.1	10.8	13.3	9.1	10.8	13.3
BASIN_452	5.3	6.3	7.8	5.4	6.4	7.9
BASIN_453	16.5	19.6	24.6	16.7	19.8	24.8

	Baseline Hydrology			Future Conditions Hydrology		
BASIN_ID	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_454	6.3	7.5	9.3	6.4	7.6	9.3
BASIN_455	5.4	6.4	8.0	5.4	6.4	8.0
BASIN_456	115.3	141.0	177.9	118.3	144.0	181.0
BASIN_457	4.3	5.2	6.4	4.5	5.3	6.6
BASIN_458	1.3	1.5	1.9	1.3	1.6	1.9
BASIN_459	11.1	13.1	16.0	11.1	13.1	16.0
BASIN_460	13.6	16.0	19.4	13.5	15.9	19.3
BASIN_461	22.9	28.1	35.4	28.3	33.4	40.4
BASIN_462	7.6	9.1	11.2	7.7	9.2	11.3
BASIN_463	14.6	17.4	21.4	14.6	17.4	21.4
BASIN_464	25.2	30.1	37.6	26.1	30.9	38.3
BASIN_465	61.2	73.0	93.1	61.2	73.0	93.1
BASIN_466	10.5	12.4	15.1	10.3	12.2	15.0
BASIN_467	9.6	11.8	15.1	10.8	13.0	16.3
BASIN_468	8.3	9.9	12.4	8.4	10.0	12.5
BASIN_469	16.5	19.8	24.6	16.8	20.1	24.9
BASIN_470	39.1	47.3	58.5	41.8	50.0	61.1
BASIN_471	8.5	10.2	12.7	8.7	10.3	12.9
BASIN_472	30.2	36.6	45.4	33.7	39.9	48.5
BASIN_473	8.1	9.8	12.3	8.3	10.0	12.5
BASIN_474	2.9	3.5	4.4	2.8	3.4	4.3
BASIN_475	7.9	9.6	12.2	7.9	9.7	12.2
BASIN_476	8.8	10.6	13.2	9.0	10.7	13.3
BASIN_477	19.0	22.8	28.3	19.4	23.2	28.6
BASIN_478	11.5	14.0	17.6	11.3	13.8	17.4
BASIN_479	2.8	3.3	4.1	2.8	3.3	4.1
BASIN_480	9.6	11.3	14.0	9.5	11.2	13.9
BASIN_481	11.0	12.9	15.9	11.0	12.9	15.9
BASIN_482	7.0	8.2	10.0	7.1	8.3	10.1
BASIN_483	2.2	2.6	3.3	2.3	2.8	3.4
BASIN_484	3.6	4.3	5.5	3.9	4.6	5.8
BASIN_485	7.2	8.6	10.8	7.7	9.1	11.4
BASIN_486	15.2	18.0	22.0	15.1	17.9	21.9
BASIN_487	19.4	22.8	27.6	19.2	22.7	27.4
BASIN_488	2.3	2.6	3.3	2.3	2.7	3.4
BASIN_489A	102.7	131.3	172.5	106.2	135.2	176.5
BASIN_489B	139.4	178.4	234.2	135.3	173.9	229.4
BASIN_490	7.2	8.6	10.8	7.2	8.6	10.8
BASIN_491	11.2	13.5	16.8	11.2	13.5	16.8
BASIN_492	16.6	19.8	24.4	16.8	20.1	24.6
BASIN_493	4.1	4.9	6.2	4.2	5.0	6.2
BASIN_494A	11.4	14.5	19.1	9.2	12.2	16.5
BASIN_494B	40.9	52.3	68.4	40.9	52.4	68.5
BASIN_495	8.5	10.2	12.8	8.6	10.3	13.0
BASIN_496	19.2	23.0	28.7	19.5	23.2	29.0
BASIN_497	9.1	11.2	14.1	9.2	11.2	14.1
BASIN_498	2.0	2.4	3.1	2.0	2.4	3.1
BASIN_499	1.4	1.7	2.2	1.4	1.7	2.2

BASIN_ID	Baseline Hydrology			Future Conditions Hydrology		
	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_500	9.4	11.4	14.5	9.6	11.6	14.7
BASIN_501	8.6	10.4	13.2	9.2	11.0	13.8
BASIN_502	1.9	2.3	3.0	1.9	2.3	3.0
BASIN_503	2.6	3.2	4.2	2.7	3.3	4.3
BASIN_504	2.0	2.4	3.1	2.1	2.5	3.1
BASIN_505	32.1	38.6	47.4	32.6	39.1	47.9
BASIN_506	0.8	1.0	1.2	0.8	1.0	1.3
BASIN_507	6.3	7.5	9.5	6.6	7.8	9.8
BASIN_508	9.4	11.2	13.9	9.4	11.2	13.9
BASIN_509	7.6	9.1	11.4	7.9	9.3	11.7
BASIN_510	9.6	11.3	13.8	9.5	11.2	13.7
BASIN_511	3.5	4.3	5.4	4.1	4.8	5.9
BASIN_512	4.6	5.4	6.7	4.6	5.4	6.7
BASIN_513	15.0	17.8	21.9	14.9	17.7	21.8
BASIN_514	17.7	21.2	26.0	19.1	22.5	27.2
BASIN_515	5.6	6.6	8.2	5.5	6.5	8.1
BASIN_516	19.4	23.3	28.9	19.7	23.6	29.2
BASIN_517	19.0	22.6	27.9	19.2	22.9	28.1
BASIN_518	28.6	34.3	43.5	29.1	34.7	43.9
BASIN_519	2.2	2.5	3.2	2.2	2.5	3.2
BASIN_520	4.3	5.2	6.6	4.4	5.3	6.7
BASIN_521	1.7	2.0	2.6	1.8	2.1	2.6
BASIN_522	1.1	1.3	1.7	1.1	1.3	1.7
BASIN_523	4.1	4.9	6.1	4.1	4.9	6.2
BASIN_524	4.2	5.1	6.5	4.2	5.1	6.5
BASIN_525	4.2	5.0	6.3	4.4	5.2	6.5
BASIN_526	6.0	7.2	9.2	6.4	7.6	9.5
BASIN_527	2.3	2.8	3.4	2.3	2.8	3.4
BASIN_528	1.3	1.6	2.0	1.3	1.6	2.0
BASIN_529	1.2	1.5	1.8	1.2	1.5	1.9
BASIN_530	2.6	3.1	3.8	2.6	3.1	3.9
BASIN_531	7.3	8.7	10.9	7.6	8.9	11.1
BASIN_532	2.8	3.3	4.1	2.9	3.4	4.2
BASIN_533	4.6	5.4	6.8	4.6	5.4	6.8
BASIN_534	3.9	4.8	6.1	3.8	4.7	6.0
BASIN_535	1.2	1.4	1.8	1.2	1.4	1.8
BASIN_536	12.0	14.2	17.3	12.0	14.2	17.3
BASIN_537	14.3	17.6	23.0	14.4	17.6	23.0
BASIN_538	6.4	7.6	9.5	6.5	7.7	9.5
BASIN_539	4.7	5.6	7.1	4.7	5.6	7.1
BASIN_540	3.9	4.6	5.8	3.9	4.7	5.8
BASIN_541	12.4	14.9	18.3	12.4	14.9	18.3
BASIN_542	3.7	4.4	5.6	3.8	4.5	5.7
BASIN_543	14.1	17.3	22.0	14.1	17.4	22.0
BASIN_544	8.6	10.2	12.8	8.7	10.3	13.0
BASIN_545	3.4	4.1	5.1	3.5	4.1	5.1
BASIN_546	50.8	62.2	77.8	57.1	68.4	83.8
BASIN_547	25.9	31.0	38.0	26.3	31.3	38.4

BASIN_ID	Baseline Hydrology			Future Conditions Hydrology		
	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)	10 yr Peak Q (cfs)	25 yr Peak Q (cfs)	100 yr Peak Q (cfs)
BASIN_548	12.2	14.5	18.3	12.0	14.4	18.2
BASIN_549	6.6	7.8	9.9	6.6	7.8	9.9
BASIN_550	97.6	119.0	148.4	97.8	119.2	148.5
BASIN_551	49.9	60.0	77.2	49.9	60.0	77.2
BASIN_552	74.8	93.1	118.3	76.8	95.2	120.4
BASIN_553	11.9	14.3	17.7	12.5	14.8	18.1
BASIN_554	13.1	15.5	19.5	13.2	15.6	19.7
BASIN_555	9.5	11.3	13.7	9.7	11.5	13.9
BASIN_556	6.3	7.4	9.0	6.3	7.4	9.0
BASIN_557	6.4	7.8	9.8	7.7	9.0	11.0

Appendix C Chapter 6 - A ppendices

Chapter 6A - Summary of Storm Drain Outfall Locations

Chapter 6B - MIKE 11 Baseline Conditions Water Surface Profiles

Chapter 6C - MIKE 11 Future Conditions Water Surface Profiles

Chapter 6D - MIKE 11 Water Surface Elevation and Flow Results

Chapter 6E - Development Review Look-Up Table

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Appendix 6A – Summary of Storm Drain Outfall Locations

Appendix 6A summarizes the storm drain outfalls from the MIKE model, including the unique identifier (MUID), creek receiving the storm drainage system discharge, and the stationing of the creek at which outfall is located.

Appendix 6A. Summary of Storm Drain Outfalls in Model

MIKE URBAN ID	M11 Creek Name	Creek Station (ft)
DP 7056	AIRPORT CREEK	0.0
DP 7084	AIRPORT CREEK	673.0
DP 7085	AIRPORT CREEK	401.2
DP 7156	AIRPORT CREEK	0.0
DP 7157	AIRPORT CREEK	0.0
DP 7158	AIRPORT CREEK	0.0
DP 7159	AIRPORT CREEK	0.0
DP 187	E WINDSOR CREEK	1232.4
DP 188	E WINDSOR CREEK	1181.8
DP 2209	E WINDSOR CREEK	1431.2
DP 3811	E WINDSOR CREEK	1809.3
DP 7032	E WINDSOR CREEK	52.2
DP 7072	E WINDSOR CREEK	2113.6
DP 7073	E WINDSOR CREEK	2113.6
DP 7097	E WINDSOR CREEK	200.8
DP 7100	E WINDSOR CREEK	472.4
DP 7118	E WINDSOR CREEK	1086.6
DP 7120	E WINDSOR CREEK	1096.2
DP 7121	E WINDSOR CREEK	1057.2
DP 7124	E WINDSOR CREEK	0.0
DP 7145	E WINDSOR CREEK	1573.9
DP 7146	E WINDSOR CREEK	1586.0
DP 117	EW TRB 11	0.0
DP 117_2	EW TRB 11	0.0
DP 7071	EW TRB 11	849.0
DP 7075	EW TRB 11	1032.9
DP 82	EW TRB 11	166.2
DP 84	EW TRB 11	420.0
DP 13636	EW_OD	20.0
DP 7142	EW_OD	290.5
DP 54	EW_US	284.3
DP 55	EW_US	375.0
DP 7103	EW_US	611.5
DP 7104	EW_US	535.1
DP 7101	EWTRB_X	117.5
DP 7117	EWTRB_X	427.0
DP 7122	EWTRB_X	19.2
DP 7123	EWTRB_X	0.0
DP 7034	FAUGHT_US	469.2

MIKE URBAN ID	M11 Creek Name	Creek Station (ft)
DP 7093	FAUGHT_US	224.7
DP 7114	FAUGHT_US	0.0
DP 7136	FAUGHT_US	469.2
DP 7148	FAUGHT_US	16.4
DP 75	FAUGHT_US	469.2
MH 3984	Faught_Walmart	329.3
MH 4389 Outlet	Faught_Walmart	85.0
MH 730 Outlet	Faught_Walmart	395.0
DP 7045	GUMVIEW CREEK	292.0
DP 7155	GUMVIEW CREEK	292.0
DP 210	POOL CREEK	879.1
DP 7094	POOL CREEK	1178.6
DP 7110	POOL CREEK	2753.1
DP 7111	POOL CREEK	2530.8
DP 7112	POOL CREEK	2461.9
DP 7127	POOL CREEK	2171.1
DP 7139	POOL CREEK	1957.1
DP 7149	POOL CREEK	588.8
DP 85	POOL CREEK	2227.7
DP 90	POOL CREEK	1795.5
DP 7113	POOLGOLFTRB	0.0
DP 7088	PRUITT CREEK	741.9
DP 7089	PRUITT CREEK	892.6
DP 7090	PRUITT CREEK	647.8
DP 7091	PRUITT CREEK	791.0
DP 7153	PRUITT CREEK	449.5
DP 104	SC TRB T-6	0.0
DP 166	SC TRB T-6	0.0
DP 7059	SC TRB T-6	622.5
DP 7060	SC TRB T-6	242.7
DP 128	STARR CREEK	1405.7
DP 129	STARR CREEK	1405.7
DP 29	STARR CREEK	1556.6
DP 7019	STARR CREEK	0.0
DP 7020	STARR CREEK	0.0
DP 7021	STARR CREEK	0.0
DP 7053	STARR CREEK	0.0
DP 7054	STARR CREEK	0.0
DP 7055	STARR CREEK	0.0
DP 7065	STARR CREEK	0.0
DP 7066	STARR CREEK	0.0
DP 7078	STARR CREEK	239.9
DP 7140	STARR CREEK	524.2
DP 7141	STARR CREEK	518.2
DP 113	STARRTRB	286.7
DP 21	STARRTRB	0.0
Node_17	STARRTRB_Upper	0.0

MIKE URBAN ID	M11 Creek Name	Creek Station (ft)
DP 118	WINDSOR CREEK	4016.6
DP 136	WINDSOR CREEK	1726.4
DP 36	WINDSOR CREEK	1059.3
DP 37	WINDSOR CREEK	1083.6
DP 47	WINDSOR CREEK	3929.0
DP 7011	WINDSOR CREEK	3957.5
DP 7023	WINDSOR CREEK	2286.4
DP 7025	WINDSOR CREEK	2880.6
DP 7026	WINDSOR CREEK	2880.6
DP 7048	WINDSOR CREEK	3929.0
DP 7057	WINDSOR CREEK	1986.1
DP 7067	WINDSOR CREEK	2286.4
DP 7080	WINDSOR CREEK	3712.5
DP 7105	WINDSOR CREEK	325.6
DP 7106	WINDSOR CREEK	216.3
DP 7107	WINDSOR CREEK	3565.5
DP 7109	WINDSOR CREEK	2479.7
DP 7115	WINDSOR CREEK	1207.3
DP 7116	WINDSOR CREEK	1059.3
DP 7143	WINDSOR CREEK	2538.3
DP 7144	WINDSOR CREEK	2548.2
DP 7154	WINDSOR CREEK	2967.4
DP 7160	WINDSOR CREEK	2111.7

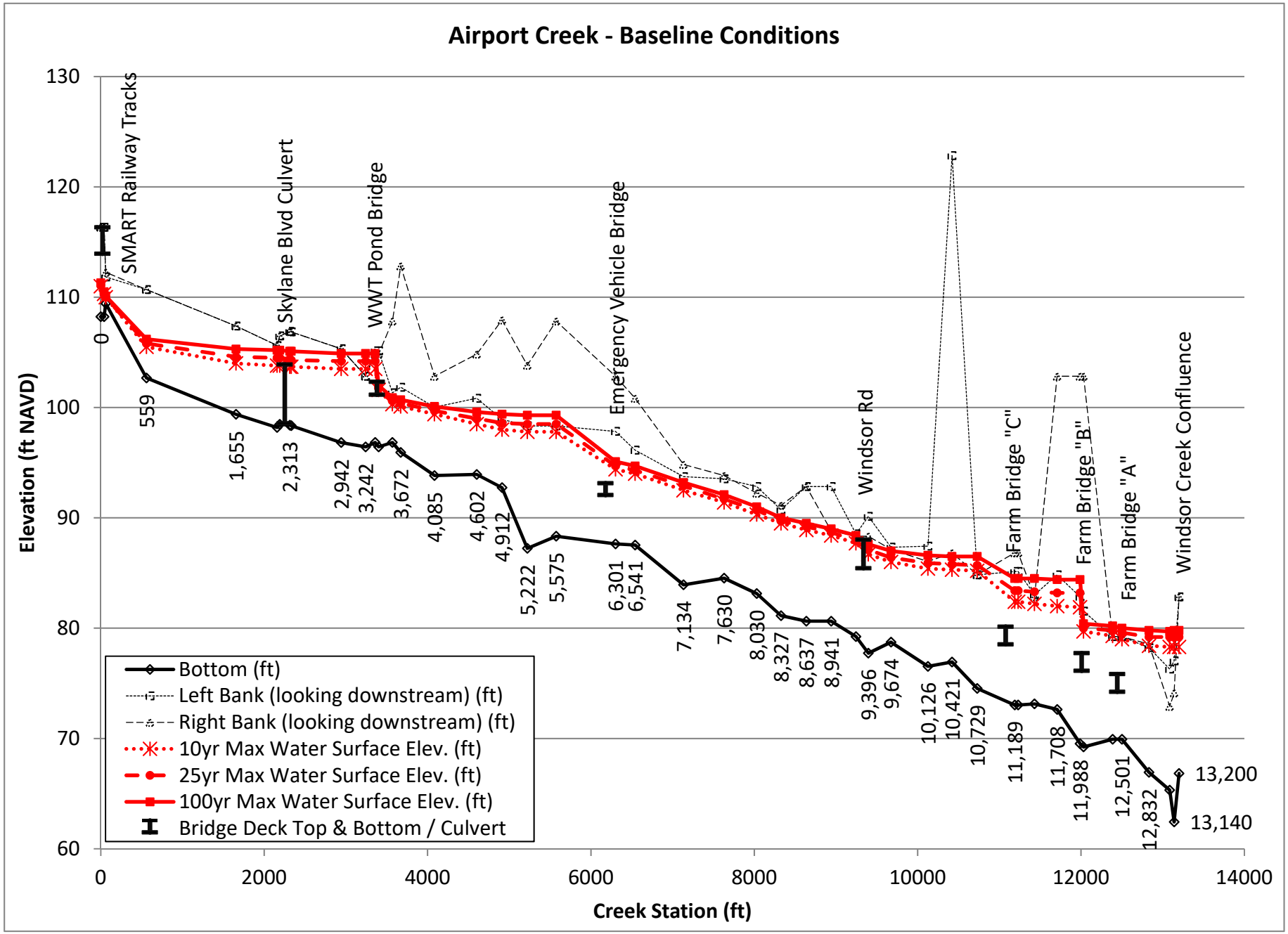
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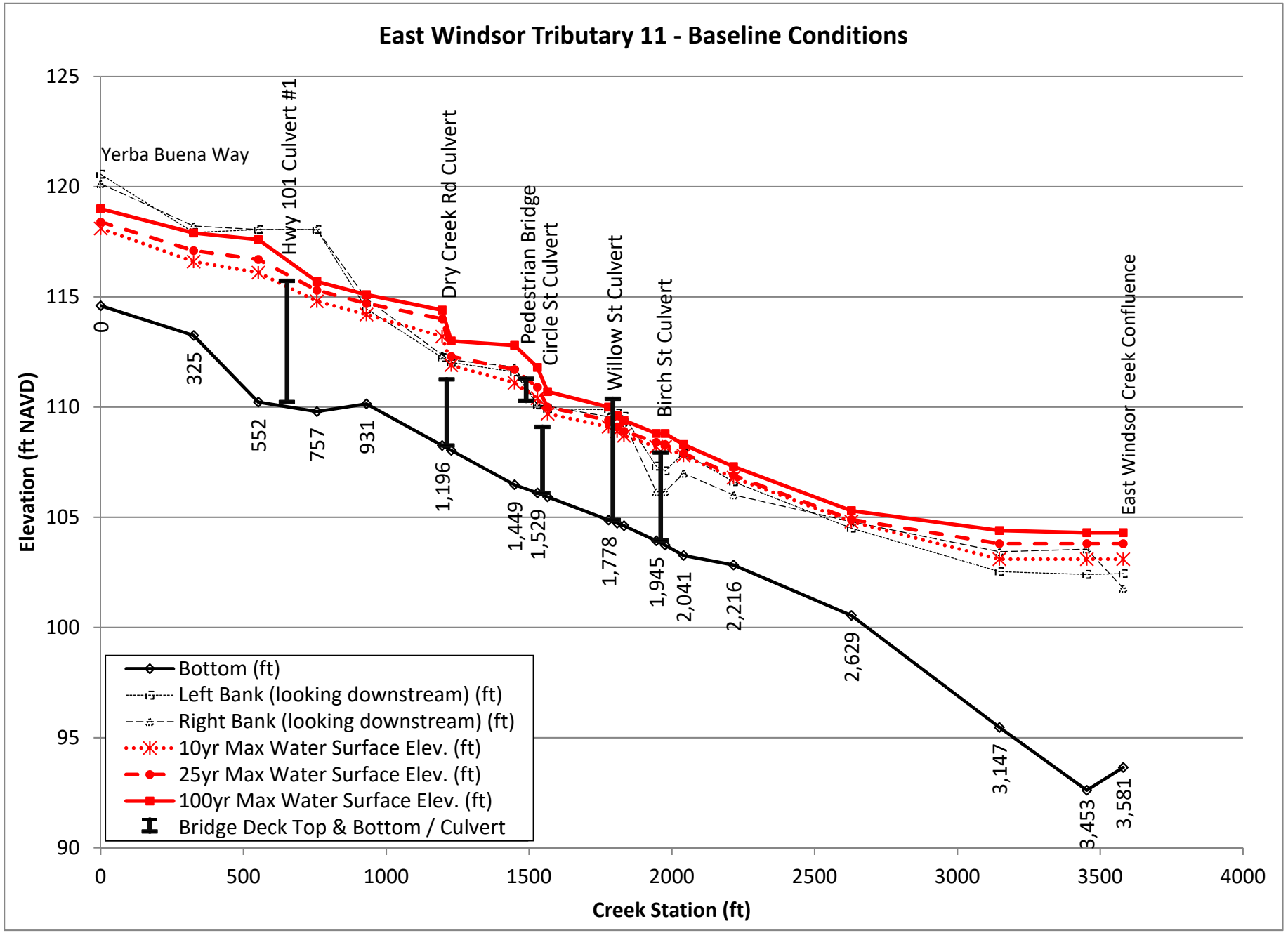
Appendix 6B – MIKE 11 Baseline Conditions Water Surface Profiles

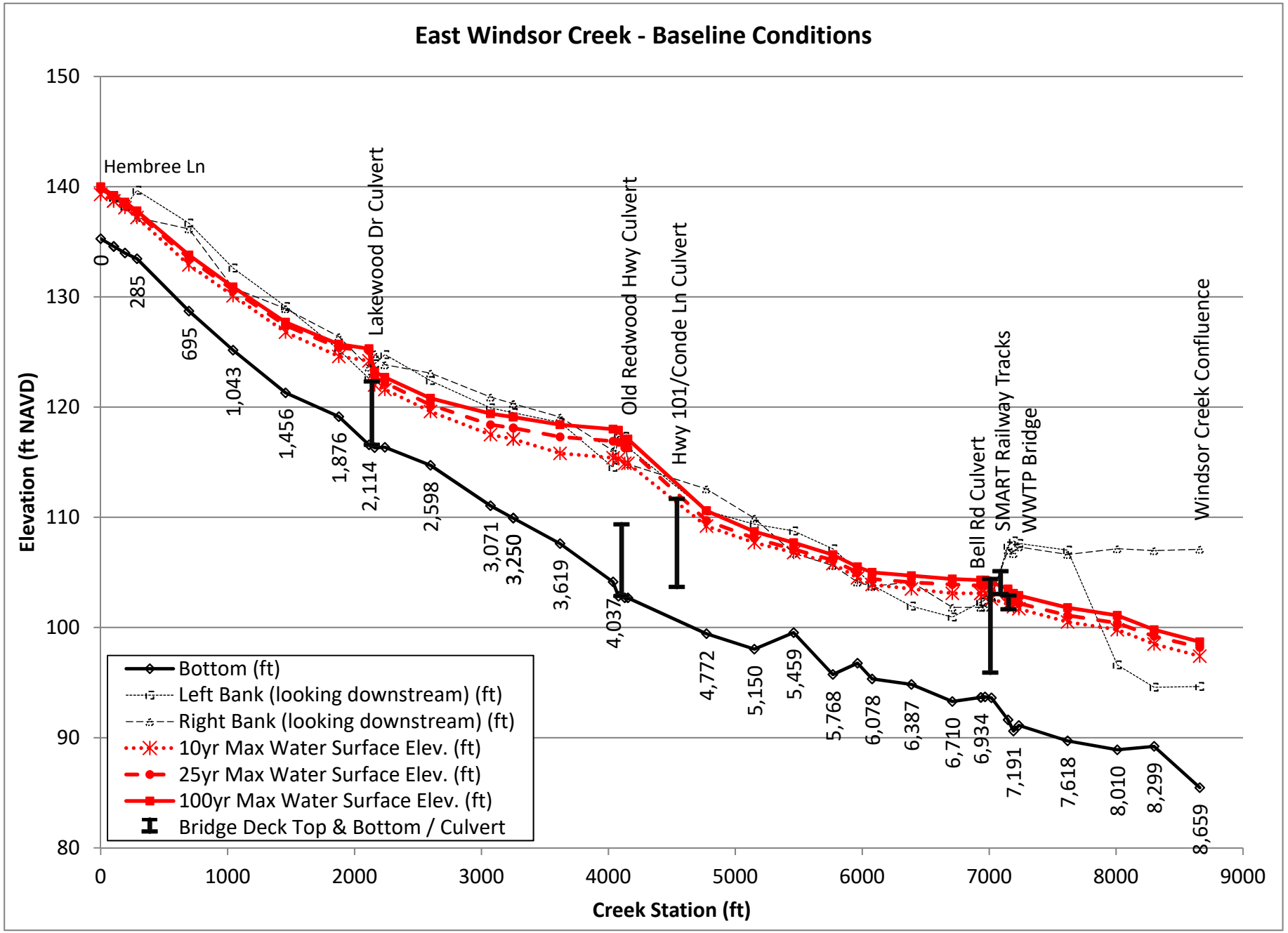
The figures below show water surface profiles for the 10-, 25-, and 100-year return period events for the Town's creeks and tributaries under baseline conditions. Baseline conditions assume no SDIPs have been implemented. The figures are presented in alphabetical order by creek, and profiles for the tributaries of creeks are presented from upstream to downstream.

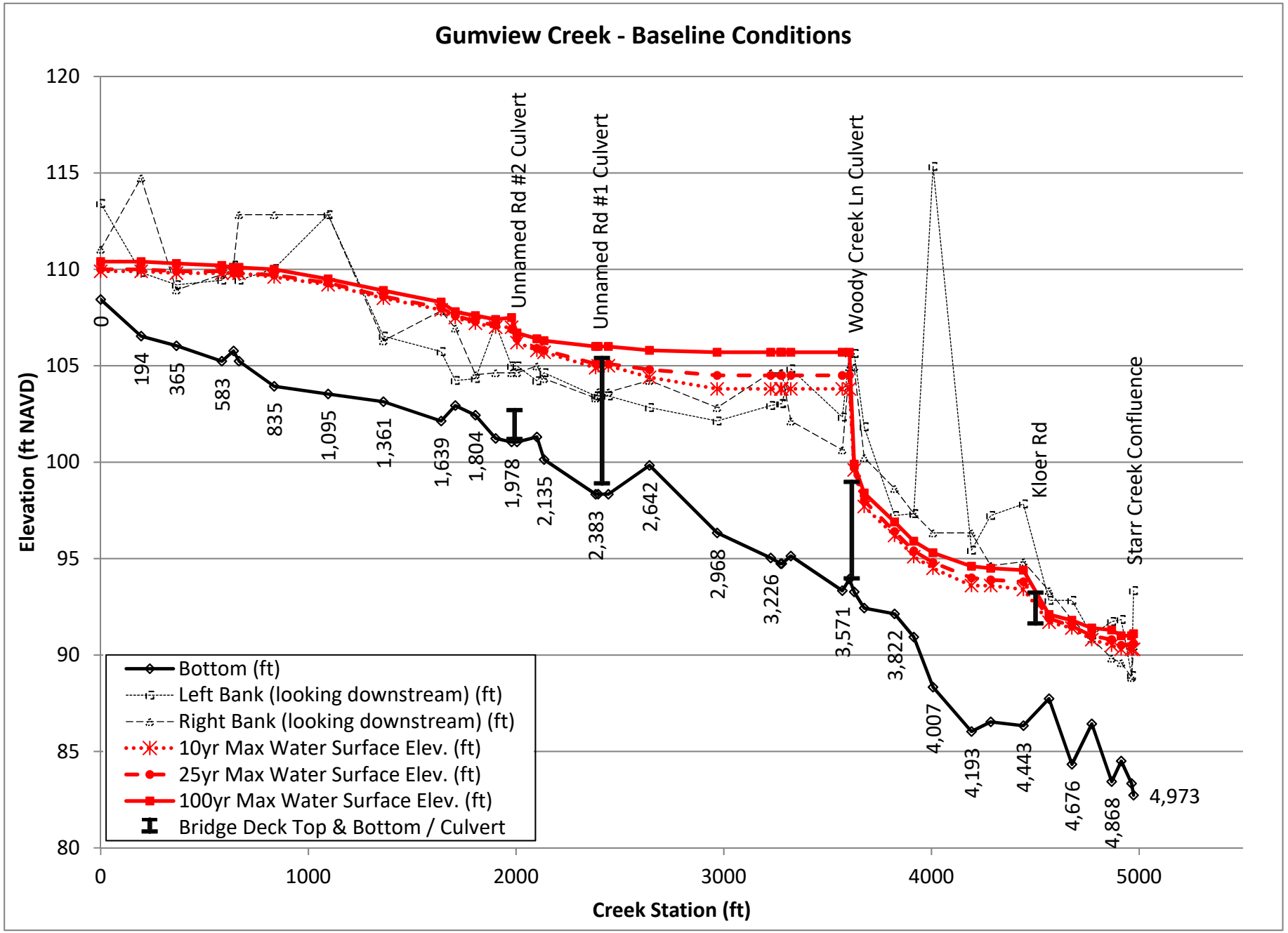
The figures also include creek bottom and left and right bank elevations, in addition to major culvert and bridge structures that were included within the MIKE 11 model. Labels are included to indicate the roadway at which the structure is located.

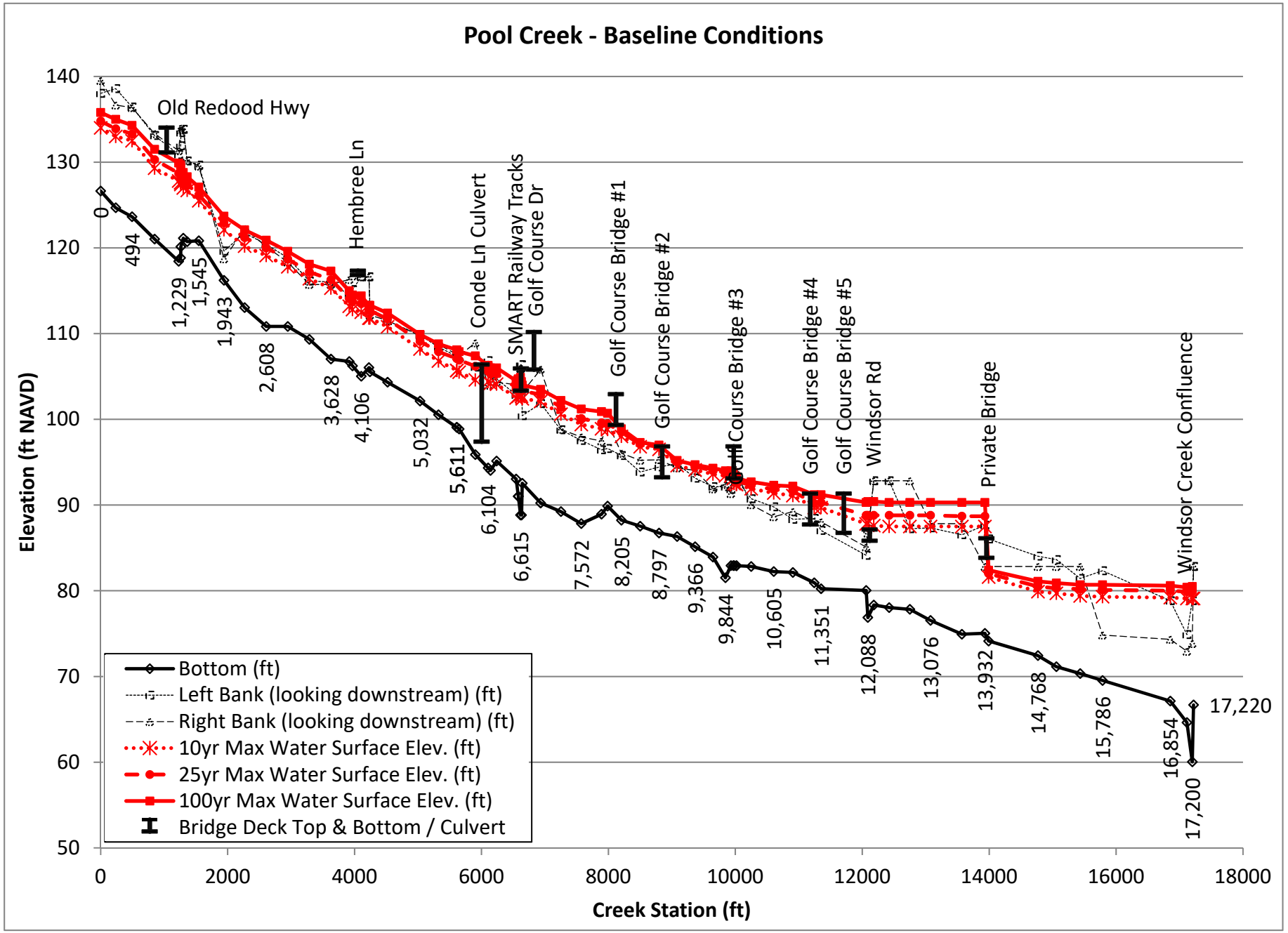
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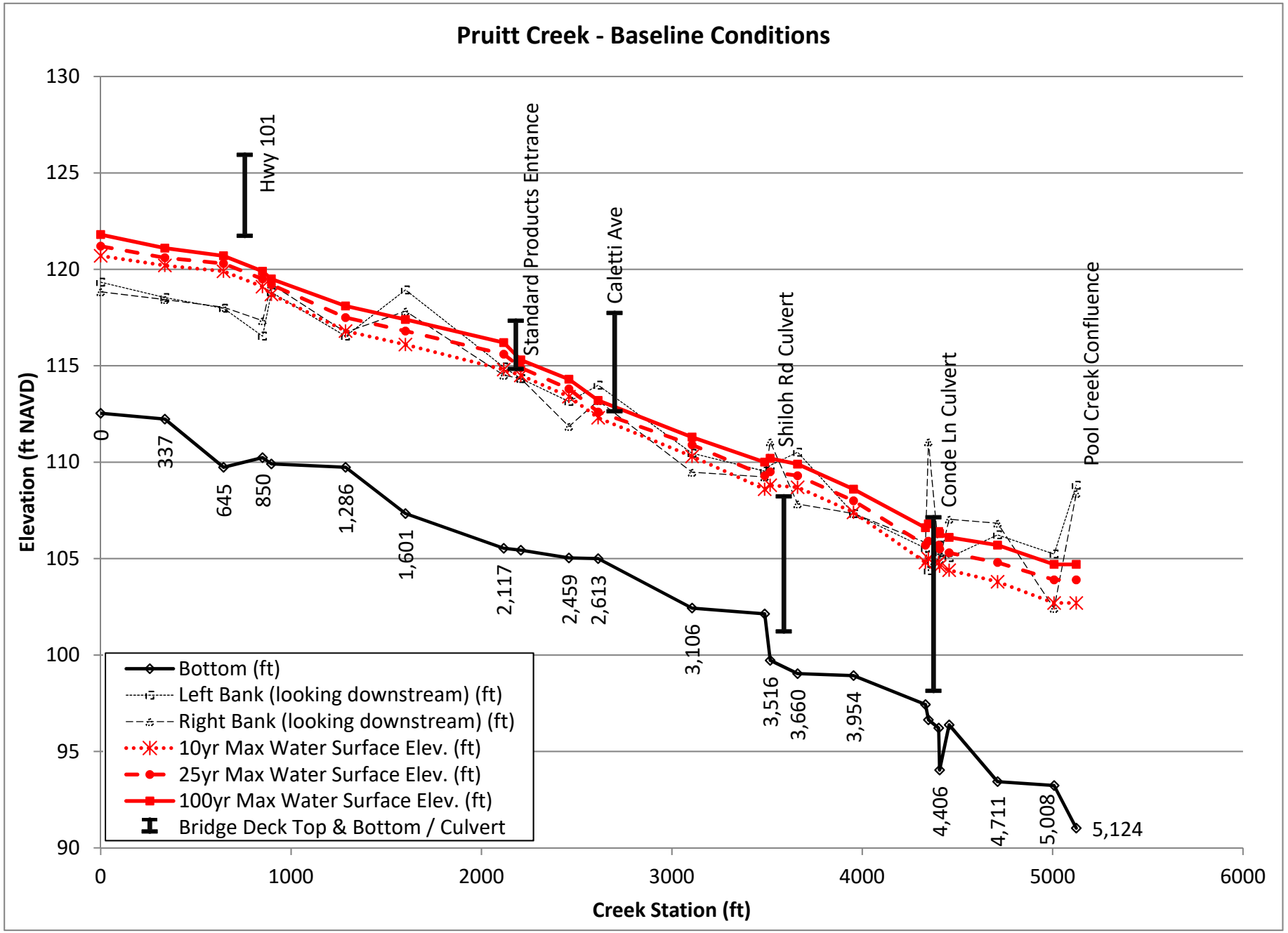

Airport Creek - Baseline Conditions
Elevation (ft NAVD)
Creek Station (ft)
130
120
110
100
90
80
70
60
0
2000
4000
6000
8000
10000
12000
14000
SMART Railway Tracks
Skylane Blvd Culvert
WWT Pond Bridge
Emergency Vehicle Bridge
Windsor Rd
Farm Bridge "C"
Farm Bridge "B"
Farm Bridge "A"
Windsor Creek Confluence
0
559
1,655
2,313
2,942
3,242
3,672
4,085
4,602
4,912
5,222
5,575
6,301
6,541
7,134
7,630
8,030
8,327
8,637
8,941
9,396
9,674
10,126
10,421
10,729
11,189
11,708
11,988
12,501
12,832
13,200
13,140
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

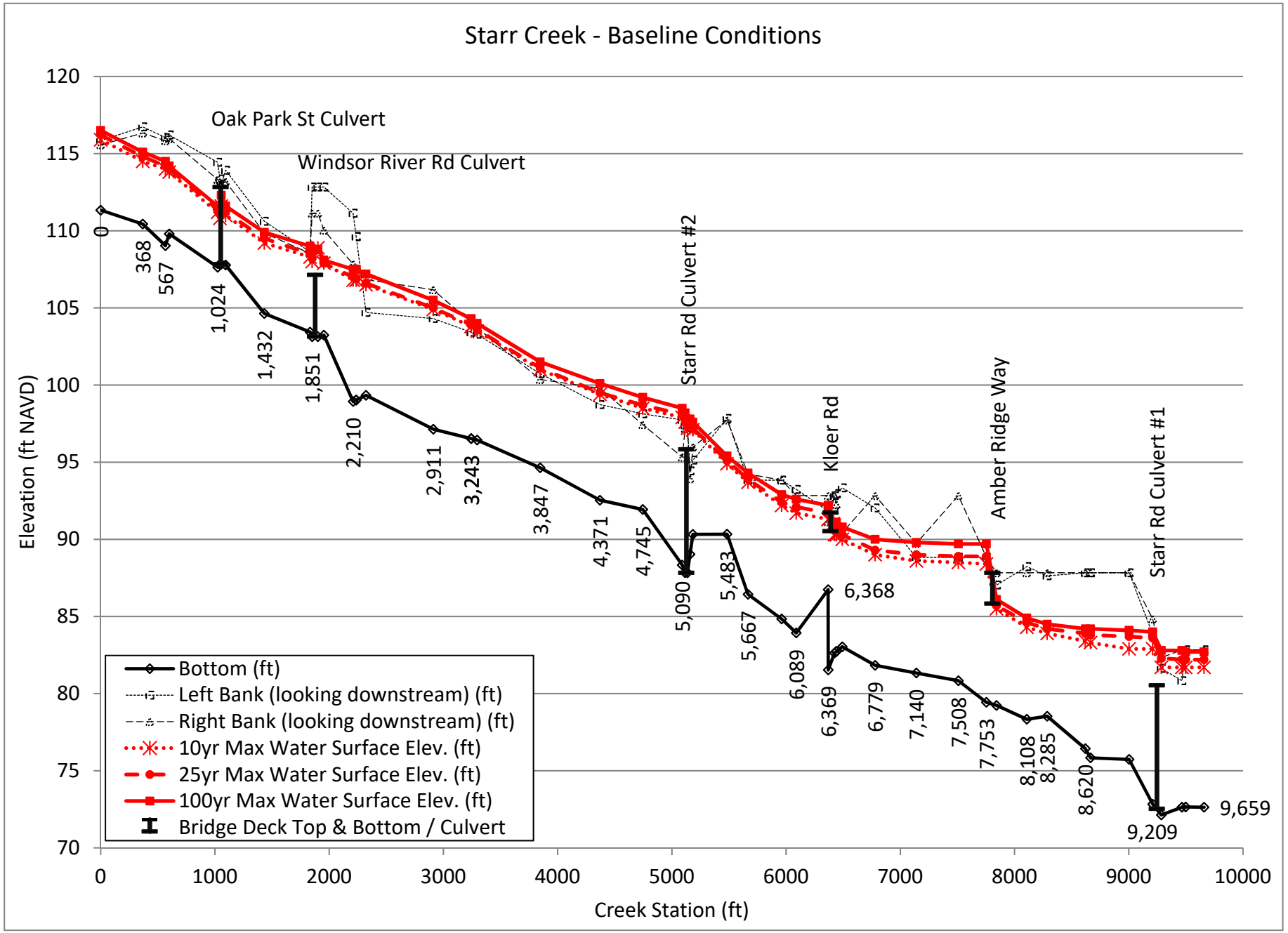

East Windsor Tributary 11 - Baseline Conditions
Elevation (ft NAVD)
Creek Station (ft)
125
120
115
110
105
100
95
90
0
500
1000
1500
2000
2500
3000
3500
4000
Yerba Buena Way
Hwy 101 Culvert #1
Dry Creek Rd Culvert
Pedestrian Bridge
Circle St Culvert
Willow St Culvert
Birch St Culvert
East Windsor Creek Confluence
0
325
552
757
931
1,196
1,449
1,529
1,778
1,945
2,041
2,216
2,629
3,147
3,453
3,581
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

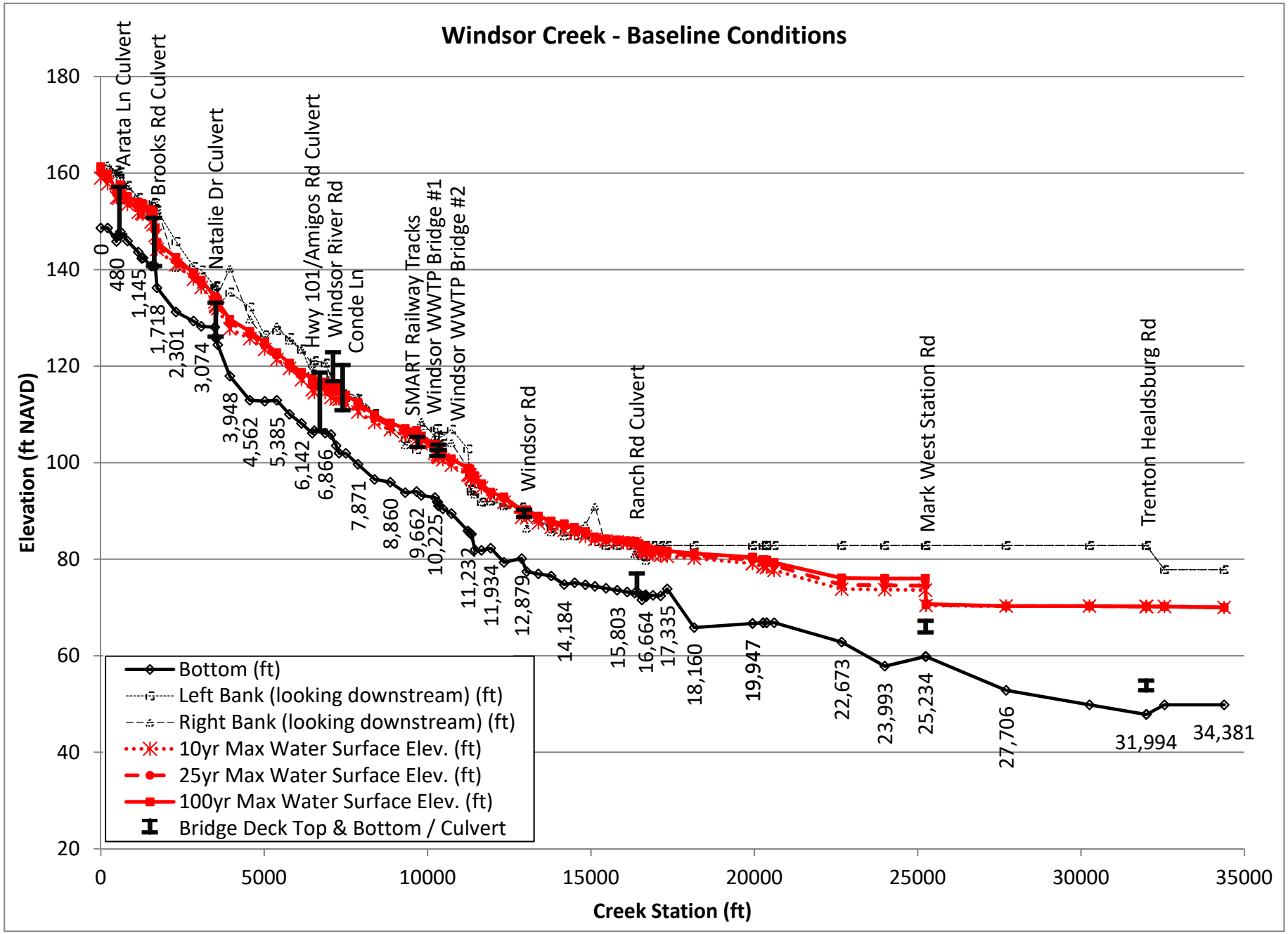

East Windsor Creek - Baseline Conditions
Elevation (ft NAVD)
Creek Station (ft)
150
140
130
120
110
100
90
80
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Hembree Ln
Lakewood Dr Culvert
Old Redwood Hwy Culvert
Hwy 101/Conde Ln Culvert
Bell Rd Culvert
SMART Railway Tracks
WWTP Bridge
Windsor Creek Confluence
0
285
695
1,043
1,456
1,876
2,114
2,598
3,071
3,250
3,619
4,037
4,772
5,150
5,459
5,768
6,078
6,387
6,710
6,934
7,191
7,618
8,010
8,299
8,659
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

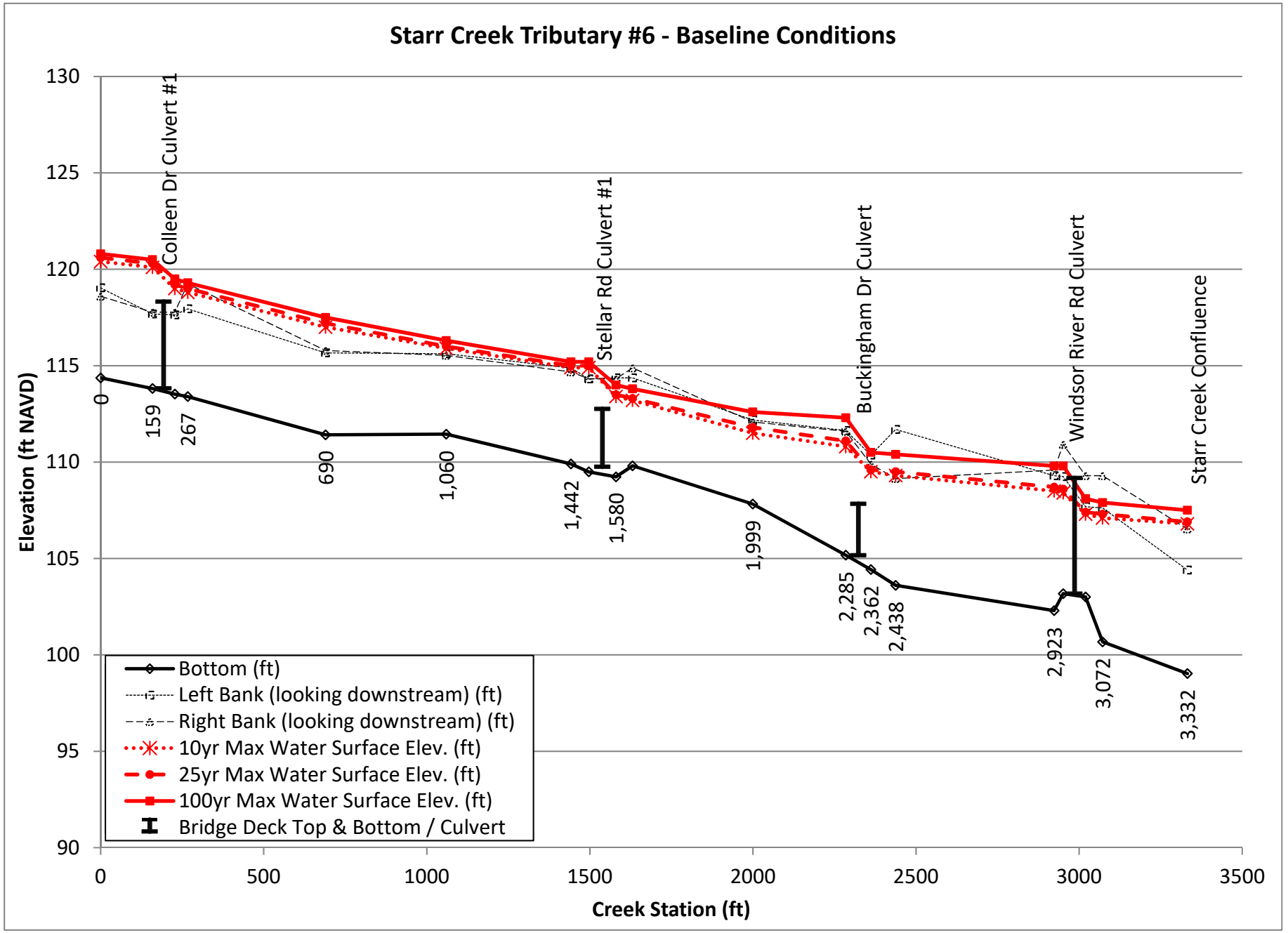

Gumview Creek - Baseline Conditions
Elevation (ft NAVD)
Creek Station (ft)
120
115
110
105
100
95
90
85
80
0
1000
2000
3000
4000
5000
Unnamed Rd #2 Culvert
Unnamed Rd #1 Culvert
Woody Creek Ln Culvert
Kloer Rd
Starr Creek Confluence
0
194
365
583
835
1,095
1,361
1,639
1,804
1,978
2,135
2,383
2,642
2,968
3,226
3,571
3,822
4,007
4,193
4,443
4,676
4,868
4,973
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

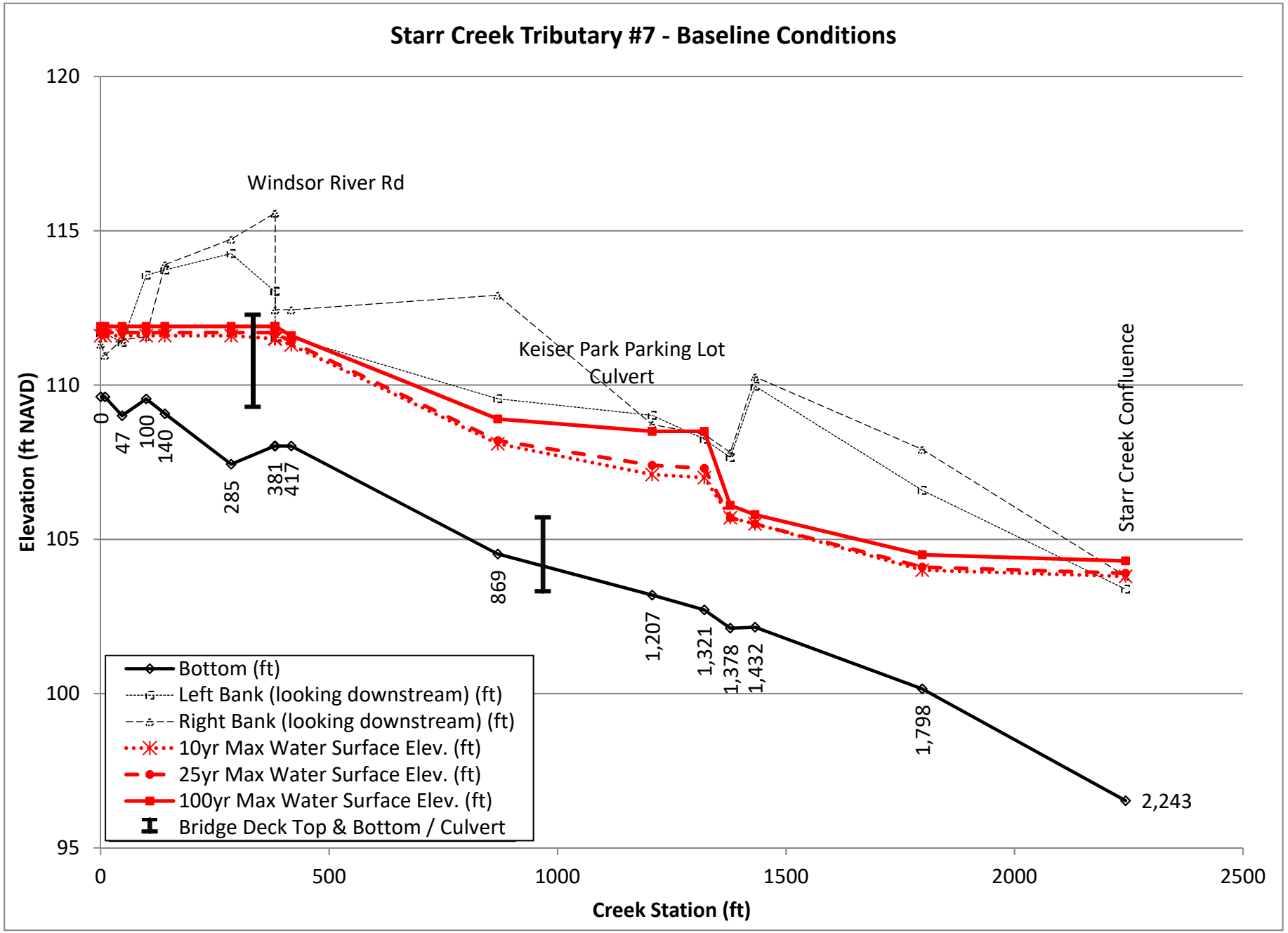

Pool Creek - Baseline Conditions
Elevation (ft NAVD)
Creek Station (ft)
140
130
120
110
100
90
80
70
60
50
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Old Redood Hwy
Hembree Ln
Conde Ln Culvert
SMART Railway Tracks
Golf Course Dr
Golf Course Bridge #1
Golf Course Bridge #2
Golf Course Bridge #3
Golf Course Bridge #4
Golf Course Bridge #5
Windsor Rd
Private Bridge
Windsor Creek Confluence
0
494
1,229
1,545
1,943
2,608
3,628
4,106
5,032
5,611
6,104
6,615
7,572
8,205
8,797
9,366
9,844
10,605
11,351
12,088
13,076
13,932
14,768
15,786
16,854
17,200
17,220
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

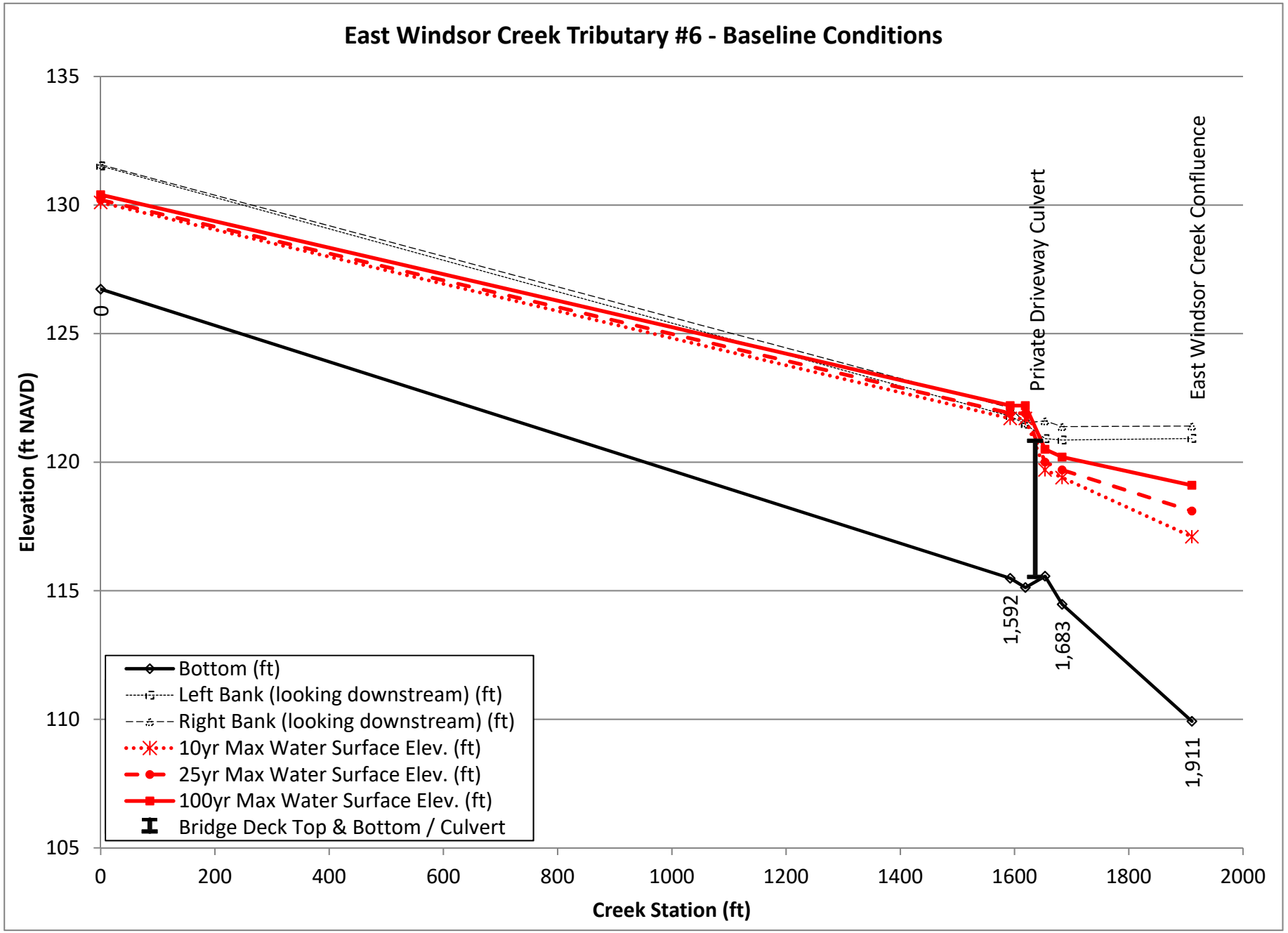

Pruitt Creek - Baseline Conditions
Elevation (ft NAVD)
Creek Station (ft)
130
125
120
115
110
105
100
95
90
0
1000
2000
3000
4000
5000
6000
Hwy 101
Standard Products Entrance
Caletti Ave
Shiloh Rd Culvert
Conde Ln Culvert
Pool Creek Confluence
0
337
645
850
1,286
1,601
2,117
2,459
2,613
3,106
3,516
3,660
3,954
4,406
4,711
5,008
5,124
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

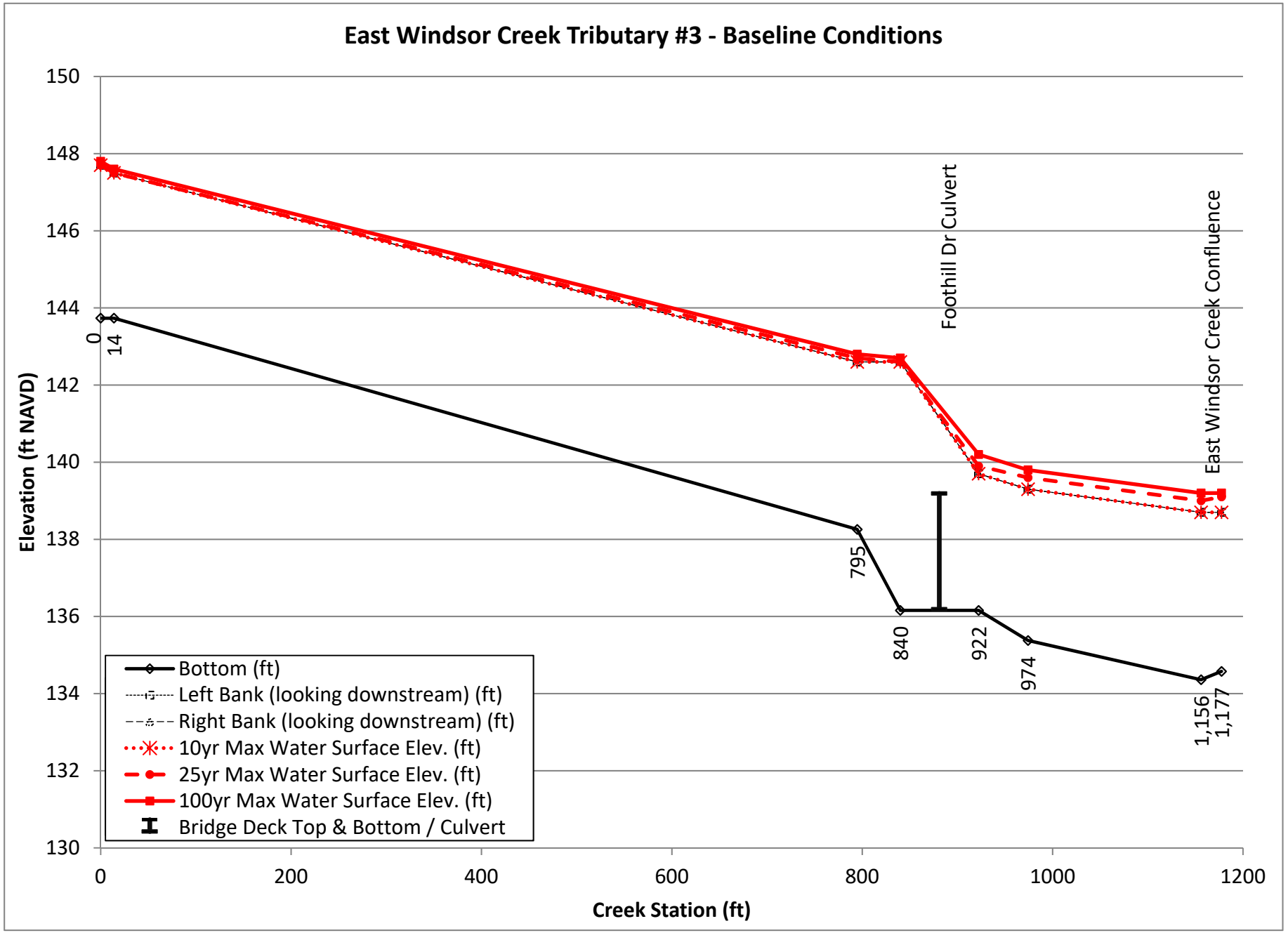

Starr Creek - Baseline Conditions
Oak Park St Culvert
Windsor River Rd Culvert
Starr Rd Culvert #2
Kloer Rd
Amber Ridge Way
Starr Rd Culvert #1
Elevation (ft NAVD)
Creek Station (ft)
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert
0
368
567
1,024
1,432
1,851
2,210
2,911
3,243
3,847
4,371
4,745
5,090
5,483
5,667
6,089
6,368
6,369
6,779
7,140
7,508
7,753
8,108
8,285
8,620
9,209
9,659

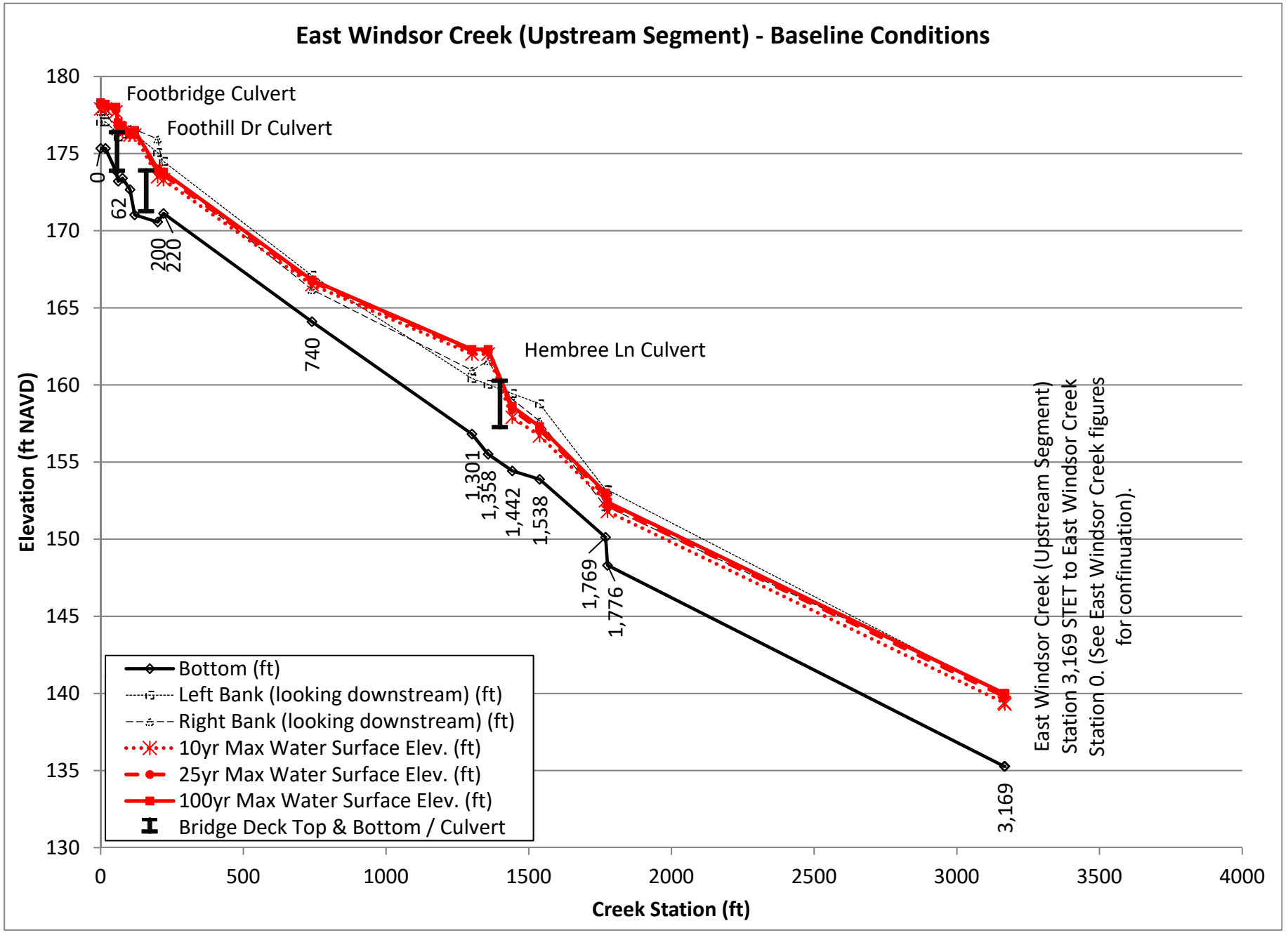

Windsor Creek - Baseline Conditions
Elevation (ft NAVD)
Creek Station (ft)
180
160
140
120
100
80
60
40
20
0
5000
10000
15000
20000
25000
30000
35000
0
480
1,145
1,718
2,301
3,074
3,948
4,562
5,385
6,142
6,866
7,871
8,860
9,662
10,225
11,232
11,934
12,879
14,184
15,803
16,664
17,335
18,160
19,947
22,673
23,993
25,234
27,706
31,994
34,381
Arata Ln Culvert
Brooks Rd Culvert
Natalie Dr Culvert
Hwy 101/Amigos Rd Culvert
Windsor River Rd
Conde Ln
SMART Railway Tracks
Windsor WWTP Bridge #1
Windsor WWTP Bridge #2
Windsor Rd
Ranch Rd Culvert
Mark West Station Rd
Trenton Healdsburg Rd
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

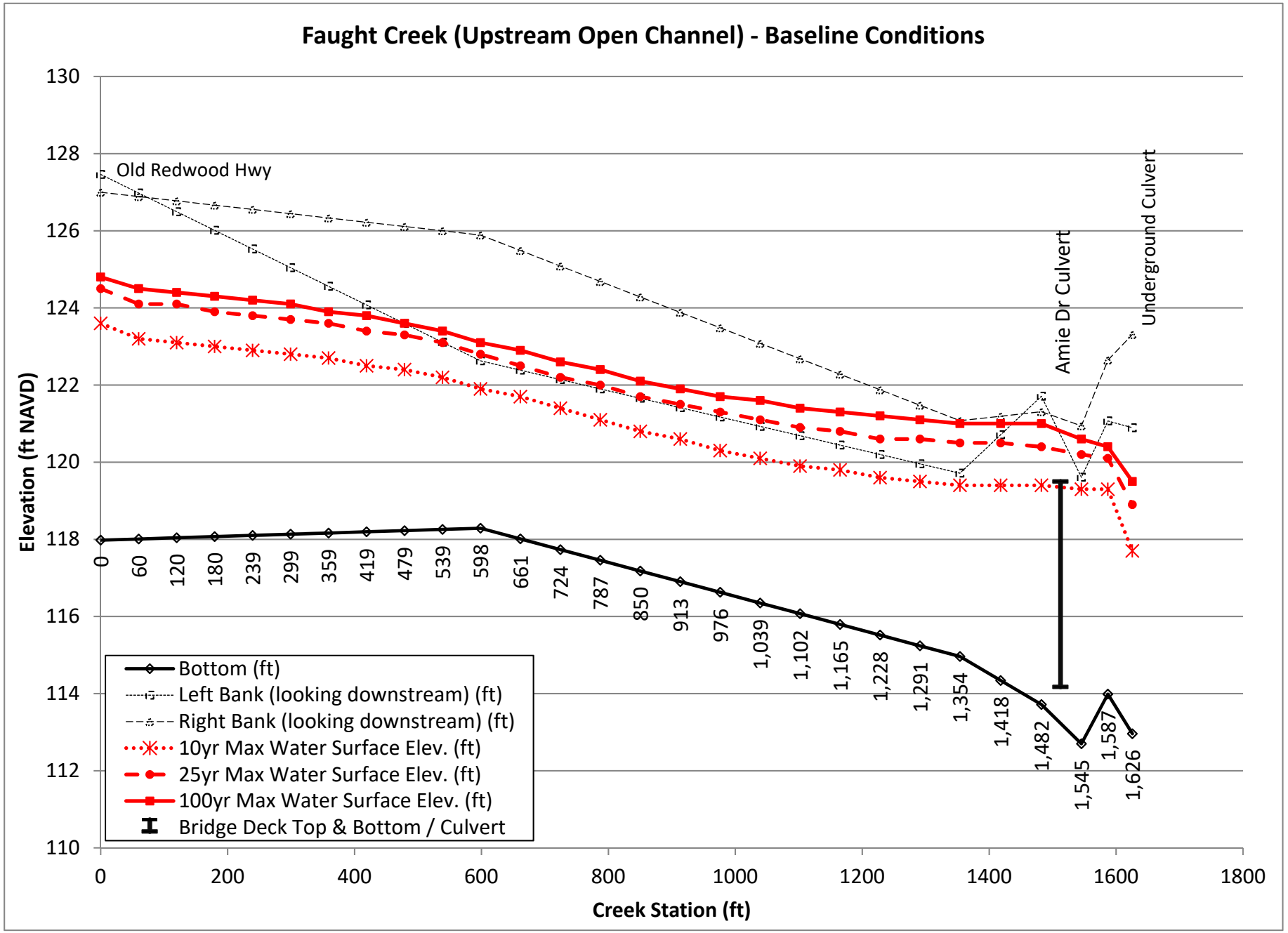

Starr Creek Tributary #6 - Baseline Conditions
Elevation (ft NAVD)
Creek Station (ft)
130
125
120
115
110
105
100
95
90
0
500
1000
1500
2000
2500
3000
3500
Colleen Dr Culvert #1
Stellar Rd Culvert #1
Buckingham Dr Culvert
Windsor River Rd Culvert
Starr Creek Confluence
0
159
267
690
1,060
1,442
1,580
1,999
2,285
2,362
2,438
2,923
3,072
3,332
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

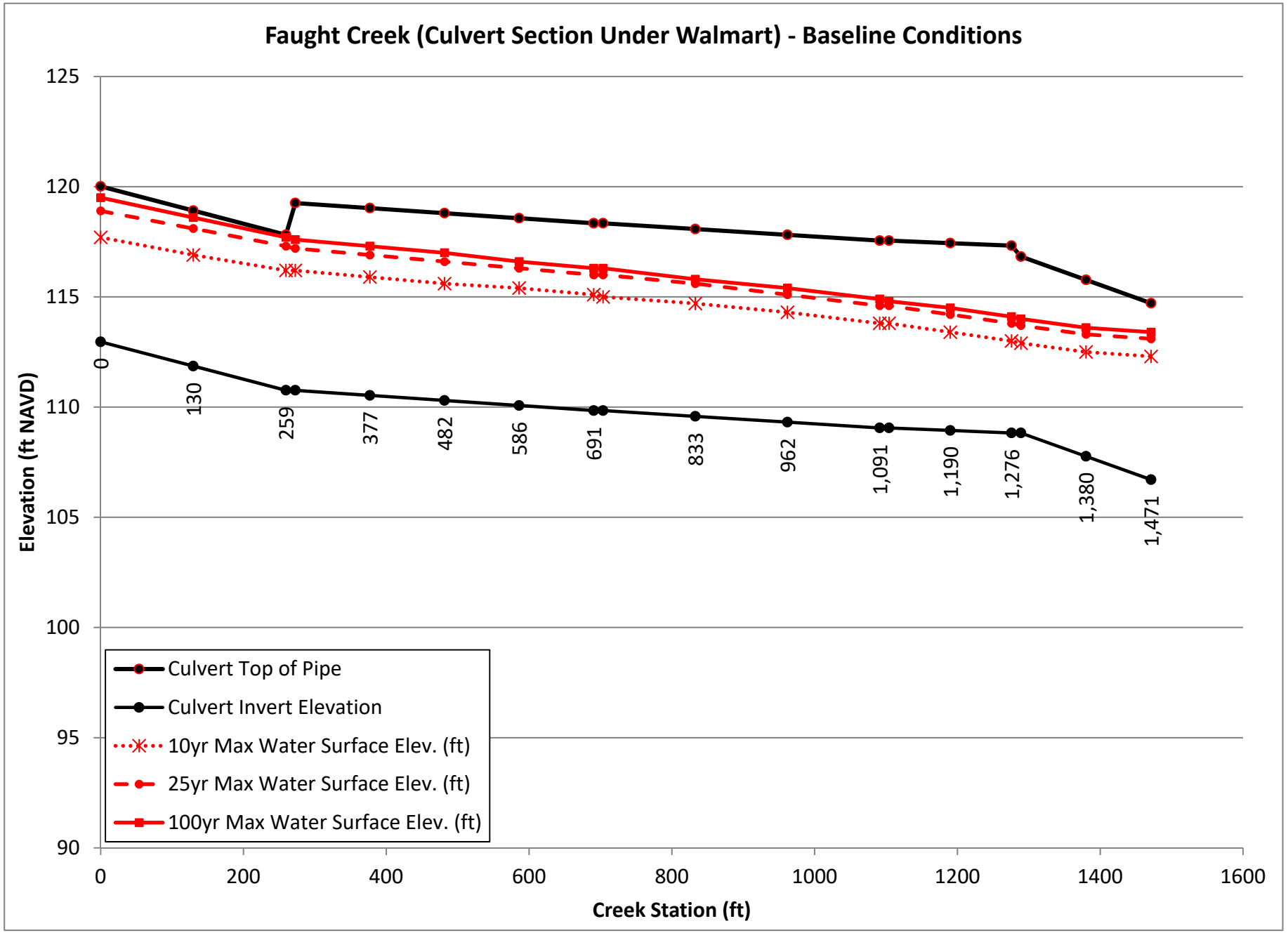

Starr Creek Tributary #7 - Baseline Conditions
Elevation (ft NAVD)
120
115
110
105
100
95
0
500
1000
1500
2000
2500
Creek Station (ft)
Windsor River Rd
Keiser Park Parking Lot
Culvert
Starr Creek Confluence
0
47
100
140
285
381
417
869
1,207
1,321
1,378
1,432
1,798
2,243
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

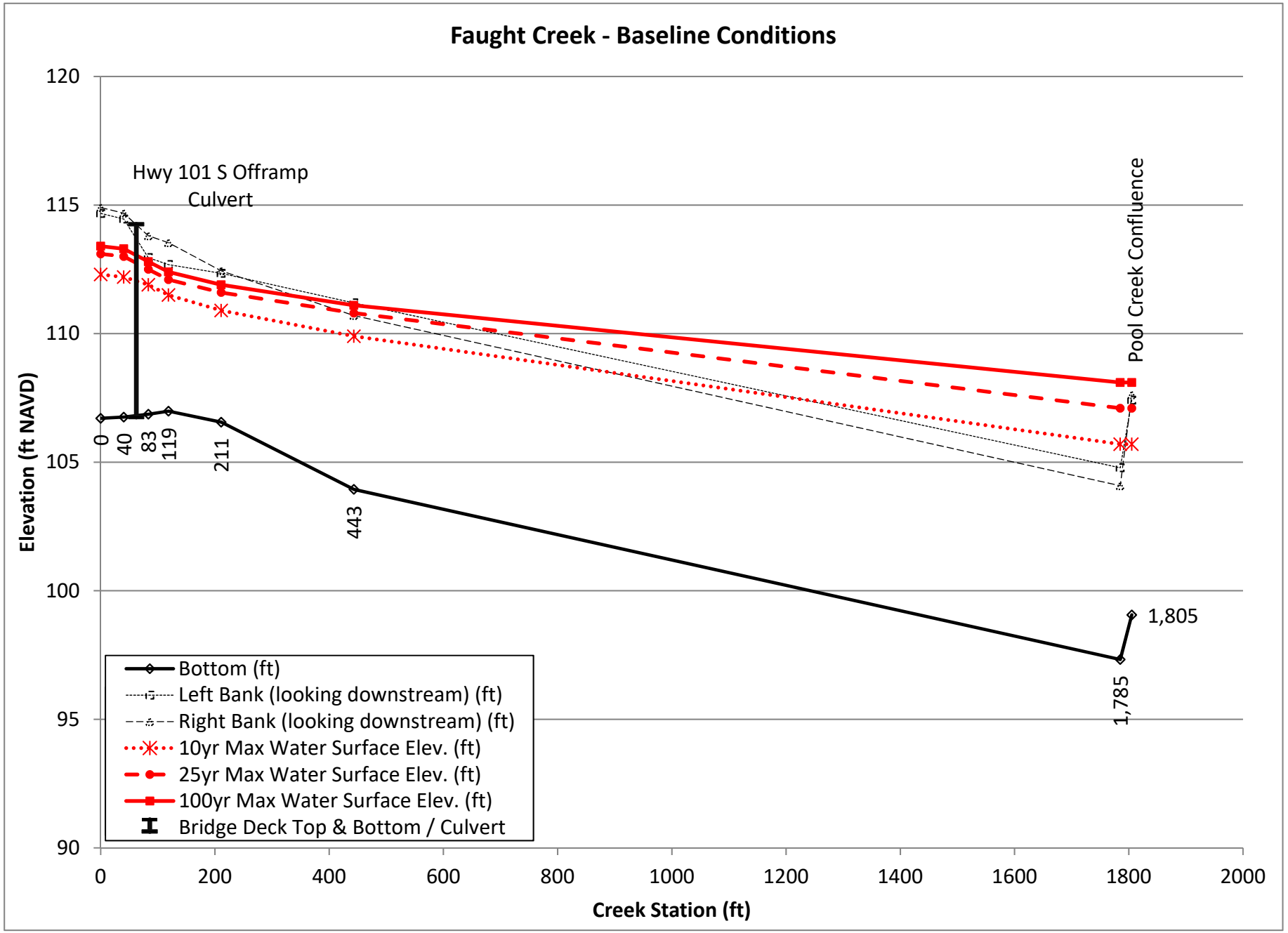

East Windsor Creek Tributary #6 - Baseline Conditions
Elevation (ft NAVD)
135
130
125
120
115
110
105
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Creek Station (ft)
Private Driveway Culvert
East Windsor Creek Confluence
1,592
1,683
1,911
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert


East Windsor Creek Tributary #3 - Baseline Conditions
Elevation (ft NAVD)
Creek Station (ft)
150
148
146
144
142
140
138
136
134
132
130
0
200
400
600
800
1000
1200
0
14
795
840
922
974
1,156
1,177
Foothill Dr Culvert
East Windsor Creek Confluence
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert


East Windsor Creek (Upstream Segment) - Baseline Conditions
Footbridge Culvert
Foothill Dr Culvert
Hembree Ln Culvert
Elevation (ft NAVD)
Creek Station (ft)
180
175
170
165
160
155
150
145
140
135
130
0
500
1000
1500
2000
2500
3000
3500
4000
0
62
200
220
740
1,301
1,358
1,442
1,538
1,769
1,776
3,169
East Windsor Creek (Upstream Segment)
Station 3,169 STET to East Windsor Creek
Station 0. (See East Windsor Creek figures
for confinuation).
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert


Faught Creek (Upstream Open Channel) - Baseline Conditions
Elevation (ft NAVD)
Creek Station (ft)
130
128
126
124
122
120
118
116
114
112
110
0
200
400
600
800
1000
1200
1400
1600
1800
Old Redwood Hwy
Amie Dr Culvert
Underground Culvert
0
60
120
180
239
299
359
419
479
539
598
661
724
787
850
913
976
1,039
1,102
1,165
1,228
1,291
1,354
1,418
1,482
1,545
1,587
1,626
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert


Faught Creek (Culvert Section Under Walmart) - Baseline Conditions
Elevation (ft NAVD)
125
120
115
110
105
100
95
90
0
130
259
377
482
586
691
833
962
1,091
1,190
1,276
1,380
1,471
0
200
400
600
800
1000
1200
1400
1600
Creek Station (ft)
Culvert Top of Pipe
Culvert Invert Elevation
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)

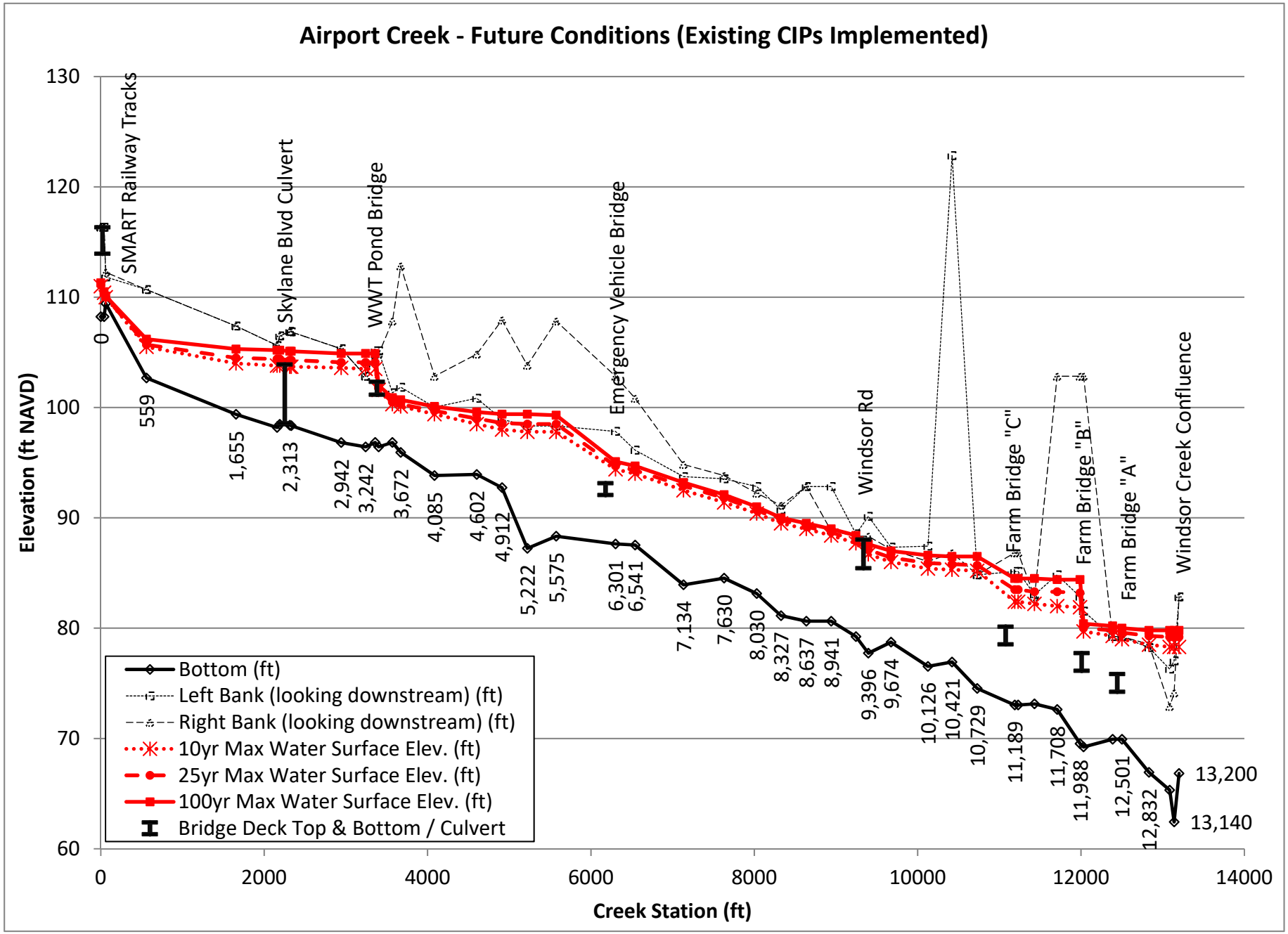

Faught Creek - Baseline Conditions
Elevation (ft NAVD)
Creek Station (ft)
Hwy 101 S Offramp Culvert
Pool Creek Confluence
0
40
83
119
211
443
1,785
1,805
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

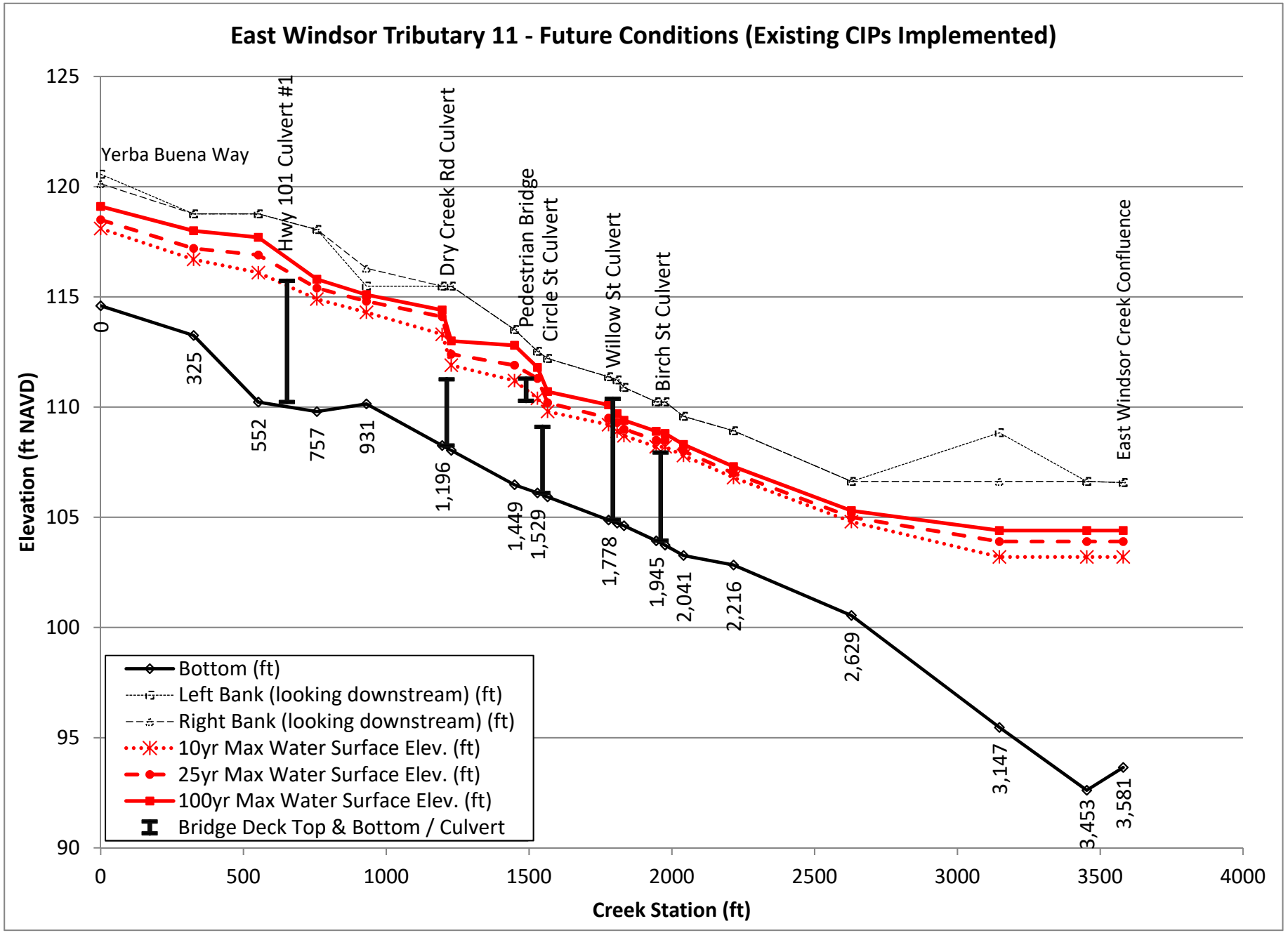
Appendix 6C – MIKE 11 Future Conditions Water Surface Profiles

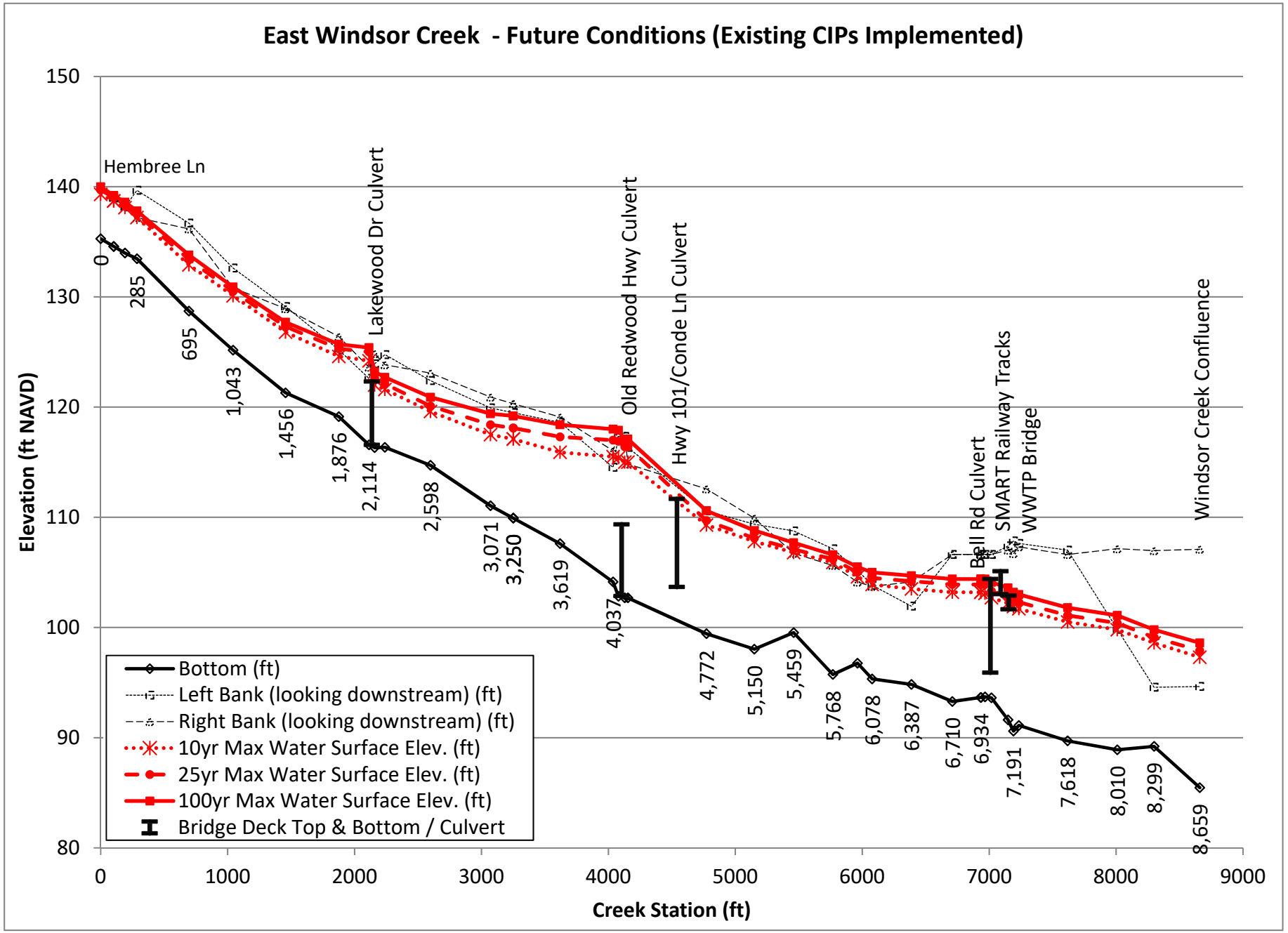
The figures below show water surface profiles for the 10-, 25-, and 100-year return period events for the Town's creeks and tributaries under future conditions with all SDIPs (existing and future) implemented. The figures are presented in alphabetical order by creek, and profiles for the tributaries of creeks are presented from upstream to downstream.

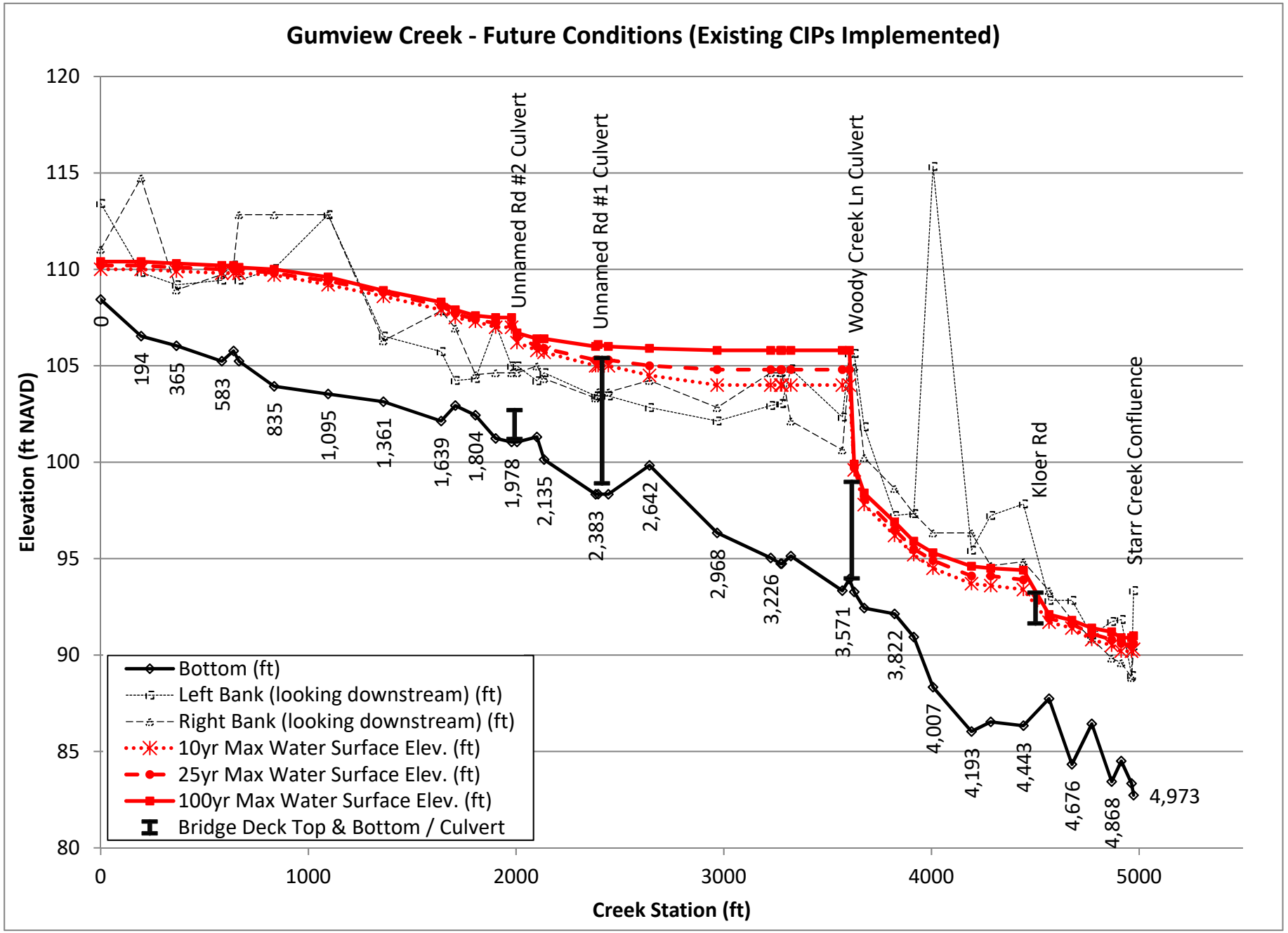
The figures also include creek bottom and left and right bank elevations, in addition to major culvert and bridge structures that were included within the MIKE 11 model. Labels are included to indicate the roadway at which the structure is located.

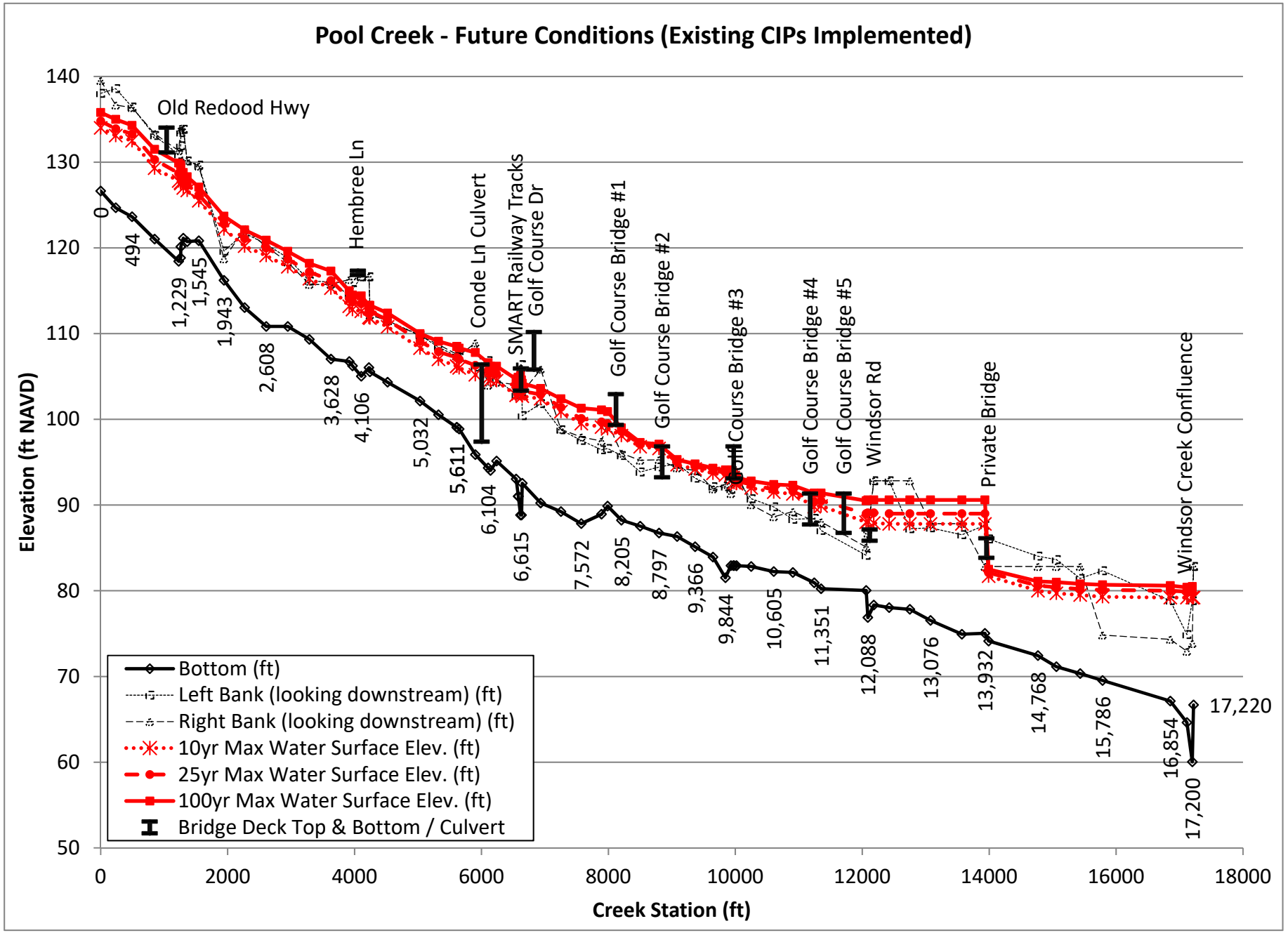
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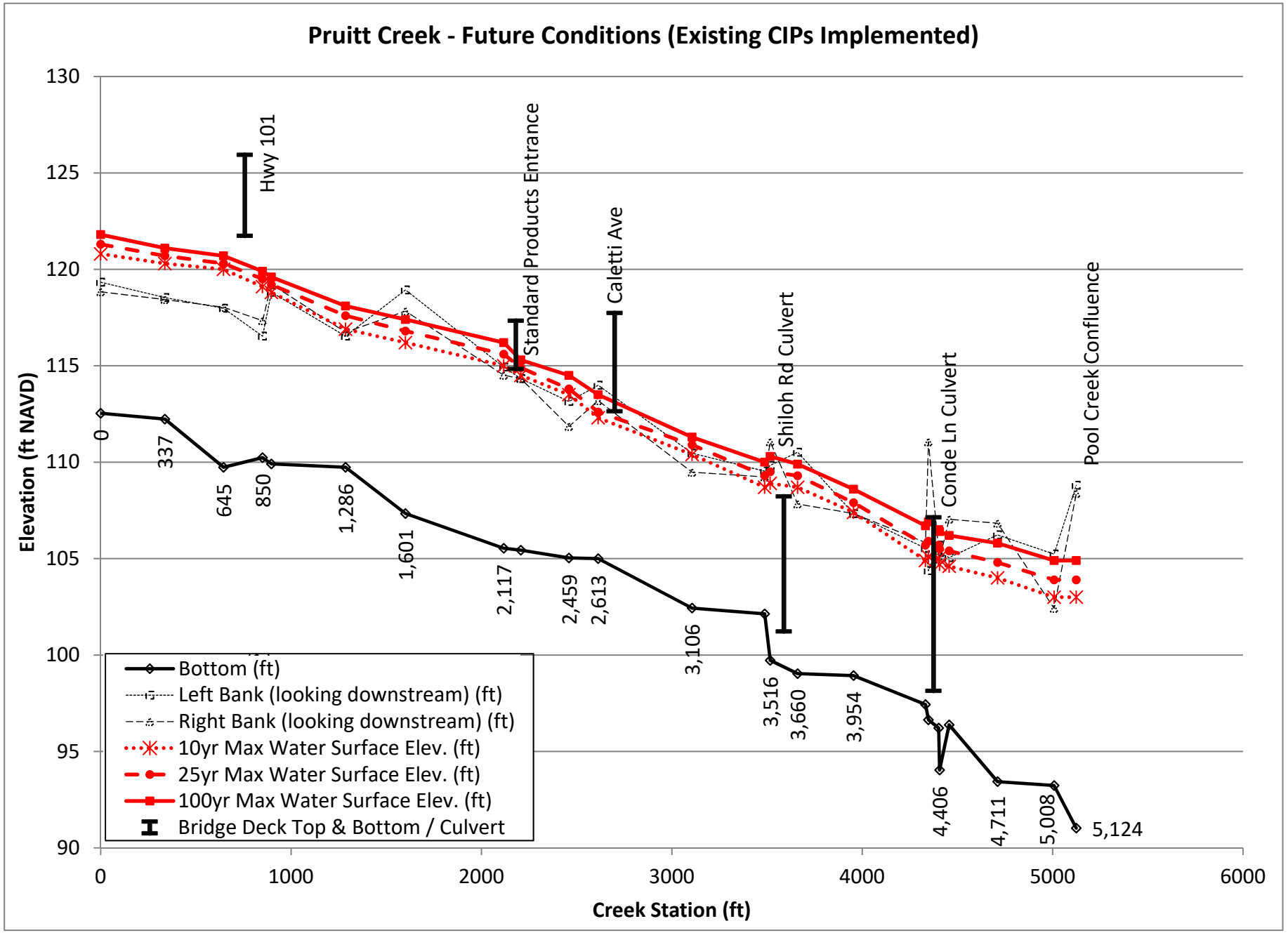

Airport Creek - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
Creek Station (ft)
130
120
110
100
90
80
70
60
0
2000
4000
6000
8000
10000
12000
14000
SMART Railway Tracks
Skylane Blvd Culvert
WWT Pond Bridge
Emergency Vehicle Bridge
Windsor Rd
Farm Bridge "C"
Farm Bridge "B"
Farm Bridge "A"
Windsor Creek Confluence
0
559
1,655
2,313
2,942
3,242
3,672
4,085
4,602
4,912
5,222
5,575
6,301
6,541
7,134
7,630
8,030
8,327
8,637
8,941
9,396
9,674
10,126
10,421
10,729
11,189
11,708
11,988
12,501
12,832
13,200
13,140
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

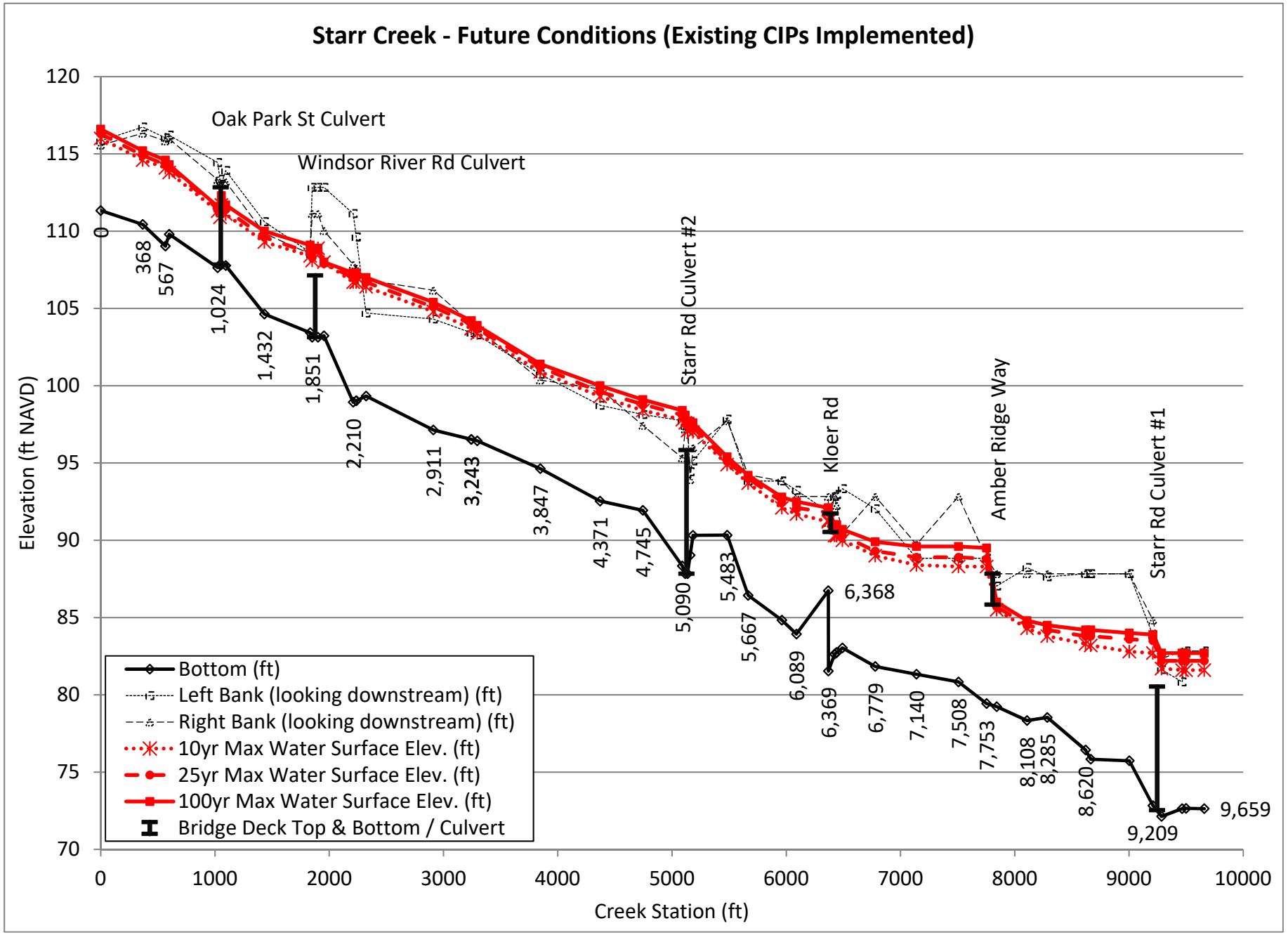

East Windsor Tributary 11 - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
Creek Station (ft)
125
120
115
110
105
100
95
90
0
500
1000
1500
2000
2500
3000
3500
4000
Yerba Buena Way
Hwy 101 Culvert #1
Dry Creek Rd Culvert
Pedestrian Bridge
Circle St Culvert
Willow St Culvert
Birch St Culvert
East Windsor Creek Confluence
0
325
552
757
931
1,196
1,449
1,529
1,778
1,945
2,041
2,216
2,629
3,147
3,453
3,581
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

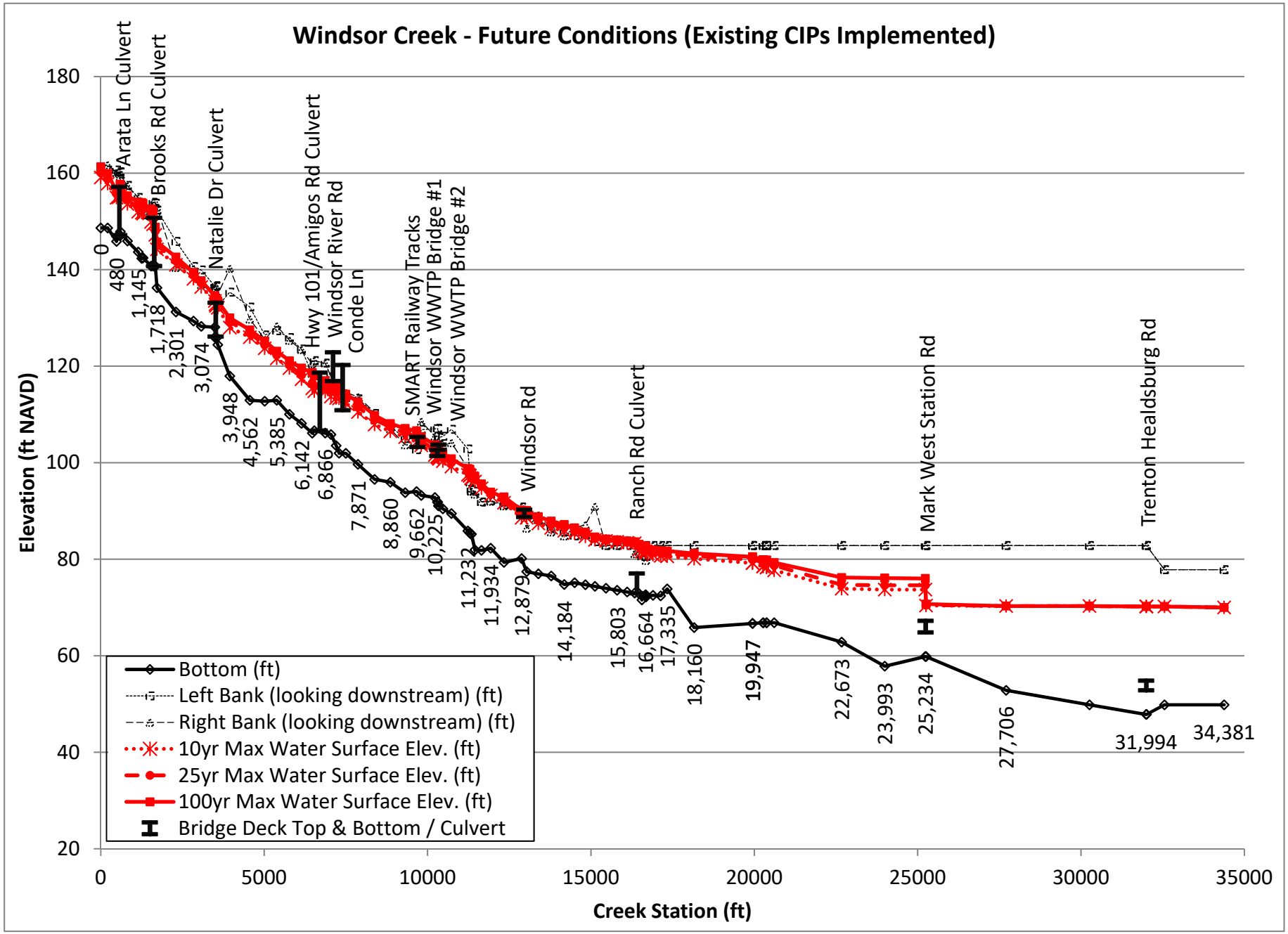

East Windsor Creek - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
Creek Station (ft)
150
140
130
120
110
100
90
80
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Hembree Ln
Lakewood Dr Culvert
Old Redwood Hwy Culvert
Hwy 101/Conde Ln Culvert
Bell Rd Culvert
SMART Railway Tracks
WWTP Bridge
Windsor Creek Confluence
0
285
695
1,043
1,456
1,876
2,114
2,598
3,071
3,250
3,619
4,037
4,772
5,150
5,459
5,768
6,078
6,387
6,710
6,934
7,191
7,618
8,010
8,299
8,659
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

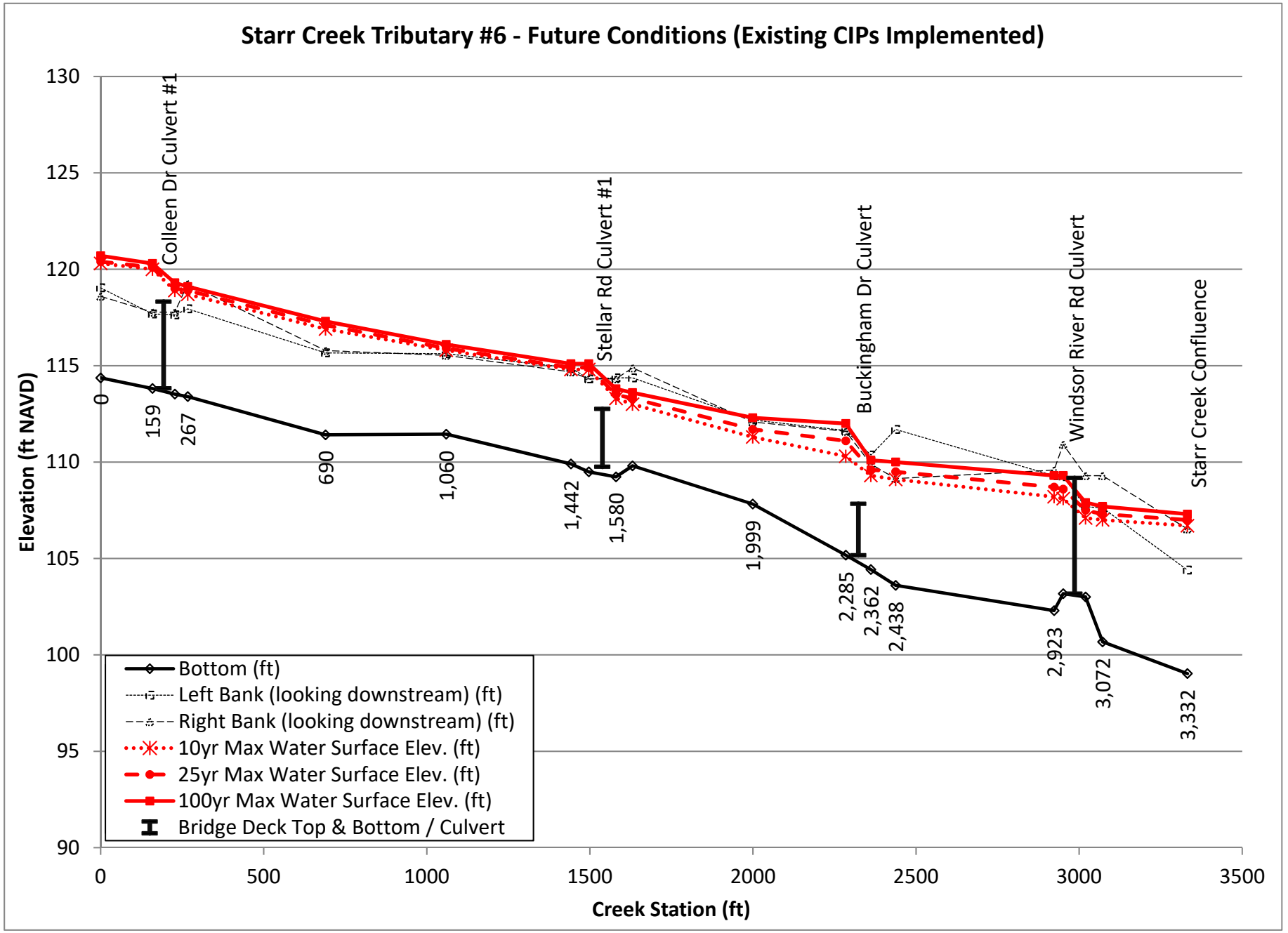

Gumview Creek - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
Creek Station (ft)
120
115
110
105
100
95
90
85
80
0
1000
2000
3000
4000
5000
Unnamed Rd #2 Culvert
Unnamed Rd #1 Culvert
Woody Creek Ln Culvert
Kloer Rd
Starr Creek Confluence
0
194
365
583
835
1,095
1,361
1,639
1,804
1,978
2,135
2,383
2,642
2,968
3,226
3,571
3,822
4,007
4,193
4,443
4,676
4,868
4,973
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

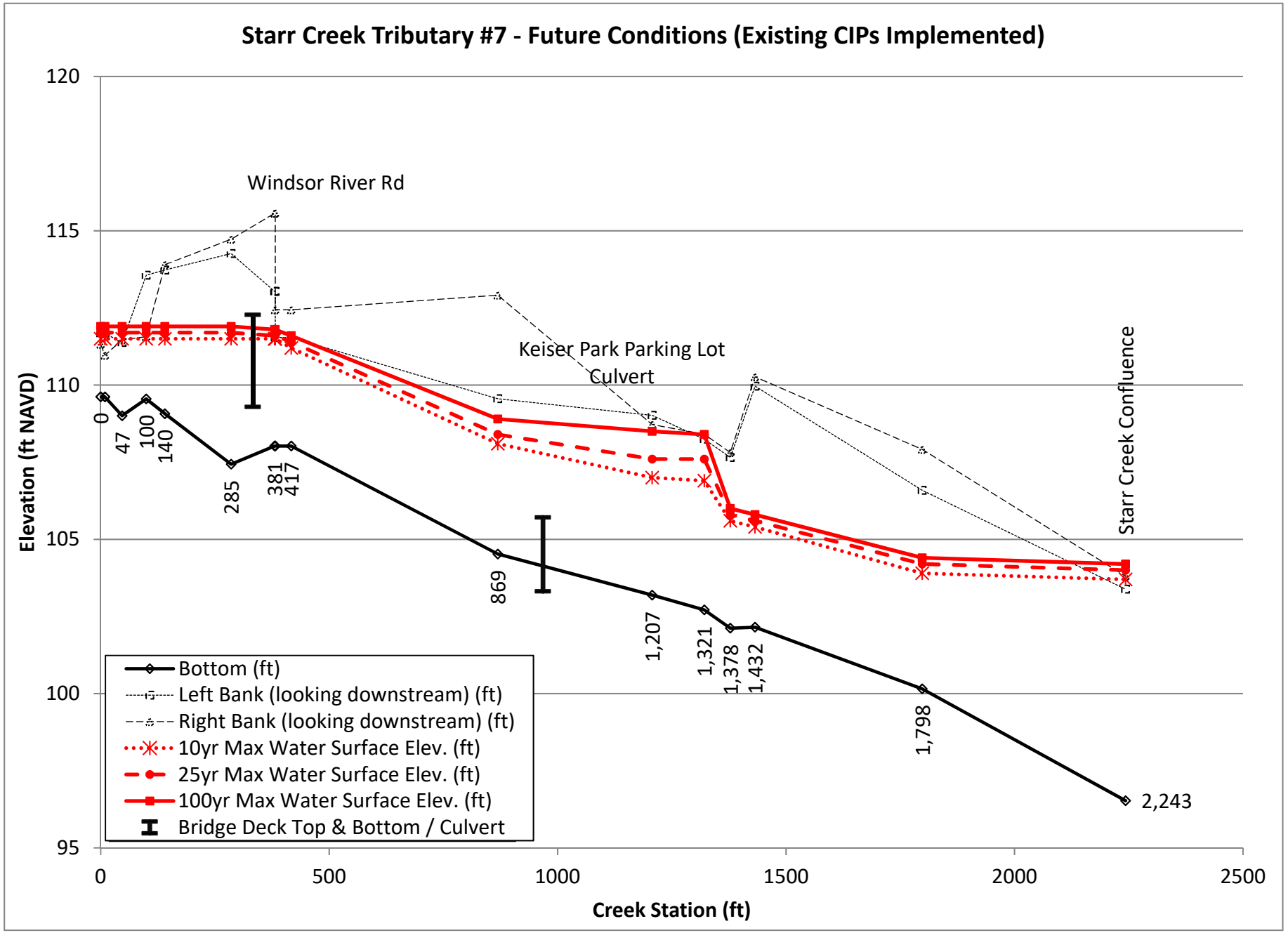

Pool Creek - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
Creek Station (ft)
140
130
120
110
100
90
80
70
60
50
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Old Redood Hwy
Hembree Ln
Conde Ln Culvert
SMART Railway Tracks
Golf Course Dr
Golf Course Bridge #1
Golf Course Bridge #2
Golf Course Bridge #3
Golf Course Bridge #4
Golf Course Bridge #5
Windsor Rd
Private Bridge
Windsor Creek Confluence
0
494
1,229
1,545
1,943
2,608
3,628
4,106
5,032
5,611
6,104
6,615
7,572
8,205
8,797
9,366
9,844
10,605
11,351
12,088
13,076
13,932
14,768
15,786
16,854
17,200
17,220
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

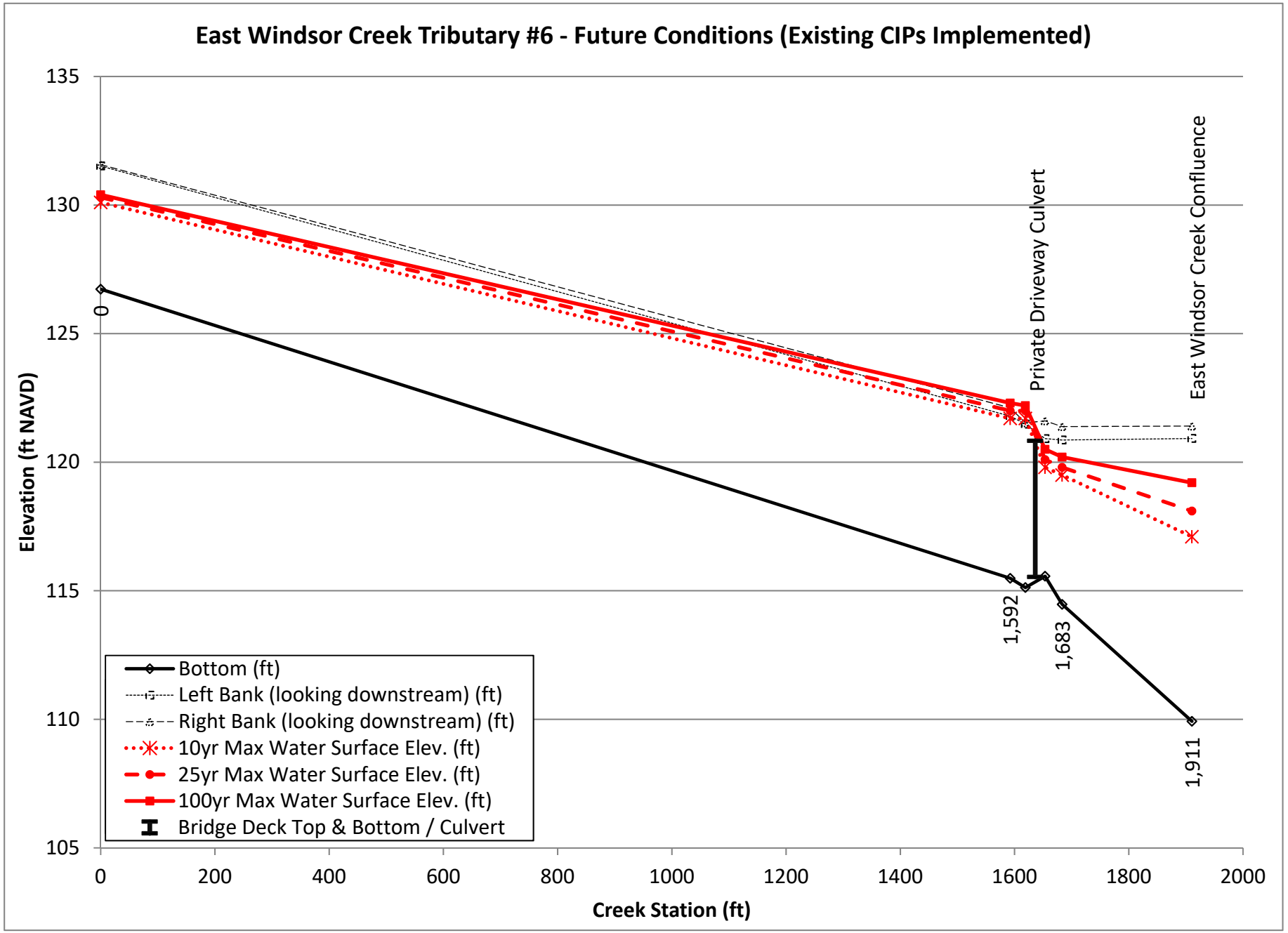

Pruitt Creek - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
Creek Station (ft)
130
125
120
115
110
105
100
95
90
0
1000
2000
3000
4000
5000
6000
Hwy 101
Standard Products Entrance
Caletti Ave
Shiloh Rd Culvert
Conde Ln Culvert
Pool Creek Confluence
0
337
645
850
1,286
1,601
2,117
2,459
2,613
3,106
3,516
3,660
3,954
4,406
4,711
5,008
5,124
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

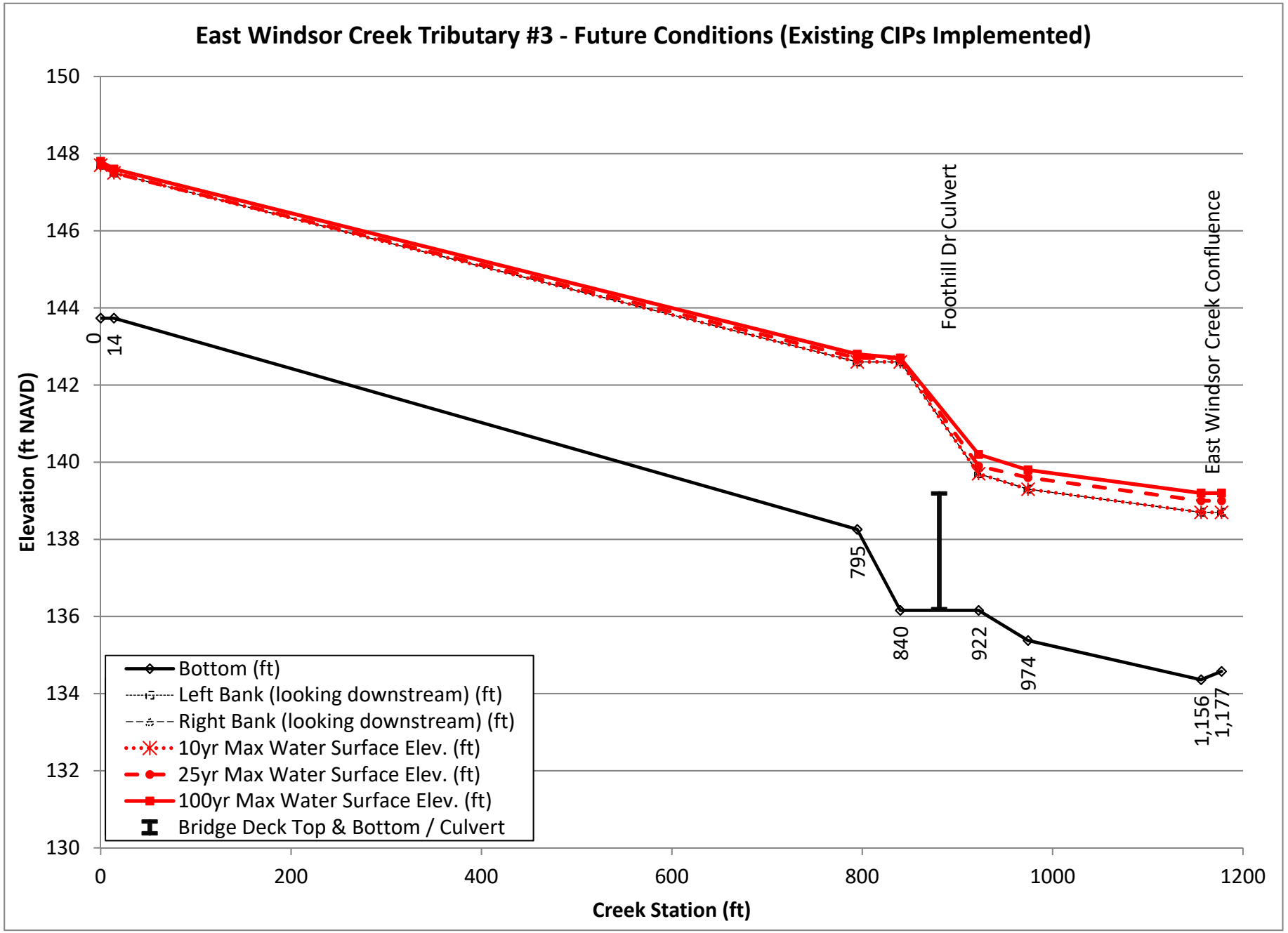

Starr Creek - Future Conditions (Existing CIPs Implemented)
Oak Park St Culvert
Windsor River Rd Culvert
Starr Rd Culvert #2
Kloer Rd
Amber Ridge Way
Starr Rd Culvert #1
0
368
567
1,024
1,432
1,851
2,210
2,911
3,243
3,847
4,371
4,745
5,090
5,483
5,667
6,089
6,368
6,369
6,779
7,140
7,508
7,753
8,108
8,285
8,620
9,209
9,659
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert
Elevation (ft NAVD)
Creek Station (ft)
120
115
110
105
100
95
90
85
80
75
70
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000

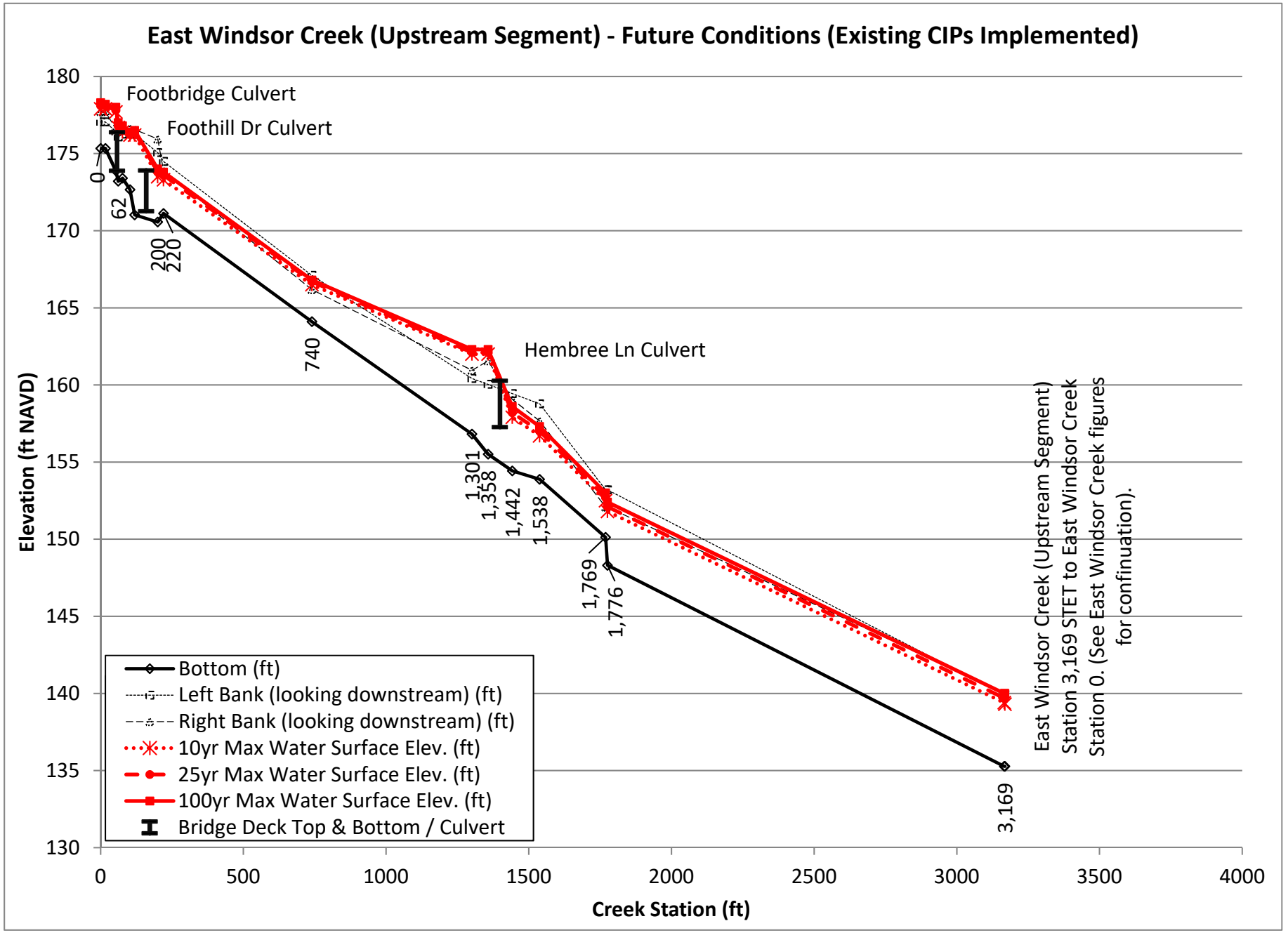

Windsor Creek - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
Creek Station (ft)
180
160
140
120
100
80
60
40
20
0
5000
10000
15000
20000
25000
30000
35000
0
480
1,145
1,718
2,301
3,074
3,948
4,562
5,385
6,142
6,866
7,871
8,860
9,662
10,225
11,232
11,934
12,879
14,184
15,803
16,664
17,335
18,160
19,947
22,673
23,993
25,234
27,706
31,994
34,381
Arata Ln Culvert
Brooks Rd Culvert
Natalie Dr Culvert
Hwy 101/Amigos Rd Culvert
Windsor River Rd
Conde Ln
SMART Railway Tracks
Windsor WWTP Bridge #1
Windsor WWTP Bridge #2
Windsor Rd
Ranch Rd Culvert
Mark West Station Rd
Trenton Healdsburg Rd
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

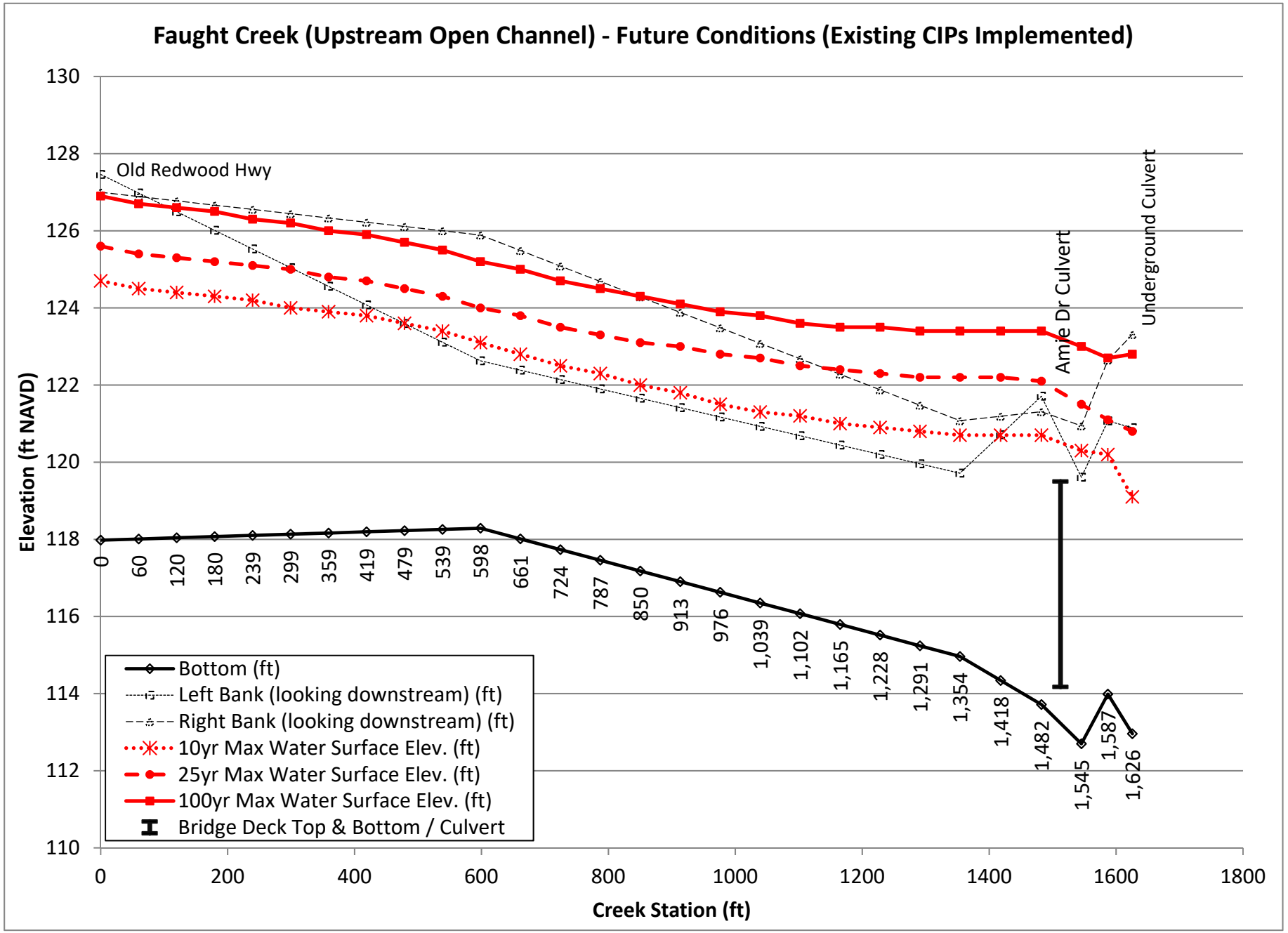

Starr Creek Tributary #6 - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
Creek Station (ft)
130
125
120
115
110
105
100
95
90
0
500
1000
1500
2000
2500
3000
3500
Colleen Dr Culvert #1
Stellar Rd Culvert #1
Buckingham Dr Culvert
Windsor River Rd Culvert
Starr Creek Confluence
0
159
267
690
1,060
1,442
1,580
1,999
2,285
2,362
2,438
2,923
3,072
3,332
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

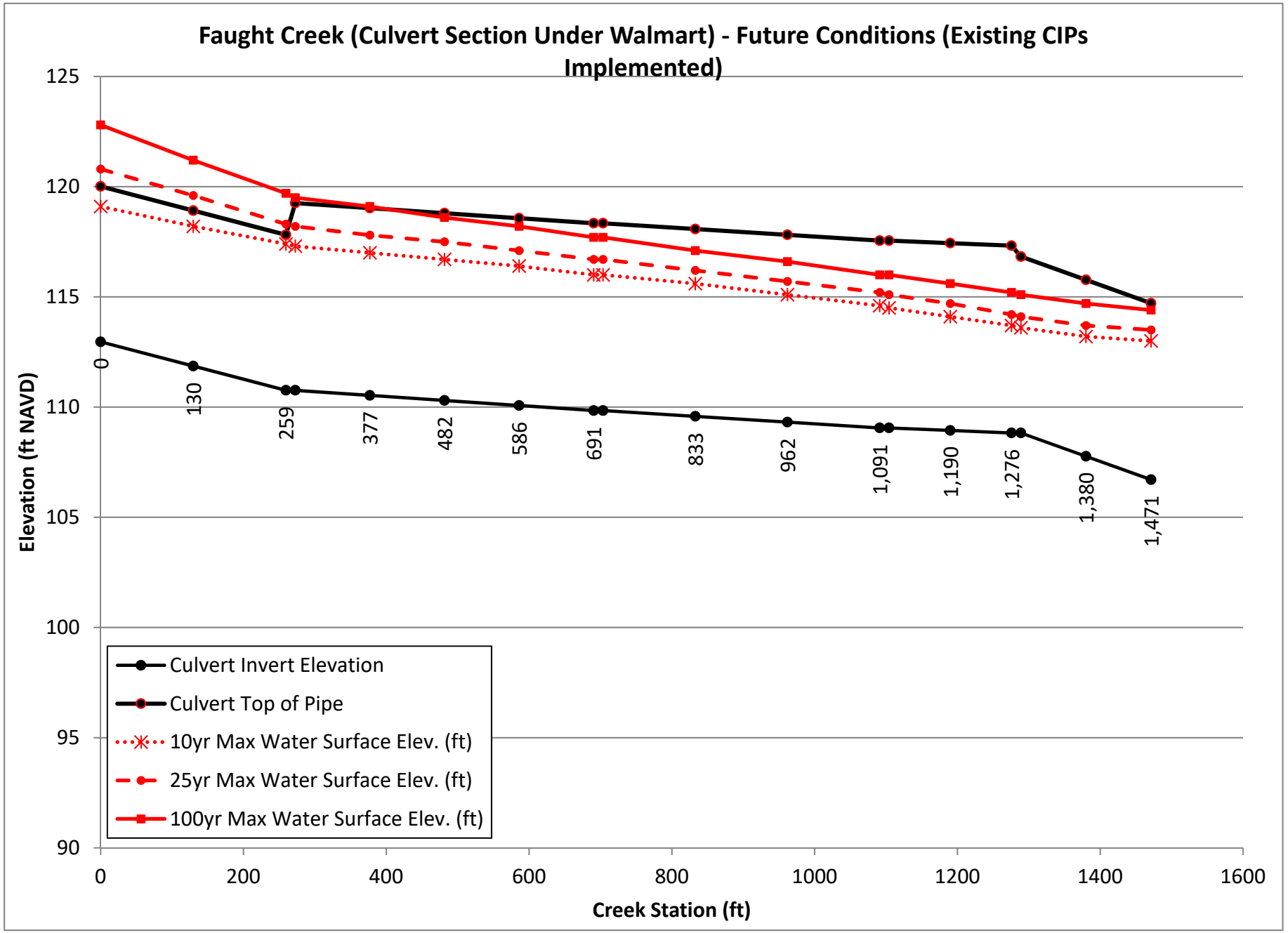

Starr Creek Tributary #7 - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
120
115
110
105
100
95
0
500
1000
1500
2000
2500
Creek Station (ft)
Windsor River Rd
Keiser Park Parking Lot Culvert
Starr Creek Confluence
0
47
100
140
285
381
417
869
1,207
1,321
1,378
1,432
1,798
2,243
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

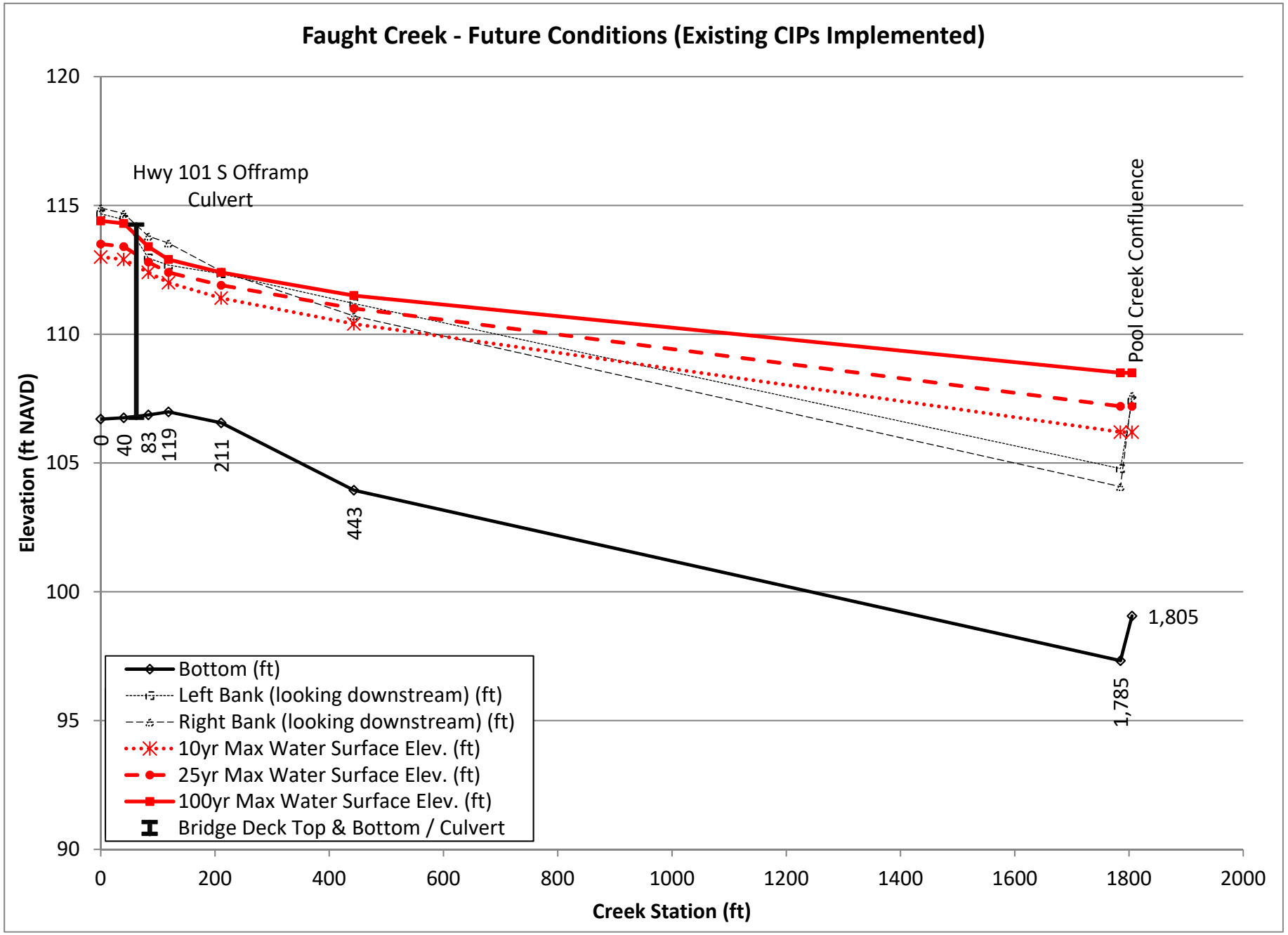

East Windsor Creek Tributary #6 - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
135
130
125
120
115
110
105
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Creek Station (ft)
0
1,592
1,683
1,911
Private Driveway Culvert
East Windsor Creek Confluence
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert

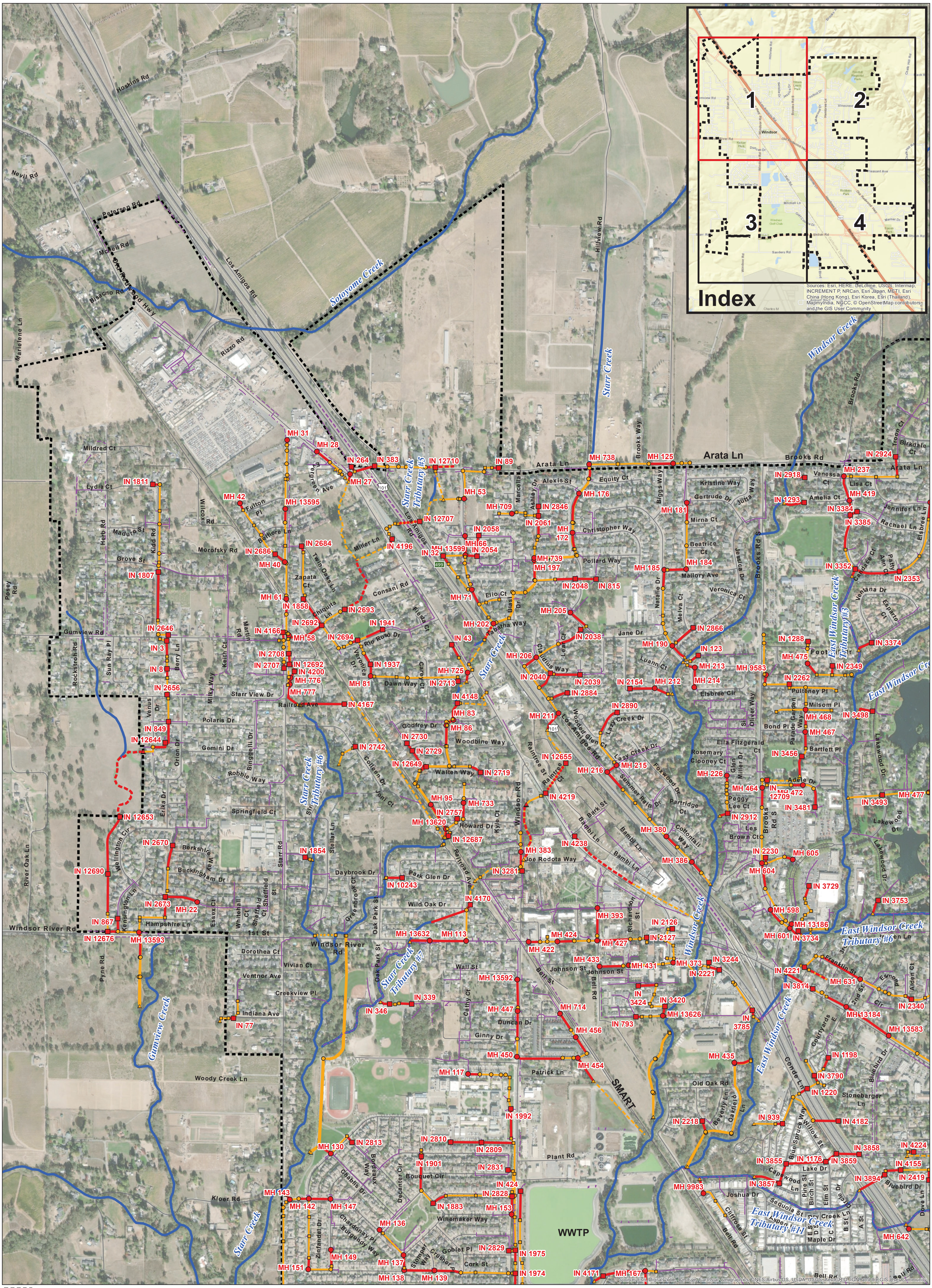

East Windsor Creek Tributary #3 - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
Creek Station (ft)
150
148
146
144
142
140
138
136
134
132
130
0
200
400
600
800
1000
1200
0
14
795
840
922
974
1,156
1,177
Foothill Dr Culvert
East Windsor Creek Confluence
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert


East Windsor Creek (Upstream Segment) - Future Conditions (Existing CIPs Implemented)
Footbridge Culvert
Foothill Dr Culvert
Hembree Ln Culvert
Elevation (ft NAVD)
Creek Station (ft)
180
175
170
165
160
155
150
145
140
135
130
0
500
1000
1500
2000
2500
3000
3500
4000
0
62
200
220
740
1,301
1,358
1,442
1,538
1,769
1,776
3,169
East Windsor Creek (Upstream Segment)
Station 3,169 STET to East Windsor Creek
Station 0. (See East Windsor Creek figures
for confinuation).
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert


Faught Creek (Upstream Open Channel) - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
Creek Station (ft)
Old Redwood Hwy
Amie Dr Culvert
Underground Culvert
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert


Faught Creek (Culvert Section Under Walmart) - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
125
120
115
110
105
100
95
90
0
130
259
377
482
586
691
833
962
1,091
1,190
1,276
1,380
1,471
0
200
400
600
800
1000
1200
1400
1600
Creek Station (ft)
Culvert Invert Elevation
Culvert Top of Pipe
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)


Faught Creek - Future Conditions (Existing CIPs Implemented)
Elevation (ft NAVD)
Creek Station (ft)
Hwy 101 S Offramp Culvert
Pool Creek Confluence
0
40
83
119
211
443
1,785
1,805
Bottom (ft)
Left Bank (looking downstream) (ft)
Right Bank (looking downstream) (ft)
10yr Max Water Surface Elev. (ft)
25yr Max Water Surface Elev. (ft)
100yr Max Water Surface Elev. (ft)
Bridge Deck Top & Bottom / Culvert



Town Limits
Streets
Rivers and Creeks
Culverts, Downstream of Model Input Location
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Downstream of Model Input Location
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Downstream of Model Input Location
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Model Input Location & ID
Inlets, Modeled
Manholes, Model Input Location & ID
Manholes, Modeled
Discharge Points, Model Input Location & ID
Discharge Point, Modeled

Paper Size 22" x 34" (ANSI D)

0 250 500 750 1,000

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

Development Review Model Input Locations

Job Number	11159126
Revision	1
Date	14 Feb 2020

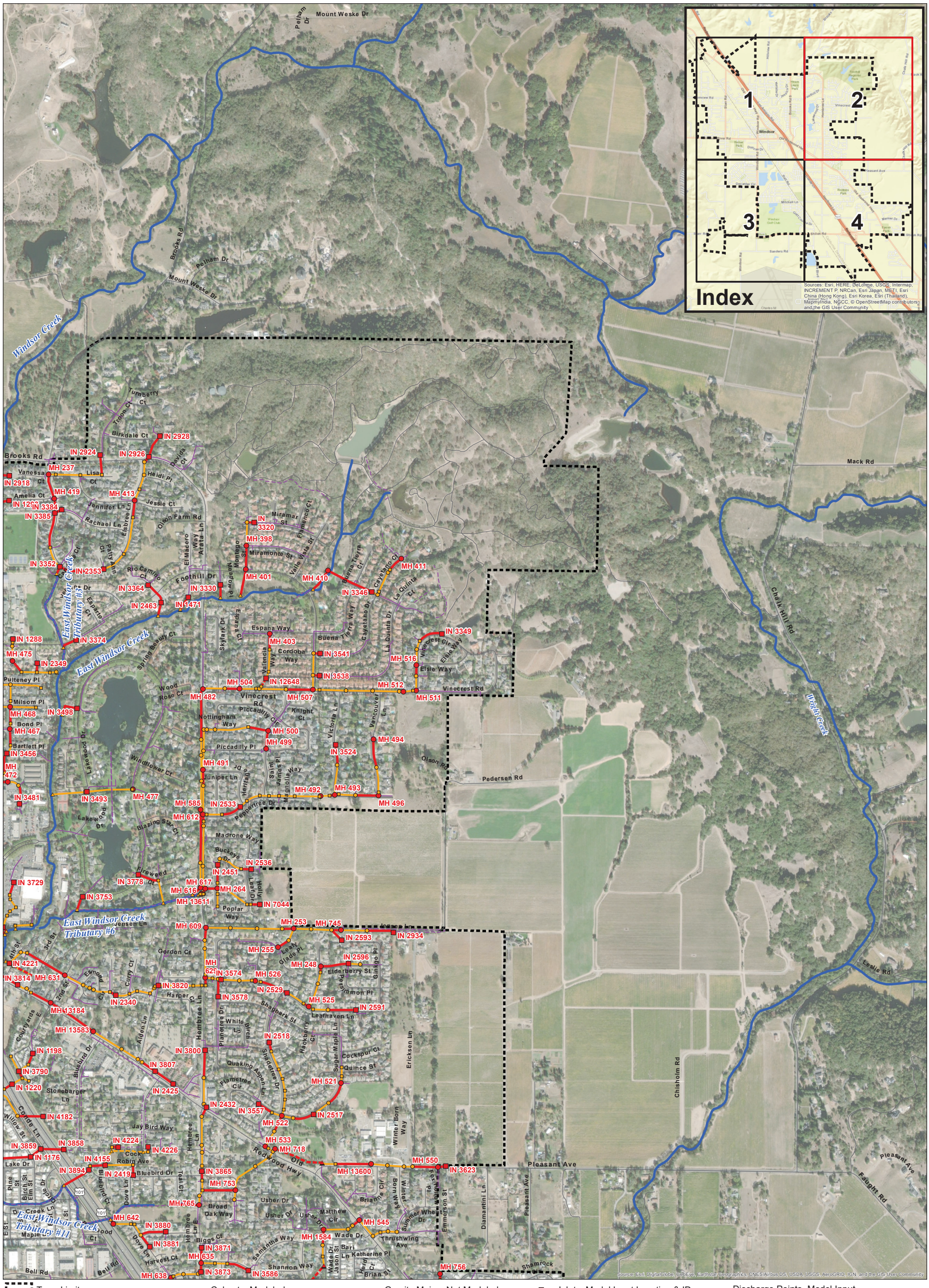
Figure 6E-1

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Town Limits
Streets
Rivers and Creeks
Culverts, Downstream of Model Input Location
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Downstream of Model Input Location
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Downstream of Model Input Location
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Model Input Location & ID
Inlets, Modeled
Manholes, Model Input Location & ID
Manholes, Modeled
Discharge Points, Model Input Location & ID
Discharge Point, Modeled

Paper Size 22" x 34" (ANSI D)
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Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

N

Town of Windsor
Storm Drainage Master Plan

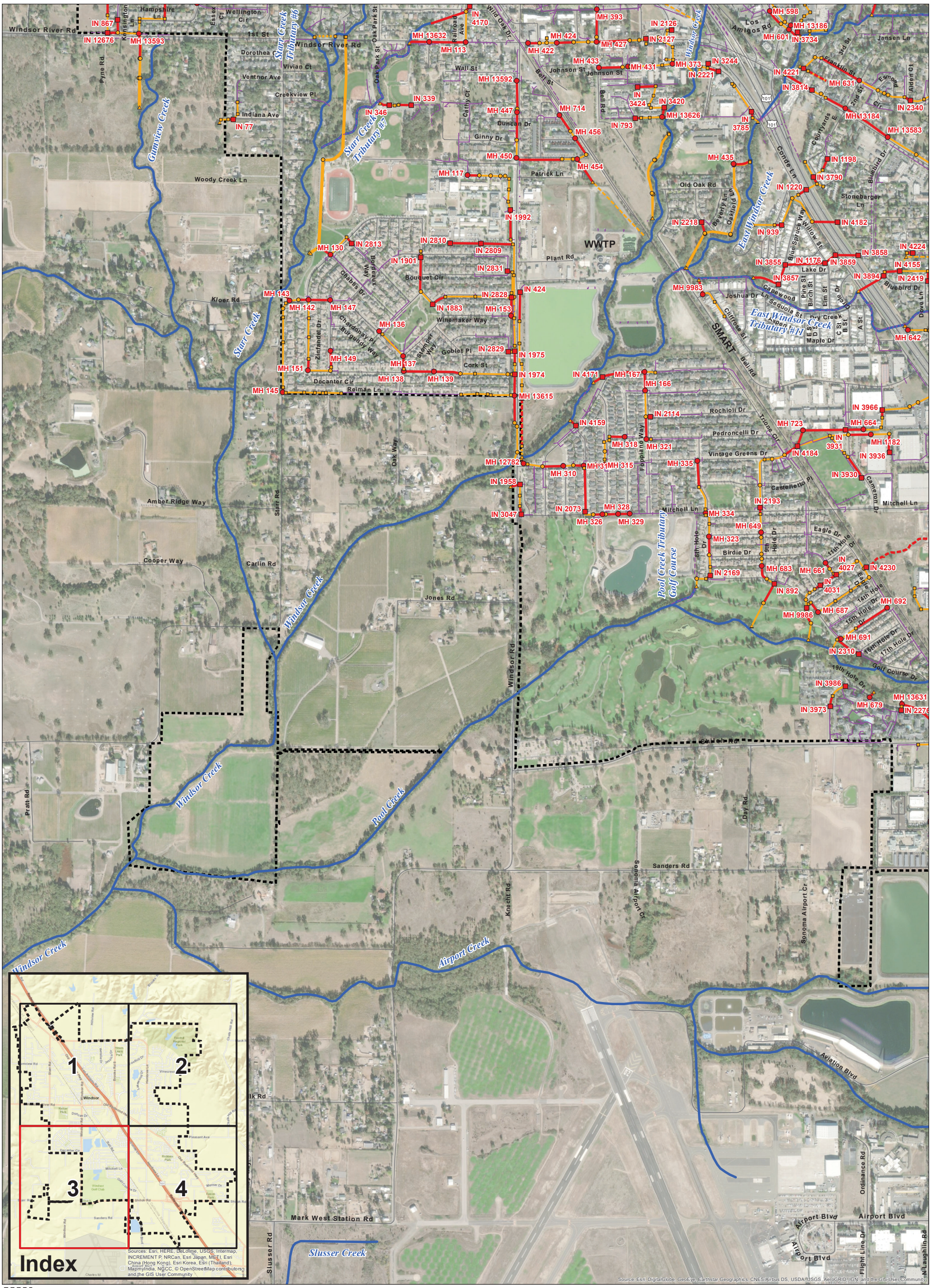
Development Review Model Input Locations

Job Number	11159126
Revision	1
Date	14 Feb 2020

Figure 6E-2

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Data source: PRMD (edited by GHD per Windsor's direction), Town Limits; Sonoma County, Streets, 2013; ESRI, Road Labels, 2012; USGS, Streams, 2013; GHD, Storm Drain System, 2019. Created by:afisher2

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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Town Limits
Streets
Rivers and Creeks
Culverts, Downstream of Model Input Location
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Downstream of Model Input Location
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Downstream of Model Input Location
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Model Input Location & ID
Inlets, Modeled
Manholes, Model Input Location & ID
Manholes, Modeled
Discharge Points, Model Input Location & ID
Discharge Point, Modeled

Paper Size 22" x 34" (ANSI D)
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Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

Development Review Model Input Locations

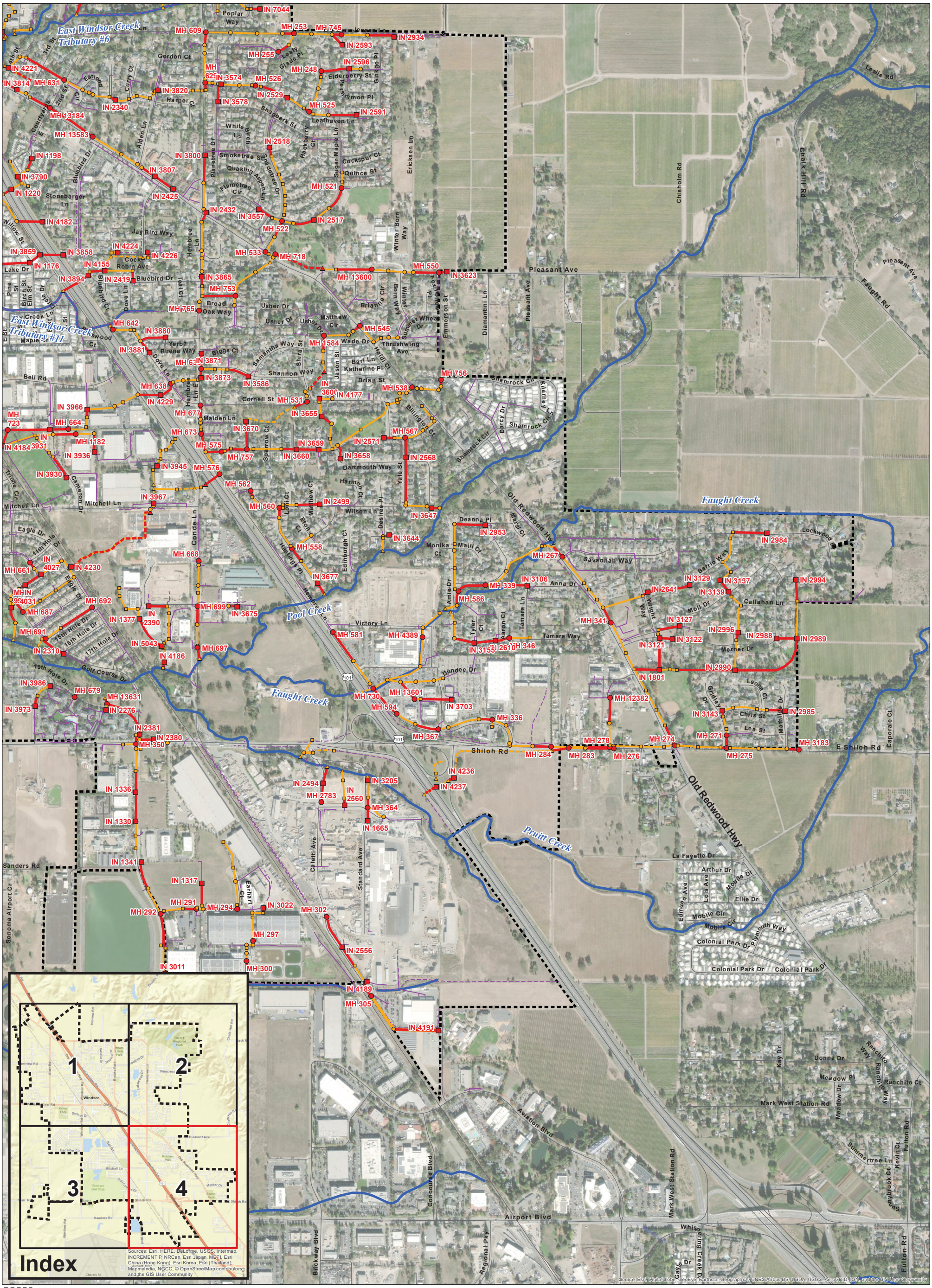
Job Number 11159126
Revision 1
Date 14 Feb 2020

Figure 6E-3

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Town Limits
Streets
Rivers and Creeks
Culverts, Downstream of Model Input Location
Culverts, Modeled
Culverts, Not Modeled
Gravity Mains, Downstream of Model Input Location
Gravity Mains, Modeled
Gravity Mains, Not Modeled
Open Channels, Downstream of Model Input Location
Open Channels, Modeled
Open Channels, Not Modeled
Inlets, Model Input Location & ID
Inlets, Modeled
Manholes, Model Input Location & ID
Manholes, Modeled
Discharge Points, Model Input Location & ID
Discharge Point, Modeled

Paper Size 22" x 34" (ANSI D)
0 250 500 750 1,000
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California II FIPS 0402 Feet

Town of Windsor
Storm Drainage Master Plan

Development Review Model Input Locations

Job Number 11159126
Revision 1
Date 14 Feb 2020

Figure 6E-4

N:\US\Santa Rosa\Projects\111\11159126 TOW Storm Drainage Master Plan Ph2\08-GIS\Maps\Deliverables\SDMP Phase II\Final\Figure 6E-4 Development Review Model Input Locations.mxd
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Appendix 6D – MIKE 11 Water Surface Elevation and Peak Discharge Results

In this appendix 6D, Table 6D-1 presents the MIKE 11 water surface elevation results and Table 6D-2 presents the MIKE 11 peak discharge results.

Table 6D-1. MIKE 11 Water Surface Elevations

		Baseline Condition			Future Condition (assumes all SDIPs implemented)		
M11 Creek Name	Station	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
AIRPORT CREEK	0	111.0	111.1	111.3	111.0	111.1	111.3
AIRPORT CREEK	40	110.3	110.4	110.5	110.4	110.4	110.5
AIRPORT CREEK	60	110.0	110.0	110.1	110.0	110.0	110.1
AIRPORT CREEK	559	105.5	105.7	106.2	105.5	105.7	106.2
AIRPORT CREEK	1655	104.0	104.5	105.3	104.0	104.5	105.3
AIRPORT CREEK	2158	103.8	104.4	105.2	103.8	104.4	105.2
AIRPORT CREEK	2191	103.8	104.4	105.2	103.8	104.4	105.2
AIRPORT CREEK	2313	103.7	104.3	105.1	103.7	104.3	105.1
AIRPORT CREEK	2331	103.7	104.3	105.1	103.7	104.3	105.1
AIRPORT CREEK	2942	103.5	104.1	104.9	103.6	104.1	104.9
AIRPORT CREEK	3242	103.5	104.1	104.9	103.5	104.1	104.9
AIRPORT CREEK	3359	103.5	104.1	104.9	103.5	104.1	104.9
AIRPORT CREEK	3401	101.6	101.8	102.0	101.6	101.8	102.0
AIRPORT CREEK	3569	100.3	100.5	100.9	100.3	100.5	100.9
AIRPORT CREEK	3672	100.1	100.3	100.7	100.1	100.3	100.7
AIRPORT CREEK	4085	99.4	99.7	100.1	99.4	99.7	100.1
AIRPORT CREEK	4602	98.5	99.0	99.6	98.5	99.0	99.6
AIRPORT CREEK	4912	98.0	98.6	99.4	98.0	98.6	99.4
AIRPORT CREEK	5222	97.8	98.5	99.3	97.8	98.5	99.4
AIRPORT CREEK	5575	97.8	98.5	99.3	97.8	98.5	99.3
AIRPORT CREEK	6301	94.4	94.7	95.1	94.4	94.7	95.1
AIRPORT CREEK	6541	94.0	94.3	94.7	94.0	94.3	94.7
AIRPORT CREEK	7134	92.5	92.9	93.2	92.5	92.9	93.2
AIRPORT CREEK	7630	91.4	91.7	92.1	91.4	91.8	92.1
AIRPORT CREEK	8030	90.3	90.7	91.0	90.4	90.7	91.0
AIRPORT CREEK	8327	89.5	89.7	90.0	89.5	89.8	90.0
AIRPORT CREEK	8637	88.9	89.2	89.5	89.0	89.2	89.5
AIRPORT CREEK	8941	88.4	88.7	89.0	88.4	88.7	89.0
AIRPORT CREEK	9245	87.7	87.9	88.4	87.7	87.9	88.4
AIRPORT CREEK	9396	86.7	87.1	87.6	86.7	87.1	87.6
AIRPORT CREEK	9674	86.0	86.4	87.0	86.0	86.4	87.0
AIRPORT CREEK	10126	85.4	85.9	86.6	85.4	85.9	86.6
AIRPORT CREEK	10421	85.3	85.8	86.5	85.3	85.8	86.5
AIRPORT CREEK	10729	85.2	85.7	86.5	85.2	85.7	86.5
AIRPORT CREEK	11189	82.4	83.5	84.5	82.4	83.5	84.5
AIRPORT CREEK	11230	82.4	83.4	84.5	82.4	83.5	84.5

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
AIRPORT CREEK	11430	82.2	83.3	84.5	82.2	83.3	84.5
AIRPORT CREEK	11708	82.0	83.3	84.4	82.0	83.3	84.4
AIRPORT CREEK	11988	81.9	83.2	84.4	81.9	83.2	84.4
AIRPORT CREEK	12031	79.7	80.0	80.4	79.7	80.0	80.4
AIRPORT CREEK	12387	79.3	79.8	80.2	79.3	79.8	80.2
AIRPORT CREEK	12501	79.0	79.6	80.0	79.0	79.6	80.0
AIRPORT CREEK	12832	78.4	79.2	79.8	78.4	79.2	79.8
AIRPORT CREEK	13085	78.3	79.1	79.7	78.3	79.2	79.7
AIRPORT CREEK	13140	78.3	79.1	79.7	78.3	79.2	79.7
AIRPORT CREEK	13200	78.3	79.1	79.7	78.3	79.2	79.7
E WINDSOR CREEK	0	139.3	139.7	140.0	139.3	139.7	140.0
E WINDSOR CREEK	103	138.7	139.0	139.2	138.7	139.0	139.2
E WINDSOR CREEK	103	138.7	139.0	139.2	138.7	139.0	139.2
E WINDSOR CREEK	191	138.1	138.3	138.6	138.1	138.3	138.6
E WINDSOR CREEK	285	137.2	137.5	137.8	137.2	137.5	137.8
E WINDSOR CREEK	695	132.9	133.4	133.8	132.9	133.4	133.8
E WINDSOR CREEK	1043	130.1	130.5	130.9	130.1	130.5	130.9
E WINDSOR CREEK	1456	126.8	127.3	127.7	126.8	127.3	127.7
E WINDSOR CREEK	1876	124.6	125.3	125.7	124.6	125.3	125.7
E WINDSOR CREEK	2114	124.2	125.0	125.3	124.2	125.0	125.3
E WINDSOR CREEK	2159	122.0	122.6	123.2	122.0	122.6	123.2
E WINDSOR CREEK	2239	121.6	122.1	122.7	121.6	122.1	122.7
E WINDSOR CREEK	2598	119.6	120.1	120.8	119.5	120.0	120.8
E WINDSOR CREEK	3071	117.4	118.3	119.4	117.2	118.0	119.1
E WINDSOR CREEK	3250	117.1	118.1	119.1	116.7	117.6	118.9
E WINDSOR CREEK	3250	117.1	118.1	119.1	116.7	117.6	118.9
E WINDSOR CREEK	3619	115.8	117.3	118.4	115.3	116.6	118.1
E WINDSOR CREEK	4037	115.3	116.9	118.0	114.8	116.3	117.8
E WINDSOR CREEK	4079	115.2	116.8	117.9	114.7	116.2	117.7
E WINDSOR CREEK	4129	114.9	116.3	117.0	114.4	115.7	116.9
E WINDSOR CREEK	4154	114.9	116.3	117.1	114.4	115.7	117.0
E WINDSOR CREEK	4772	109.2	109.7	110.6	109.0	109.6	110.3
E WINDSOR CREEK	5150	107.7	108.1	108.8	107.6	108.0	108.5
E WINDSOR CREEK	5459	106.8	107.1	107.7	106.7	107.0	107.5
E WINDSOR CREEK	5768	105.8	106.1	106.6	105.7	106.0	106.4
E WINDSOR CREEK	5963	104.5	105.0	105.5	104.3	104.8	105.3
E WINDSOR CREEK	6078	103.9	104.5	105.0	103.6	104.2	104.8
E WINDSOR CREEK	6387	103.5	104.2	104.7	103.1	103.9	104.5
E WINDSOR CREEK	6710	103.1	103.9	104.4	102.8	103.7	104.3
E WINDSOR CREEK	6934	103.1	103.8	104.3	102.7	103.6	104.3
E WINDSOR CREEK	6934	103.1	103.8	104.3	102.7	103.6	104.3
E WINDSOR CREEK	6967	103.1	103.8	104.3	102.7	103.6	104.3

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
E WINDSOR CREEK	7018	102.6	103.3	104.1	102.3	103.0	103.9
E WINDSOR CREEK	7149	102.1	102.7	103.5	101.8	102.4	103.3
E WINDSOR CREEK	7191	101.9	102.4	103.2	101.5	102.1	102.9
E WINDSOR CREEK	7234	101.7	102.2	102.9	101.3	101.9	102.7
E WINDSOR CREEK	7618	100.5	101.1	101.8	100.0	100.6	101.4
E WINDSOR CREEK	8010	99.8	100.4	101.1	99.4	100.1	100.8
E WINDSOR CREEK	8299	98.5	99.2	99.8	98.5	99.1	99.9
E WINDSOR CREEK	8659	97.4	98.1	98.7	97.4	98.1	98.9
EW TRB 11	0	118.1	118.5	119.0	118.1	118.5	119.1
EW TRB 11	325	116.6	117.1	117.9	116.7	117.2	118.0
EW TRB 11	552	116.1	116.8	117.6	116.2	116.9	117.8
EW TRB 11	757	114.8	115.4	115.7	114.9	115.5	115.9
EW TRB 11	931	114.2	114.8	115.1	114.3	114.9	115.2
EW TRB 11	1196	113.2	114.1	114.4	113.4	114.1	114.5
EW TRB 11	1228	111.9	112.4	113.0	111.9	112.4	112.9
EW TRB 11	1449	111.1	111.9	112.8	111.1	111.8	112.3
EW TRB 11	1529	110.4	111.1	111.8	110.4	111.4	112.1
EW TRB 11	1565	109.7	110.1	110.7	109.7	110.1	110.7
EW TRB 11	1778	109.1	109.5	110.0	109.1	109.5	110.0
EW TRB 11	1808	108.9	109.2	109.6	108.9	109.2	109.6
EW TRB 11	1832	108.7	109.0	109.4	108.6	108.9	109.3
EW TRB 11	1945	108.2	108.5	108.9	108.2	108.5	108.9
EW TRB 11	1976	108.2	108.4	108.8	108.1	108.4	108.8
EW TRB 11	2041	107.8	108.0	108.3	107.7	108.0	108.3
EW TRB 11	2216	106.8	107.0	107.3	106.8	107.1	107.4
EW TRB 11	2629	104.7	105.0	105.3	104.8	105.1	105.4
EW TRB 11	3147	103.1	103.9	104.4	102.8	103.6	104.3
EW TRB 11	3453	103.1	103.8	104.3	102.7	103.6	104.3
EW TRB 11	3581	103.1	103.8	104.3	102.7	103.6	104.3
FAUGHT CREEK	0	112.3	112.8	113.5	113.0	113.5	114.5
FAUGHT CREEK	40	112.2	112.7	113.4	112.9	113.4	114.3
FAUGHT CREEK	83	111.9	112.3	112.8	112.4	112.8	113.4
FAUGHT CREEK	119	111.5	111.9	112.4	112.0	112.4	112.9
FAUGHT CREEK	211	110.9	111.3	111.9	111.4	111.9	112.4
FAUGHT CREEK	443	109.9	110.4	111.1	110.5	110.9	111.3
FAUGHT CREEK	1785	105.7	106.7	108.1	106.2	107.2	108.2
FAUGHT CREEK	1805	105.7	106.7	108.2	106.2	107.2	108.2
GUMVIEW CREEK	0	109.9	110.2	110.4	110.0	110.2	110.4
GUMVIEW CREEK	194	109.9	110.1	110.4	110.0	110.2	110.4
GUMVIEW CREEK	365	109.8	110.1	110.3	109.9	110.1	110.3
GUMVIEW CREEK	583	109.8	110.0	110.2	109.8	110.0	110.2
GUMVIEW CREEK	640	109.8	109.9	110.1	109.8	110.0	110.2

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
GUMVIEW CREEK	666	109.8	109.9	110.1	109.8	110.0	110.1
GUMVIEW CREEK	835	109.6	109.8	110.0	109.7	109.8	110.0
GUMVIEW CREEK	1095	109.2	109.4	109.5	109.2	109.4	109.6
GUMVIEW CREEK	1361	108.5	108.7	108.9	108.6	108.8	108.9
GUMVIEW CREEK	1639	107.9	108.1	108.3	107.9	108.1	108.3
GUMVIEW CREEK	1707	107.5	107.7	107.8	107.5	107.7	107.9
GUMVIEW CREEK	1804	107.2	107.4	107.6	107.3	107.4	107.6
GUMVIEW CREEK	1902	107.0	107.2	107.4	107.0	107.2	107.5
GUMVIEW CREEK	1978	107.0	107.1	107.5	106.9	107.1	107.5
GUMVIEW CREEK	2005	106.2	106.4	106.7	106.3	106.4	106.7
GUMVIEW CREEK	2100	105.8	106.0	106.4	105.8	106.0	106.4
GUMVIEW CREEK	2135	105.7	105.9	106.3	105.7	105.9	106.4
GUMVIEW CREEK	2383	104.9	105.2	106.0	105.0	105.3	106.0
GUMVIEW CREEK	2395	105.0	105.2	106.0	105.0	105.3	106.1
GUMVIEW CREEK	2444	105.0	105.2	106.0	105.0	105.3	106.0
GUMVIEW CREEK	2642	104.3	105.0	105.8	104.5	105.0	105.9
GUMVIEW CREEK	2968	103.8	104.7	105.7	104.0	104.8	105.8
GUMVIEW CREEK	3226	103.8	104.7	105.7	104.0	104.8	105.8
GUMVIEW CREEK	3274	103.8	104.7	105.7	104.0	104.8	105.8
GUMVIEW CREEK	3279	103.8	104.7	105.7	104.0	104.8	105.8
GUMVIEW CREEK	3323	103.8	104.7	105.7	104.0	104.8	105.8
GUMVIEW CREEK	3571	103.8	104.7	105.7	104.0	104.8	105.8
GUMVIEW CREEK	3605	103.8	104.7	105.7	104.0	104.8	105.8
GUMVIEW CREEK	3628	99.6	99.7	99.9	99.6	99.7	99.9
GUMVIEW CREEK	3676	97.7	98.0	98.4	97.8	98.1	98.4
GUMVIEW CREEK	3822	96.1	96.5	96.9	96.2	96.5	96.9
GUMVIEW CREEK	3915	95.1	95.5	95.9	95.2	95.5	95.9
GUMVIEW CREEK	4007	94.4	94.9	95.3	94.5	94.9	95.3
GUMVIEW CREEK	4193	93.6	94.1	94.6	93.7	94.1	94.6
GUMVIEW CREEK	4285	93.5	94.0	94.5	93.6	94.1	94.5
GUMVIEW CREEK	4443	93.3	93.9	94.4	93.4	93.9	94.4
GUMVIEW CREEK	4566	91.7	91.9	92.1	91.7	91.9	92.1
GUMVIEW CREEK	4676	91.3	91.6	91.8	91.4	91.6	91.8
GUMVIEW CREEK	4772	90.8	91.1	91.4	90.7	91.0	91.3
GUMVIEW CREEK	4868	90.5	90.9	91.3	90.4	90.8	91.2
GUMVIEW CREEK	4914	90.3	90.6	91.0	90.2	90.5	90.9
GUMVIEW CREEK	4963	90.3	90.6	91.0	90.2	90.5	90.9
GUMVIEW CREEK	4973	90.3	90.7	91.1	90.2	90.5	90.9
POOL CREEK	0	134.0	134.8	135.8	134.0	134.8	135.8
POOL CREEK	236	133.0	133.9	135.0	133.1	133.9	135.0
POOL CREEK	494	132.5	133.3	134.3	132.5	133.3	134.3
POOL CREEK	849	129.3	130.3	131.5	129.3	130.3	131.5

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
POOL CREEK	1229	127.8	128.7	129.9	127.8	128.7	129.9
POOL CREEK	1259	127.6	128.5	129.7	127.6	128.6	129.7
POOL CREEK	1262	127.4	128.3	129.4	127.5	128.3	129.4
POOL CREEK	1302	127.0	127.8	128.8	127.0	127.8	128.8
POOL CREEK	1363	126.7	127.4	128.3	126.7	127.4	128.3
POOL CREEK	1545	125.5	126.2	127.1	125.5	126.2	127.1
POOL CREEK	1943	122.1	122.9	123.7	122.2	122.9	123.7
POOL CREEK	2268	120.2	121.1	122.1	120.2	121.1	122.1
POOL CREEK	2608	119.1	120.0	120.9	119.1	120.0	120.9
POOL CREEK	2948	117.8	118.7	119.6	117.8	118.7	119.6
POOL CREEK	3288	116.4	117.2	118.1	116.4	117.2	118.2
POOL CREEK	3628	115.3	116.2	117.3	115.3	116.2	117.3
POOL CREEK	3916	113.2	114.0	115.0	113.2	114.1	115.0
POOL CREEK	3968	112.8	113.6	114.5	112.8	113.7	114.5
POOL CREEK	4106	112.5	113.4	114.4	112.6	113.5	114.4
POOL CREEK	4226	111.8	112.6	113.3	111.9	112.6	113.2
POOL CREEK	4242	111.8	112.6	113.3	111.8	112.6	113.3
POOL CREEK	4519	110.8	111.6	112.4	110.8	111.6	112.2
POOL CREEK	5032	108.2	109.0	109.9	108.3	109.1	109.8
POOL CREEK	5322	106.8	107.6	108.8	107.0	107.9	108.8
POOL CREEK	5611	105.7	106.7	108.2	106.2	107.2	108.2
POOL CREEK	5611	105.7	106.7	108.2	106.2	107.2	108.2
POOL CREEK	5649	105.5	106.4	107.9	106.0	106.9	108.0
POOL CREEK	5904	104.6	105.7	107.4	105.2	106.3	107.5
POOL CREEK	6104	104.4	105.3	106.3	104.8	105.6	106.4
POOL CREEK	6143	104.1	105.0	106.0	104.6	105.4	106.1
POOL CREEK	6238	104.1	105.0	106.0	104.5	105.3	106.0
POOL CREEK	6547	102.5	103.4	104.5	102.8	103.7	104.5
POOL CREEK	6579	102.7	103.6	104.7	103.0	103.9	104.7
POOL CREEK	6579	102.7	103.6	104.7	103.0	103.9	104.7
POOL CREEK	6615	102.8	103.8	104.9	103.1	104.0	105.0
POOL CREEK	6631	102.7	103.4	104.4	103.0	103.7	104.5
POOL CREEK	6643	102.4	103.0	104.0	102.7	103.3	104.0
POOL CREEK	6932	102.1	102.7	103.5	102.3	102.9	103.5
POOL CREEK	7252	100.6	101.2	102.2	100.8	101.4	102.2
POOL CREEK	7572	99.4	99.8	101.2	99.5	100.1	101.2
POOL CREEK	7892	98.9	99.3	100.9	99.0	99.6	100.9
POOL CREEK	7988	98.8	99.2	100.7	98.9	99.5	100.7
POOL CREEK	8205	98.0	98.4	98.9	98.1	98.5	98.9
POOL CREEK	8501	96.8	97.0	97.3	96.8	97.1	97.3
POOL CREEK	8797	96.5	96.8	97.0	96.6	96.8	97.0
POOL CREEK	9083	94.6	94.9	95.2	94.7	95.0	95.2

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
POOL CREEK	9366	94.1	94.4	94.7	94.2	94.5	94.7
POOL CREEK	9648	93.6	93.9	94.3	93.7	94.0	94.3
POOL CREEK	9844	93.4	93.7	94.0	93.5	93.8	94.1
POOL CREEK	9931	93.4	93.7	94.0	93.5	93.8	94.0
POOL CREEK	9968	93.1	93.4	93.8	93.2	93.5	93.8
POOL CREEK	9981	92.5	92.8	93.2	92.6	92.9	93.2
POOL CREEK	10018	92.4	92.7	93.1	92.5	92.8	93.1
POOL CREEK	10018	92.4	92.7	93.1	92.5	92.8	93.1
POOL CREEK	10250	91.9	92.2	92.6	92.0	92.3	92.7
POOL CREEK	10605	91.4	91.7	92.3	91.5	91.8	92.3
POOL CREEK	10907	91.1	91.5	92.2	91.3	91.6	92.2
POOL CREEK	11243	89.7	90.2	91.2	89.8	90.4	91.3
POOL CREEK	11351	89.7	90.3	91.2	89.9	90.4	91.3
POOL CREEK	12062	87.8	88.7	90.3	88.0	89.0	90.4
POOL CREEK	12088	87.9	88.8	90.4	88.1	89.1	90.5
POOL CREEK	12182	87.6	88.8	90.3	87.9	89.0	90.5
POOL CREEK	12424	87.5	88.7	90.3	87.8	89.0	90.5
POOL CREEK	12750	87.5	88.7	90.3	87.8	89.0	90.4
POOL CREEK	13076	87.5	88.7	90.3	87.7	89.0	90.4
POOL CREEK	13571	87.4	88.7	90.3	87.7	89.0	90.4
POOL CREEK	13932	87.4	88.7	90.3	87.7	89.0	90.4
POOL CREEK	13991	81.6	82.0	82.4	81.7	82.1	82.5
POOL CREEK	14768	79.9	80.5	81.1	80.0	80.5	81.1
POOL CREEK	15059	79.6	80.3	80.9	79.7	80.4	80.9
POOL CREEK	15434	79.4	80.1	80.7	79.4	80.2	80.8
POOL CREEK	15786	79.3	80.1	80.7	79.3	80.1	80.7
POOL CREEK	16854	79.2	80.0	80.6	79.2	80.0	80.6
POOL CREEK	17116	79.1	79.9	80.4	79.1	79.9	80.4
POOL CREEK	17200	79.1	79.9	80.5	79.1	79.9	80.4
POOL CREEK	17220	79.1	79.9	80.4	79.1	79.9	80.4
PRUITT CREEK	0	120.7	121.2	121.8	120.8	121.3	121.8
PRUITT CREEK	337	120.2	120.6	121.1	120.3	120.7	121.2
PRUITT CREEK	645	119.9	120.3	120.7	120.0	120.3	120.8
PRUITT CREEK	850	119.1	119.5	119.9	119.1	119.5	119.9
PRUITT CREEK	897	118.7	119.2	119.5	118.8	119.2	119.5
PRUITT CREEK	1286	116.7	117.4	118.0	116.8	117.4	118.0
PRUITT CREEK	1601	115.9	116.6	117.2	116.1	116.7	117.3
PRUITT CREEK	2117	114.7	115.4	116.0	114.8	115.5	116.1
PRUITT CREEK	2207	114.4	114.8	115.2	114.5	114.8	115.3
PRUITT CREEK	2459	113.4	113.7	114.0	113.4	113.7	114.4
PRUITT CREEK	2613	112.3	112.5	112.9	112.3	112.5	113.4
PRUITT CREEK	3106	110.2	110.8	111.3	110.3	110.8	111.3

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
PRUITT CREEK	3488	108.5	109.2	110.0	108.6	109.2	110.0
PRUITT CREEK	3516	108.7	109.4	110.2	108.8	109.4	110.2
PRUITT CREEK	3660	108.6	109.2	109.8	108.7	109.2	109.8
PRUITT CREEK	3954	107.3	107.8	108.5	107.3	107.8	108.5
PRUITT CREEK	4332	104.7	105.6	106.6	104.9	105.6	106.6
PRUITT CREEK	4347	104.9	105.7	106.8	105.0	105.8	106.8
PRUITT CREEK	4402	104.7	105.5	106.4	104.9	105.6	106.4
PRUITT CREEK	4406	104.5	105.3	106.2	104.6	105.4	106.2
PRUITT CREEK	4456	104.4	105.2	106.1	104.5	105.3	106.1
PRUITT CREEK	4711	103.8	104.6	105.6	104.0	104.8	105.7
PRUITT CREEK	5008	102.7	103.6	104.7	103.0	103.9	104.8
PRUITT CREEK	5124	102.7	103.6	104.7	103.0	103.9	104.7
STARR CREEK	0	115.9	116.2	116.5	115.9	116.2	116.5
STARR CREEK	368	114.5	114.8	115.1	114.5	114.8	115.1
STARR CREEK	567	114.0	114.3	114.5	114.0	114.3	114.5
STARR CREEK	600	113.8	114.0	114.2	113.8	114.0	114.3
STARR CREEK	1024	111.2	111.4	111.6	111.2	111.4	111.6
STARR CREEK	1044	110.8	111.1	111.2	110.8	111.1	111.2
STARR CREEK	1056	111.6	111.9	112.3	111.6	111.9	112.2
STARR CREEK	1094	111.0	111.3	111.6	111.0	111.3	111.6
STARR CREEK	1432	109.2	109.5	109.9	109.2	109.5	109.9
STARR CREEK	1833	108.3	108.6	109.0	108.3	108.6	109.0
STARR CREEK	1851	108.4	108.3	108.7	108.0	108.2	108.7
STARR CREEK	1901	108.9	108.9	108.8	108.9	108.9	108.9
STARR CREEK	1954	107.9	108.0	108.1	108.0	107.9	108.0
STARR CREEK	2210	106.8	107.1	107.5	106.6	107.0	107.4
STARR CREEK	2236	106.8	107.1	107.5	106.6	107.0	107.4
STARR CREEK	2236	106.8	107.1	107.5	106.6	107.0	107.4
STARR CREEK	2322	106.5	106.8	107.2	106.3	106.7	107.1
STARR CREEK	2911	104.9	105.2	105.5	104.8	105.1	105.4
STARR CREEK	3243	103.8	104.1	104.3	103.7	104.0	104.3
STARR CREEK	3243	103.8	104.1	104.3	103.7	104.0	104.3
STARR CREEK	3295	103.5	103.8	104.0	103.4	103.7	103.9
STARR CREEK	3847	101.0	101.3	101.5	100.9	101.2	101.4
STARR CREEK	4371	99.4	99.7	100.1	99.2	99.6	100.0
STARR CREEK	4745	98.5	98.8	99.2	98.4	98.7	99.1
STARR CREEK	5090	97.9	98.2	98.5	97.8	98.1	98.4
STARR CREEK	5116	97.6	97.9	98.2	97.5	97.8	98.1
STARR CREEK	5136	97.2	97.4	97.8	97.1	97.4	97.7
STARR CREEK	5159	97.2	97.5	97.8	97.2	97.4	97.7
STARR CREEK	5184	97.1	97.3	97.6	97.0	97.3	97.5
STARR CREEK	5483	94.9	95.1	95.4	94.8	95.1	95.3

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
STARR CREEK	5667	93.7	94.0	94.3	93.6	93.9	94.2
STARR CREEK	5961	92.2	92.6	92.9	92.1	92.5	92.8
STARR CREEK	6089	91.7	92.2	92.6	91.6	92.1	92.5
STARR CREEK	6368	91.3	91.8	92.2	91.1	91.7	92.1
STARR CREEK	6369	91.3	91.8	92.2	91.2	91.7	92.1
STARR CREEK	6423	90.3	90.7	91.1	90.3	90.6	91.0
STARR CREEK	6440	90.3	90.7	91.1	90.2	90.5	90.9
STARR CREEK	6440	90.3	90.7	91.1	90.2	90.5	90.9
STARR CREEK	6492	90.0	90.4	90.8	89.9	90.2	90.6
STARR CREEK	6779	89.0	89.4	90.0	88.9	89.3	89.8
STARR CREEK	7140	88.5	89.1	89.8	88.3	88.8	89.5
STARR CREEK	7508	88.4	89.0	89.7	88.2	88.8	89.5
STARR CREEK	7753	88.4	89.0	89.7	88.2	88.7	89.5
STARR CREEK	7842	85.5	85.8	86.0	85.4	85.7	86.0
STARR CREEK	8108	84.3	84.6	84.9	84.2	84.5	84.8
STARR CREEK	8285	83.9	84.2	84.5	83.8	84.1	84.5
STARR CREEK	8620	83.3	83.9	84.2	83.2	83.8	84.2
STARR CREEK	8665	83.3	83.9	84.2	83.1	83.7	84.1
STARR CREEK	9003	82.9	83.7	84.0	82.7	83.6	84.0
STARR CREEK	9209	82.8	83.6	84.0	82.6	83.5	83.9
STARR CREEK	9285	81.7	82.3	82.8	81.7	82.2	82.8
STARR CREEK	9465	81.7	82.2	82.8	81.7	82.2	82.7
STARR CREEK	9499	81.7	82.2	82.7	81.6	82.2	82.7
STARR CREEK	9659	81.7	82.2	82.7	81.6	82.2	82.7
SC TRB T-6	0	120.4	120.6	120.8	120.3	120.5	120.8
SC TRB T-6	159	120.1	120.3	120.5	120.0	120.2	120.4
SC TRB T-6	227	119.0	119.2	119.5	118.9	119.1	119.4
SC TRB T-6	267	118.8	119.1	119.3	118.7	119.0	119.2
SC TRB T-6	690	117.0	117.2	117.5	116.9	117.2	117.4
SC TRB T-6	1060	115.9	116.0	116.3	115.8	116.0	116.2
SC TRB T-6	1442	114.9	115.0	115.2	114.8	115.0	115.2
SC TRB T-6	1497	114.9	115.0	115.2	114.8	115.0	115.1
SC TRB T-6	1580	113.4	113.7	114.0	113.3	113.6	113.9
SC TRB T-6	1631	113.2	113.4	113.8	113.1	113.4	113.7
SC TRB T-6	1999	111.5	112.1	112.6	111.3	111.8	112.5
SC TRB T-6	2285	110.8	111.6	112.3	110.3	111.3	112.1
SC TRB T-6	2362	109.5	109.9	110.5	109.3	109.7	110.2
SC TRB T-6	2438	109.3	109.7	110.4	109.1	109.6	110.1
SC TRB T-6	2923	108.5	109.0	109.8	108.2	108.8	109.5
SC TRB T-6	2951	108.4	108.9	109.8	108.1	108.7	109.5
SC TRB T-6	3020	107.3	107.6	108.1	107.1	107.5	107.9
SC TRB T-6	3072	107.1	107.4	107.9	106.9	107.3	107.7

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
SC TRB T-6	3332	106.8	107.1	107.5	106.6	107.0	107.4
WINDSOR CREEK	0	159.0	160.1	161.3	159.1	160.1	161.3
WINDSOR CREEK	210	157.8	158.9	159.8	157.8	158.9	159.9
WINDSOR CREEK	480	154.9	155.7	156.2	155.0	155.7	156.2
WINDSOR CREEK	547	154.9	155.2	155.7	155.2	155.0	155.0
WINDSOR CREEK	590	155.2	156.2	157.6	155.3	156.0	157.7
WINDSOR CREEK	598	155.3	156.2	157.2	155.3	156.3	157.3
WINDSOR CREEK	814	153.5	154.3	155.2	153.6	154.4	155.3
WINDSOR CREEK	1145	151.9	152.9	153.9	152.0	152.9	154.0
WINDSOR CREEK	1253	151.7	152.7	153.7	151.8	152.7	153.9
WINDSOR CREEK	1293	151.5	152.5	153.5	151.6	152.5	153.7
WINDSOR CREEK	1538	149.9	151.0	152.4	149.9	151.0	152.6
WINDSOR CREEK	1599	149.3	150.5	152.0	149.4	150.5	152.2
WINDSOR CREEK	1669	147.1	148.0	148.7	147.2	148.0	148.8
WINDSOR CREEK	1718	144.2	145.0	145.6	144.2	145.0	145.7
WINDSOR CREEK	2301	141.0	141.8	142.5	141.0	141.8	142.6
WINDSOR CREEK	2835	138.0	138.7	139.3	138.1	138.8	139.4
WINDSOR CREEK	3074	136.3	137.1	137.8	136.4	137.2	137.7
WINDSOR CREEK	3490	133.3	134.0	134.4	133.5	134.1	134.5
WINDSOR CREEK	3510	132.6	133.4	133.9	132.8	133.5	134.0
WINDSOR CREEK	3525	132.3	133.0	133.6	132.5	133.2	133.7
WINDSOR CREEK	3579	131.9	132.7	133.3	132.1	132.9	133.4
WINDSOR CREEK	3948	127.7	129.0	129.7	128.0	129.2	129.9
WINDSOR CREEK	4562	125.7	126.5	127.2	125.9	126.7	127.4
WINDSOR CREEK	5017	123.5	124.2	124.9	123.7	124.4	125.1
WINDSOR CREEK	5385	121.4	122.1	122.8	121.6	122.3	123.1
WINDSOR CREEK	5774	119.5	120.0	120.7	119.6	120.2	121.1
WINDSOR CREEK	6142	117.2	117.8	118.8	117.3	118.1	119.6
WINDSOR CREEK	6472	115.1	116.2	117.5	115.4	116.6	118.7
WINDSOR CREEK	6535	114.5	115.5	116.9	114.8	116.0	118.0
WINDSOR CREEK	6866	114.5	115.5	116.7	114.7	115.8	117.0
WINDSOR CREEK	7044	113.5	114.6	115.9	113.8	114.9	116.4
WINDSOR CREEK	7203	113.2	114.5	115.8	113.5	114.8	116.3
WINDSOR CREEK	7292	113.1	114.4	115.8	113.4	114.8	116.2
WINDSOR CREEK	7499	112.2	113.1	114.0	112.4	113.3	114.2
WINDSOR CREEK	7871	110.5	111.5	112.5	110.8	111.8	112.8
WINDSOR CREEK	8381	108.3	109.1	109.9	108.5	109.3	110.2
WINDSOR CREEK	8860	106.8	107.5	108.2	107.0	107.7	108.5
WINDSOR CREEK	9314	105.6	106.3	107.1	105.8	106.5	107.5
WINDSOR CREEK	9662	104.7	105.6	106.7	105.0	105.9	107.1
WINDSOR CREEK	9809	103.9	104.6	105.5	104.1	104.8	105.8
WINDSOR CREEK	10225	102.0	102.7	103.8	102.2	103.0	104.1

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
WINDSOR CREEK	10300	101.7	102.4	103.5	101.9	102.6	103.8
WINDSOR CREEK	10310	101.3	102	102.9	101.5	102.1	103.2
WINDSOR CREEK	10331	101.3	101.9	102.8	101.4	102.1	103.1
WINDSOR CREEK	10351	101.1	101.7	102.5	101.2	101.9	102.7
WINDSOR CREEK	10468	100.6	101.2	101.9	100.7	101.4	102.2
WINDSOR CREEK	10731	99.5	100.1	100.8	99.6	100.3	101.1
WINDSOR CREEK	11232	97.5	98.2	98.9	97.6	98.3	99.0
WINDSOR CREEK	11293	97.4	98.1	98.7	97.4	98.1	98.9
WINDSOR CREEK	11293	97.4	98.1	98.7	97.4	98.1	98.9
WINDSOR CREEK	11333	96.9	97.5	98.0	96.9	97.5	98.1
WINDSOR CREEK	11343	96.7	97.3	97.9	96.8	97.4	98.0
WINDSOR CREEK	11451	96.1	96.7	97.2	96.2	96.7	97.3
WINDSOR CREEK	11651	94.8	95.2	95.6	94.8	95.3	95.7
WINDSOR CREEK	11934	93.2	93.6	93.9	93.2	93.7	94.0
WINDSOR CREEK	12339	91.8	92.5	92.9	91.8	92.6	93.0
WINDSOR CREEK	12879	88.7	90.0	90.2	88.7	90.0	90.4
WINDSOR CREEK	13034	88.6	89.4	90.2	88.7	89.4	90.3
WINDSOR CREEK	13391	87.5	88.2	88.9	87.5	88.2	89.0
WINDSOR CREEK	13786	86.6	87.3	87.9	86.6	87.3	88.1
WINDSOR CREEK	14184	86.0	86.6	87.3	86.0	86.6	87.4
WINDSOR CREEK	14499	85.4	86.0	86.6	85.4	86.0	86.7
WINDSOR CREEK	14832	84.7	85.2	85.7	84.8	85.2	85.7
WINDSOR CREEK	15124	84.1	84.3	84.6	84.1	84.3	84.7
WINDSOR CREEK	15460	83.8	83.9	84.2	83.8	84.0	84.3
WINDSOR CREEK	15803	83.6	83.8	84.0	83.6	83.8	84.1
WINDSOR CREEK	16108	83.4	83.5	83.8	83.4	83.5	83.9
WINDSOR CREEK	16339	83.3	83.3	83.7	83.3	83.3	83.8
WINDSOR CREEK	16476	82.0	82.6	83.2	82.0	82.6	83.3
WINDSOR CREEK	16560	81.7	82.2	82.8	81.6	82.2	82.9
WINDSOR CREEK	16664	81.7	82.2	82.7	81.6	82.2	82.7
WINDSOR CREEK	16664	81.7	82.2	82.7	81.6	82.2	82.7
WINDSOR CREEK	16678	81.7	82.2	82.7	81.6	82.2	82.7
WINDSOR CREEK	16688	81.3	81.9	82.4	81.3	81.8	82.4
WINDSOR CREEK	16900	80.9	81.4	81.9	80.9	81.4	81.9
WINDSOR CREEK	17135	80.8	81.3	81.8	80.8	81.3	81.8
WINDSOR CREEK	17335	80.6	81.2	81.7	80.6	81.2	81.7
WINDSOR CREEK	18160	80.1	80.7	81.2	80.1	80.7	81.2
WINDSOR CREEK	19947	79.1	79.9	80.4	79.1	79.9	80.4
WINDSOR CREEK	19947	79.1	79.9	80.4	79.1	79.9	80.4
WINDSOR CREEK	20266	78.5	79.3	79.9	78.5	79.4	79.9
WINDSOR CREEK	20276	78.4	79.3	79.9	78.5	79.3	79.9
WINDSOR CREEK	20379	78.3	79.1	79.7	78.3	79.2	79.7

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
WINDSOR CREEK	20379	78.3	79.1	79.7	78.3	79.2	79.7
WINDSOR CREEK	20609	77.7	78.7	79.3	77.7	78.7	79.3
WINDSOR CREEK	22673	73.8	74.6	76.1	73.8	74.7	76.0
WINDSOR CREEK	23993	73.7	74.5	76.0	73.7	74.6	76.0
WINDSOR CREEK	25234	73.6	74.5	76.0	73.7	74.5	75.9
WINDSOR CREEK	25256	70.4	70.5	70.7	70.4	70.5	70.7
WINDSOR CREEK	27706	70.3	70.3	70.3	70.3	70.3	70.3
WINDSOR CREEK	30258	70.3	70.3	70.3	70.3	70.3	70.3
WINDSOR CREEK	31994	70.2	70.2	70.2	70.2	70.2	70.2
WINDSOR CREEK	32004	70.2	70.2	70.2	70.2	70.2	70.2
WINDSOR CREEK	32554	70.2	70.2	70.2	70.2	70.2	70.2
WINDSOR CREEK	34381	70.0	70.0	70.0	70.0	70.0	70.0
EW_US	0	177.9	178.1	178.3	177.9	178.1	178.3
EW_US	17	177.9	178.1	178.2	177.9	178.1	178.2
EW_US	53	177.7	177.8	178.0	177.7	177.8	178.0
EW_US	62	176.7	176.8	177.0	176.7	176.8	177.0
EW_US	77	176.4	176.5	176.8	176.4	176.5	176.8
EW_US	103	176.2	176.3	176.4	176.2	176.3	176.4
EW_US	119	176.2	176.4	176.5	176.2	176.4	176.5
EW_US	200	173.5	173.8	174.0	173.5	173.8	174.0
EW_US	220	173.3	173.6	173.8	173.3	173.6	173.8
EW_US	740	166.5	166.7	166.8	166.5	166.7	166.8
EW_US	1301	162.0	162.1	162.3	162.0	162.1	162.3
EW_US	1358	162.0	162.1	162.3	162.0	162.1	162.3
EW_US	1442	157.9	158.2	158.6	157.9	158.2	158.6
EW_US	1538	156.7	157.0	157.3	156.7	157.0	157.3
EW_US	1769	152.5	152.7	153.0	152.5	152.7	153.0
EW_US	1776	151.8	152.1	152.4	151.8	152.1	152.4
EW_US	3166	139.4	139.7	140.0	139.4	139.7	140.0
EW_US	3169	139.3	139.7	140.0	139.3	139.7	140.0
FAUGHT_US	0	123.6	124.1	124.9	124.7	125.6	126.9
FAUGHT_US	60	123.2	123.7	124.5	124.5	125.4	126.7
FAUGHT_US	120	123.1	123.6	124.4	124.4	125.3	126.6
FAUGHT_US	180	123.0	123.5	124.3	124.3	125.2	126.5
FAUGHT_US	239	122.9	123.4	124.2	124.2	125.1	126.3
FAUGHT_US	299	122.8	123.3	124.1	124.1	125.0	126.2
FAUGHT_US	359	122.7	123.1	123.9	123.9	124.8	126.0
FAUGHT_US	419	122.5	123.0	123.8	123.8	124.7	125.9
FAUGHT_US	479	122.4	122.8	123.6	123.6	124.5	125.7
FAUGHT_US	539	122.2	122.6	123.4	123.4	124.3	125.5
FAUGHT_US	598	121.9	122.4	123.1	123.1	124.0	125.2
FAUGHT_US	661	121.7	122.1	122.9	122.8	123.8	125.0

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
FAUGHT_US	724	121.4	121.8	122.6	122.5	123.5	124.7
FAUGHT_US	787	121.1	121.5	122.4	122.3	123.3	124.5
FAUGHT_US	850	120.8	121.3	122.1	122.0	123.1	124.3
FAUGHT_US	913	120.6	121.0	121.9	121.8	123.0	124.1
FAUGHT_US	976	120.3	120.8	121.7	121.5	122.8	123.9
FAUGHT_US	1039	120.1	120.6	121.6	121.3	122.7	123.8
FAUGHT_US	1102	119.9	120.4	121.4	121.2	122.5	123.6
FAUGHT_US	1165	119.8	120.3	121.3	121.0	122.4	123.5
FAUGHT_US	1228	119.6	120.2	121.2	120.9	122.3	123.5
FAUGHT_US	1291	119.5	120.1	121.1	120.8	122.2	123.4
FAUGHT_US	1354	119.4	120.0	121.0	120.7	122.2	123.4
FAUGHT_US	1418	119.4	120.0	121.0	120.7	122.2	123.4
FAUGHT_US	1482	119.4	120.0	121.0	120.7	122.2	123.4
FAUGHT_US	1545	119.3	119.8	120.6	120.3	121.5	123.0
FAUGHT_US	1587	119.3	119.8	120.4	120.2	121.1	122.7
FAUGHT_US	1626	117.7	118.3	119.6	119.1	120.8	122.8
EWTRB_X	0	130.1	130.3	130.4	129.8	129.9	130.0
EWTRB_X	1592	121.7	122.0	122.2	121.2	121.5	121.8
EWTRB_X	1619	121.7	122.0	122.2	121.1	121.5	121.8
EWTRB_X	1653	119.7	120.1	120.5	119.4	119.6	120.1
EWTRB_X	1683	119.4	119.7	120.2	119.0	119.3	119.8
EWTRB_X	1911	117.1	118.1	119.1	116.7	117.6	118.9
POOLGOLFTRB	0	94.3	94.6	94.9	94.4	94.7	95.0
POOLGOLFTRB	266	92.4	92.7	93.1	92.5	92.8	93.1
POOLGOLFTRB	330	92.4	92.7	93.1	92.5	92.8	93.1
STARRTRB	0	111.5	111.7	111.9	111.5	111.6	111.8
STARRTRB	35	111.3	111.4	111.6	111.2	111.4	111.6
STARRTRB	487	108.1	108.4	108.9	108.1	108.4	108.9
STARRTRB	825	107.1	107.8	108.5	107.0	107.6	108.5
STARRTRB	939	107.0	107.7	108.5	106.9	107.6	108.4
STARRTRB	996	105.7	105.9	106.1	105.6	105.8	106.0
STARRTRB	1050	105.5	105.6	105.8	105.4	105.6	105.8
STARRTRB	1416	104.0	104.2	104.5	103.9	104.2	104.4
STARRTRB	1861	103.8	104.1	104.3	103.7	104.0	104.3
EW_OD	0	147.7	147.7	147.8	147.7	147.7	147.8
EW_OD	14	147.5	147.5	147.6	147.5	147.5	147.6
EW_OD	795	142.6	142.7	142.8	142.6	142.7	142.8
EW_OD	840	142.6	142.7	142.7	142.6	142.7	142.7
EW_OD	922	139.7	139.9	140.2	139.7	139.9	140.2
EW_OD	974	139.3	139.6	139.8	139.3	139.6	139.8
EW_OD	1156	138.7	139.0	139.2	138.7	139.0	139.2
EW_OD	1177	138.7	139.0	139.2	138.7	139.0	139.2

M11 Creek Name	Station	Baseline Condition			Future Condition (assumes all SDIPs implemented)		
		10-yr Max HGL	25-yr Max HGL	100-yr Max HGL	10-yr Max HGL	25-yr Max HGL	100-yr Max HGL
	feet	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD	ft NAVD
FAUGHT_WALMART	0	117.7	118.3	119.6	119.1	120.8	122.8
FAUGHT_WALMART	130	116.9	117.5	118.6	118.2	119.6	121.2
FAUGHT_WALMART	259	116.3	116.9	117.7	117.4	118.4	119.7
FAUGHT_WALMART	273	116.2	116.8	117.6	117.3	118.2	119.6
FAUGHT_WALMART	377	115.9	116.5	117.3	117.0	117.9	119.1
FAUGHT_WALMART	482	115.7	116.2	117.0	116.7	117.5	118.7
FAUGHT_WALMART	586	115.4	115.9	116.7	116.4	117.1	118.2
FAUGHT_WALMART	691	115.1	115.6	116.3	116.0	116.7	117.8
FAUGHT_WALMART	704	115.1	115.6	116.3	116.0	116.7	117.7
FAUGHT_WALMART	833	114.7	115.2	115.9	115.6	116.2	117.1
FAUGHT_WALMART	962	114.3	114.8	115.4	115.1	115.7	116.6
FAUGHT_WALMART	1091	113.8	114.4	114.9	114.6	115.2	116.0
FAUGHT_WALMART	1104	113.8	114.3	114.9	114.6	115.1	116.0
FAUGHT_WALMART	1190	113.4	113.9	114.5	114.2	114.7	115.6
FAUGHT_WALMART	1276	113.0	113.5	114.2	113.7	114.2	115.2
FAUGHT_WALMART	1289	112.9	113.5	114.1	113.6	114.1	115.1
FAUGHT_WALMART	1380	112.6	113.1	113.7	113.3	113.8	114.7
FAUGHT_WALMART	1471	112.3	112.8	113.5	113.0	113.5	114.5
STARRTRB_UPPER	0	111.6	111.8	111.9	111.5	111.7	111.9
STARRTRB_UPPER	9	111.6	111.7	111.9	111.5	111.7	111.9
STARRTRB_UPPER	47	111.6	111.7	111.9	111.5	111.7	111.9
STARRTRB_UPPER	100	111.6	111.7	111.9	111.5	111.7	111.9
STARRTRB_UPPER	140	111.6	111.7	111.9	111.5	111.7	111.9
STARRTRB_UPPER	285	111.6	111.7	111.9	111.5	111.7	111.9
STARRTRB_UPPER	381	111.5	111.7	111.9	111.5	111.6	111.8
STARRTRB_UPPER	382	111.5	111.7	111.9	111.5	111.6	111.8

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Table 6D-2. MIKE 11 Peak Discharges

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
AIRPORT CREEK	20	106.4	120.4	143.8	109.4	124.2	146.6
AIRPORT CREEK	50	106.4	120.4	143.8	109.4	124.2	146.6
AIRPORT CREEK	309	123.3	140.5	169.3	125.9	144.4	171.6
AIRPORT CREEK	1107	177.7	204.3	249.7	179.3	209.2	250.9
AIRPORT CREEK	1907	232.4	276.2	328.6	233.1	278.1	331.8
AIRPORT CREEK	2175	248.1	293.3	351.5	248.5	293.6	360.2
AIRPORT CREEK	2252	282.6	346.7	414.4	282.8	342.8	415.2
AIRPORT CREEK	2322	286.0	351.0	419.4	286.2	346.9	418.9
AIRPORT CREEK	2637	302.3	371.4	441.6	302.0	366.1	440.8
AIRPORT CREEK	3092	322.8	398.8	473.3	322.4	390.2	475.3
AIRPORT CREEK	3300	308.9	375.3	456.9	310.1	367.9	457.1
AIRPORT CREEK	3380	313.8	381.0	464.3	315.0	373.9	464.5
AIRPORT CREEK	3485	320.4	388.8	474.6	321.7	382.0	474.8
AIRPORT CREEK	3621	328.5	398.0	485.2	329.7	391.7	485.5
AIRPORT CREEK	3878	344.4	416.4	508.1	345.7	411.0	508.5
AIRPORT CREEK	4343	371.2	445.9	542.6	372.5	442.0	542.9
AIRPORT CREEK	4757	391.9	466.5	568.1	393.3	463.6	568.3
AIRPORT CREEK	5067	401.1	474.4	578.5	402.5	471.7	578.7
AIRPORT CREEK	5398	408.7	484.4	582.6	410.3	482.4	582.8
AIRPORT CREEK	6179	445.1	518.7	602.2	446.8	518.5	602.6
AIRPORT CREEK	6421	458.1	533.4	619.7	459.9	533.7	620.1
AIRPORT CREEK	6837	480.5	558.9	650.5	482.3	560.0	650.9
AIRPORT CREEK	7382	509.6	592.4	691.6	511.5	594.6	692.0
AIRPORT CREEK	7830	533.3	619.8	725.8	535.2	623.0	726.2
AIRPORT CREEK	8179	551.8	641.3	752.4	553.7	645.1	752.9
AIRPORT CREEK	8482	567.8	659.9	775.5	569.7	664.3	776.1
AIRPORT CREEK	8789	583.3	678.4	798.2	585.3	683.4	798.8
AIRPORT CREEK	9093	597.5	696.1	818.9	599.5	701.7	819.5
AIRPORT CREEK	9337	609.7	710.6	835.8	611.8	716.6	836.4
AIRPORT CREEK	9535	619.6	722.0	849.5	621.6	728.3	850.1
AIRPORT CREEK	9900	637.3	740.9	870.7	639.3	747.4	871.2
AIRPORT CREEK	10274	654.0	756.6	880.7	655.9	763.1	881.1
AIRPORT CREEK	10575	666.9	768.2	891.2	668.8	774.8	891.3
AIRPORT CREEK	11077	688.4	788.8	907.7	690.1	795.4	907.6
AIRPORT CREEK	11209	693.0	790.8	914.6	694.5	796.6	914.8
AIRPORT CREEK	11330	697.3	792.8	921.6	698.5	797.8	921.9
AIRPORT CREEK	11569	704.5	787.2	935.6	705.2	789.7	935.8
AIRPORT CREEK	11848	708.9	785.5	951.9	708.4	791.9	952.1
AIRPORT CREEK	12008	710.5	790.7	961.3	709.4	798.4	961.4
AIRPORT CREEK	12209	717.1	799.7	973.1	716.9	807.6	973.2
AIRPORT CREEK	12444	724.6	812.2	989.6	726.0	820.7	989.9

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
AIRPORT CREEK	12667	733.7	824.1	1008.0	735.1	833.3	1007.6
AIRPORT CREEK	12959	747.9	841.9	1033.0	748.4	852.0	1031.3
AIRPORT CREEK	13113	754.7	849.2	1042.7	755.0	859.5	1040.9
AIRPORT CREEK	13170	757.4	851.4	1046.1	757.3	861.9	1043.8
E WINDSOR CREEK	51	211.1	304.8	354.4	211.5	273.0	354.4
E WINDSOR CREEK	147	319.4	426.4	497.0	320.0	397.8	497.1
E WINDSOR CREEK	238	331.3	440.0	512.4	331.9	411.6	512.5
E WINDSOR CREEK	490	333.2	441.9	514.3	333.8	414.2	514.5
E WINDSOR CREEK	869	356.6	473.7	550.3	357.6	444.6	550.6
E WINDSOR CREEK	1250	359.2	473.9	554.4	360.2	447.3	554.7
E WINDSOR CREEK	1666	375.9	491.2	577.2	376.8	465.7	577.7
E WINDSOR CREEK	1995	372.6	490.8	585.4	373.6	467.7	586.0
E WINDSOR CREEK	2137	372.7	491.2	587.7	373.6	470.5	588.4
E WINDSOR CREEK	2199	373.2	492.4	594.0	374.1	473.0	594.8
E WINDSOR CREEK	2419	375.0	493.3	595.7	375.9	473.4	596.5
E WINDSOR CREEK	2835	377.2	491.8	598.4	378.0	475.9	599.4
E WINDSOR CREEK	3161	378.2	484.3	598.7	379.1	470.7	601.2
E WINDSOR CREEK	3435	746.4	902.5	1096.0	754.9	907.3	1100.7
E WINDSOR CREEK	3828	798.5	941.1	1166.5	805.7	946.5	1172.3
E WINDSOR CREEK	4058	989.4	1167.0	1410.7	999.8	1664.1	1417.1
E WINDSOR CREEK	4104	1557.8	2154.9	2160.4	2047.0	1832.1	1511.1
E WINDSOR CREEK	4141	988.5	1164.4	1414.7	998.8	1697.0	1421.0
E WINDSOR CREEK	4540	990.2	1148.9	1276.3	1000.1	1151.7	1281.0
E WINDSOR CREEK	4961	992.5	1153.1	1431.1	1002.3	1157.2	1438.0
E WINDSOR CREEK	5304	898.1	1018.4	1228.8	905.8	1023.2	1234.5
E WINDSOR CREEK	5614	899.7	1019.0	1229.4	907.2	1024.4	1235.5
E WINDSOR CREEK	5866	900.7	1019.5	1229.7	908.2	1025.0	1235.2
E WINDSOR CREEK	6020	922.9	1041.4	1253.4	930.5	1047.8	1258.6
E WINDSOR CREEK	6232	919.9	1038.4	1252.2	927.7	1046.7	1257.4
E WINDSOR CREEK	6548	912.8	1028.1	1231.1	920.2	1039.2	1237.0
E WINDSOR CREEK	6822	908.5	1026.3	1229.2	914.3	1037.4	1234.9
E WINDSOR CREEK	6951	1285.5	1477.6	1803.7	1300.8	1512.4	1821.0
E WINDSOR CREEK	7010	1284.6	1477.2	1801.6	1299.2	1511.6	1819.1
E WINDSOR CREEK	7090	1280.8	1449.4	1749.5	1292.3	1487.6	1770.1
E WINDSOR CREEK	7153	1280.8	1449.2	1747.6	1292.1	1487.1	1769.8
E WINDSOR CREEK	7213	1280.4	1448.4	1746.1	1291.9	1486.5	1769.2
E WINDSOR CREEK	7426	1279.7	1446.5	1743.6	1291.5	1486.6	1768.4
E WINDSOR CREEK	7814	1276.0	1445.0	1739.3	1289.0	1483.5	1763.0
E WINDSOR CREEK	8154	1269.9	1441.4	1733.0	1285.2	1478.8	1757.8
E WINDSOR CREEK	8479	1268.4	1442.2	1733.6	1284.9	1478.7	1757.5
EW TRB 11	163	253.3	305.0	373.9	258.7	313.2	380.5
EW TRB 11	439	254.4	299.5	371.5	260.0	312.1	380.7
EW TRB 11	652	255.3	301.0	377.0	261.8	313.8	384.8

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
EW TRB 11	844	258.2	302.8	383.7	264.4	318.9	391.5
EW TRB 11	1063	262.1	305.2	390.3	268.1	324.6	397.6
EW TRB 11	1212	265.3	310.6	369.5	270.8	321.2	374.9
EW TRB 11	1338	268.4	305.5	369.0	273.6	324.9	374.1
EW TRB 11	1490	309.9	353.0	401.8	313.8	373.3	404.9
EW TRB 11	1547	310.9	353.8	403.2	314.9	374.9	406.4
EW TRB 11	1672	313.5	355.2	431.4	318.0	378.8	435.9
EW TRB 11	1793	316.2	356.9	461.4	321.2	382.0	467.8
EW TRB 11	1820	317.0	357.3	463.2	321.9	382.7	469.8
EW TRB 11	1889	318.8	358.3	465.2	323.6	384.5	472.3
EW TRB 11	1961	323.8	359.3	478.7	328.5	386.4	474.8
EW TRB 11	2009	320.7	359.4	469.3	325.2	387.5	475.7
EW TRB 11	2128	323.1	359.2	458.1	327.4	386.7	463.9
EW TRB 11	2422	328.4	359.2	444.1	332.2	387.2	448.4
EW TRB 11	2888	342.9	372.2	454.8	347.2	402.2	459.1
EW TRB 11	3300	330.5	358.7	444.4	333.7	391.8	448.7
EW TRB 11	3517	320.7	342.9	409.0	322.9	372.7	414.0
FAUGHT CREEK	20	438.6	564.5	612.7	551.5	637.9	792.5
FAUGHT CREEK	62	438.2	564.5	612.6	551.4	637.9	792.3
FAUGHT CREEK	101	438.4	564.7	612.8	551.8	638.3	792.5
FAUGHT CREEK	165	439.2	565.0	613.1	552.6	639.0	792.9
FAUGHT CREEK	327	440.7	564.8	613.2	554.1	640.4	793.8
FAUGHT CREEK	1114	441.7	563.3	611.8	556.4	640.5	751.8
FAUGHT CREEK	1795	415.2	555.5	614.9	532.6	623.0	776.7
GUMVIEW CREEK	97	6.2	7.9	10	6.3	7.8	10.2
GUMVIEW CREEK	280	17.4	22.3	28.8	17.4	22.5	29.5
GUMVIEW CREEK	474	37.0	39.6	71.3	43.0	57.6	73.7
GUMVIEW CREEK	611	67.1	82.3	137.0	81.3	110.3	142.3
GUMVIEW CREEK	653	69.0	83.8	141.7	83.3	113.4	147.1
GUMVIEW CREEK	751	73.3	87.3	150.0	87.8	119.9	155.9
GUMVIEW CREEK	965	374.4	386.7	446.6	388.7	418.6	452.1
GUMVIEW CREEK	1228	382.4	397.0	462.7	396.7	430.0	468.9
GUMVIEW CREEK	1500	327.9	343.9	388.4	337.7	363.6	392.9
GUMVIEW CREEK	1673	338.5	354.9	405.0	347.7	376.8	409.1
GUMVIEW CREEK	1756	351.7	368.2	415.5	360.5	389.5	419.4
GUMVIEW CREEK	1853	338.0	352.8	393.4	346.7	371.9	397.1
GUMVIEW CREEK	1940	329.0	336.1	373.6	335.8	351.9	376.0
GUMVIEW CREEK	1993	283.3	510.5	616.9	358.3	549.7	630.0
GUMVIEW CREEK	2052	299.4	310.4	323.2	301.0	320.6	317.7
GUMVIEW CREEK	2118	307.5	316.0	333.2	312.1	326.9	334.6
GUMVIEW CREEK	2259	335.1	345.7	369.6	340.6	360.0	370.9
GUMVIEW CREEK	2389	433.8	462.3	546.8	447.2	501.5	551.5
GUMVIEW CREEK	2414	442.0	472.4	563.6	456.1	514.0	568.6

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
GUMVIEW CREEK	2543	450.3	481.5	575.9	464.4	524.4	580.7
GUMVIEW CREEK	2805	463.7	492.7	590.6	477.2	538.0	594.9
GUMVIEW CREEK	3097	421.1	460.3	551.8	434.2	494.1	556.7
GUMVIEW CREEK	3250	389.9	433.7	515.5	400.7	457.5	521.8
GUMVIEW CREEK	3277	385.3	429.9	511.2	396.1	452.6	517.7
GUMVIEW CREEK	3301	381.7	426.9	508.5	392.7	448.7	514.3
GUMVIEW CREEK	3447	369.8	420.2	503.4	381.9	439.3	509.5
GUMVIEW CREEK	3588	371.4	423.8	508.6	383.4	443.1	514.7
GUMVIEW CREEK	3616	372.1	424.7	509.8	384.0	444.0	515.9
GUMVIEW CREEK	3652	373.2	425.8	511.4	385.1	445.2	517.5
GUMVIEW CREEK	3749	376.2	428.9	515.9	388.0	448.6	522.0
GUMVIEW CREEK	3869	379.8	432.7	521.6	391.6	452.8	527.7
GUMVIEW CREEK	3961	382.7	435.7	526.2	394.4	456.1	532.4
GUMVIEW CREEK	4100	386.9	440.2	533.5	398.6	461.1	539.7
GUMVIEW CREEK	4239	391.3	444.6	541.1	402.8	466.4	547.4
GUMVIEW CREEK	4364	395.1	448.6	548.2	406.6	471.5	554.5
GUMVIEW CREEK	4501	399.4	453.0	556.2	410.7	477.1	562.5
GUMVIEW CREEK	4621	403.2	456.9	563.4	414.6	482.2	569.8
GUMVIEW CREEK	4724	406.5	460.3	569.7	418.0	486.6	576.1
GUMVIEW CREEK	4820	409.7	463.8	575.7	421.4	491.2	582.3
GUMVIEW CREEK	4891	412.5	466.8	580.2	425.1	495.2	587.4
GUMVIEW CREEK	4939	413.5	467.9	582.1	426.3	496.7	589.4
GUMVIEW CREEK	4968	413.7	468.0	582.1	426.9	496.9	589.5
POOL CREEK	118	834.7	1096.8	1482.7	837.9	1098.9	1481.6
POOL CREEK	365	845.2	1109.7	1498.7	850.1	1113.5	1499.2
POOL CREEK	672	858.8	1126.7	1519.9	865.9	1132.6	1522.3
POOL CREEK	1039	874.9	1146.6	1544.9	883.9	1154.2	1548.9
POOL CREEK	1244	883.9	1157.7	1558.7	893.6	1165.9	1563.8
POOL CREEK	1261	884.6	1158.5	1559.8	894.4	1166.8	1565.0
POOL CREEK	1282	884.7	1158.7	1560.0	894.5	1167.0	1565.2
POOL CREEK	1332	885.1	1159.2	1560.6	894.9	1167.4	1565.8
POOL CREEK	1454	885.9	1160.3	1562.0	895.8	1168.6	1567.3
POOL CREEK	1744	887.6	1162.9	1564.9	898.1	1171.3	1570.5
POOL CREEK	2105	896.1	1147.9	1463.5	906.2	1145.3	1468.2
POOL CREEK	2438	898.4	1187.4	1575.1	909.1	1183.8	1580.9
POOL CREEK	2778	900.0	1189.2	1561.0	910.3	1185.4	1566.1
POOL CREEK	3118	903.2	1194.1	1565.4	914.0	1189.9	1570.8
POOL CREEK	3458	904.7	1193.2	1542.1	915.4	1189.2	1547.2
POOL CREEK	3772	906.0	1195.9	1524.3	916.7	1192.2	1528.6
POOL CREEK	3942	926.1	1248.6	1593.4	939.4	1220.9	1600.1
POOL CREEK	4054	926.7	1249.3	1619.8	940.1	1221.7	1631.0
POOL CREEK	4166	927.0	1249.4	1620.2	940.4	1222.0	1631.4
POOL CREEK	4234	927.2	1249.6	1620.5	940.5	1222.3	1631.7

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
POOL CREEK	4381	927.6	1250.3	1621.1	941.2	1222.9	1632.0
POOL CREEK	4776	929.2	1247.6	1600.5	942.9	1221.9	1609.6
POOL CREEK	5177	930.8	1248.9	1619.5	944.4	1223.5	1628.9
POOL CREEK	5467	932.5	1250.2	1617.7	946.4	1225.2	1628.7
POOL CREEK	5630	1255.6	1799.2	2222.1	1455.0	1838.3	2400.4
POOL CREEK	5776	1271.8	1816.8	2234.7	1472.0	1858.0	2398.7
POOL CREEK	6004	1311.2	1870.0	2275.5	1513.4	1905.4	2436.7
POOL CREEK	6123	1310.6	1868.6	2275.0	1513.1	1904.7	2436.3
POOL CREEK	6190	1310.4	1867.9	2274.8	1512.9	1904.4	2436.1
POOL CREEK	6392	1309.2	1842.5	2209.4	1512.3	1877.2	2340.6
POOL CREEK	6563	1316.6	1875.4	2278.8	1521.8	1912.8	2422.0
POOL CREEK	6597	2367.3	3128.8	3765.0	2603.6	3173.5	3944.2
POOL CREEK	6623	2367.2	3128.8	3765.0	2603.6	3173.5	3944.1
POOL CREEK	6637	2367.4	3129.1	3765.4	2603.8	3173.8	3944.6
POOL CREEK	6827	2369.9	3129.5	3769.7	2606.6	3176.0	3950.7
POOL CREEK	7092	2362.1	2897.0	3272.7	2549.1	2927.8	3382.0
POOL CREEK	7412	2396.0	2942.1	3288.1	2584.3	2962.7	3392.9
POOL CREEK	7732	2402.8	2947.5	3352.7	2586.8	2970.5	3473.7
POOL CREEK	7940	2404.2	3173.7	3818.2	2595.7	3220.8	3982.1
POOL CREEK	8119	2400.5	3129.0	3517.2	2584.9	3168.9	3628.1
POOL CREEK	8353	2212.0	2764.4	3136.1	2353.1	2791.5	3232.1
POOL CREEK	8649	1862.9	2266.7	2535.1	1967.9	2286.2	2602.7
POOL CREEK	8847	1110.5	1145.1	1176.5	1116.3	1146.9	1184.5
POOL CREEK	9224	1256.4	1326.3	1381.3	1270.8	1326.4	1396.4
POOL CREEK	9507	1386.1	1504.2	1592.7	1413.6	1504.8	1616.7
POOL CREEK	9746	1328.3	1514.4	1641.2	1372.0	1514.7	1674.7
POOL CREEK	9888	1166.8	1279.9	1370.2	1191.6	1280.6	1392.3
POOL CREEK	9949	1125.7	1208.5	1272.4	1144.7	1208.3	1283.7
POOL CREEK	9974	1126.2	1209.0	1274.0	1145.1	1209.1	1285.9
POOL CREEK	9999	1126.7	1209.7	1276.7	1145.6	1209.9	1289.9
POOL CREEK	10134	1227.9	1373.3	1475.1	1265.1	1373.2	1501.2
POOL CREEK	10428	1317.8	1459.6	1548.4	1351.4	1455.6	1571.0
POOL CREEK	10756	1435.4	1572.5	1631.8	1460.7	1553.1	1648.8
POOL CREEK	11179	1308.2	1340.4	1367.0	1318.6	1329.0	1367.2
POOL CREEK	11297	1347.9	1433.3	1455.3	1367.9	1428.4	1452.3
POOL CREEK	11709	1126.7	1181.9	1164.7	1142.2	1174.9	1152.2
POOL CREEK	12075	2130.0	2797.3	3349.0	2278.5	2840.7	3637.7
POOL CREEK	12118	2492.3	3323.4	3985.7	2679.8	3381.7	4099.8
POOL CREEK	12303	2475.2	3233.3	3891.7	2639.6	3276.5	3947.0
POOL CREEK	12587	2402.4	3033.0	3691.0	2535.8	3092.5	3772.0
POOL CREEK	12913	2280.3	2776.0	3419.7	2376.8	2879.5	3629.1
POOL CREEK	13323	1986.3	2489.8	3269.1	2051.0	2613.2	3420.2
POOL CREEK	13751	1870.5	2398.8	3153.7	1990.2	2515.5	3291.6

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
POOL CREEK	13958	1870.3	2398.3	3153.0	1989.4	2515.7	3289.8
POOL CREEK	14380	1874.1	2401.7	3156.9	1992.8	2519.1	3293.4
POOL CREEK	14914	1878.6	2403.9	3157.6	1992.0	2517.7	3293.9
POOL CREEK	15246	1887.2	2410.4	3164.7	1995.8	2522.1	3298.4
POOL CREEK	15610	1905.0	2421.1	3178.1	2006.1	2531.3	3307.5
POOL CREEK	16320	1955.4	2450.3	3213.8	2043.5	2558.6	3336.3
POOL CREEK	16985	1996.3	2476.3	3245.7	2081.8	2584.5	3363.3
POOL CREEK	17158	2000.4	2479.7	3249.9	2085.8	2587.9	3367.1
POOL CREEK	17210	2003.1	2481.2	3251.7	2088.5	2589.4	3368.5
PRUITT CREEK	169	982.1	1173.2	1436.4	1034.7	1218.9	1469.5
PRUITT CREEK	491	929.8	1130.6	1402.3	954.1	1157.2	1420.1
PRUITT CREEK	757	930.8	1132.2	1405.0	954.4	1159.0	1419.3
PRUITT CREEK	873	926.7	1113.8	1349.8	950.0	1137.8	1365.2
PRUITT CREEK	1091	931.4	1100.8	1297.7	955.8	1121.2	1302.3
PRUITT CREEK	1443	937.3	1110.1	1311.7	963.0	1131.7	1317.3
PRUITT CREEK	1859	999.2	1192.5	1406.0	1023.8	1216.2	1413.5
PRUITT CREEK	2181	1010.2	1199.3	1366.9	1037.1	1217.9	1373.1
PRUITT CREEK	2333	1012.8	1203.4	1371.0	1040.4	1222.6	1377.7
PRUITT CREEK	2536	1017.6	1214.3	1373.4	1046.3	1230.2	1380.3
PRUITT CREEK	2700	1021.7	1222.0	1400.2	1051.1	1236.1	1463.4
PRUITT CREEK	3297	1055.3	1237.2	1395.4	1083.6	1243.4	1432.5
PRUITT CREEK	3502	1066.5	1273.6	1431.7	1088.2	1268.6	1452.2
PRUITT CREEK	3589	1066.3	1273.4	1430.0	1087.9	1268.1	1450.9
PRUITT CREEK	3807	1066.2	1272.8	1442.0	1087.8	1266.8	1453.1
PRUITT CREEK	4143	1066.4	1264.6	1458.8	1087.9	1258.8	1455.3
PRUITT CREEK	4340	1066.1	1273.3	1528.8	1201.4	1266.0	1523.3
PRUITT CREEK	4375	1066.1	1273.5	1528.8	1087.4	1265.9	1523.2
PRUITT CREEK	4404	1066.2	1273.7	1528.9	1087.6	1265.9	1523.1
PRUITT CREEK	4431	1066.4	1273.9	1529.0	1087.7	1265.9	1523.1
PRUITT CREEK	4584	1066.6	1274.2	1528.6	1087.8	1265.1	1521.5
PRUITT CREEK	4859	1067.8	1282.0	1531.2	1088.4	1265.5	1520.5
PRUITT CREEK	5066	1069.0	1285.8	1533.2	1088.9	1266.1	1523.2
STARR CREEK	184	286.0	347.6	389.1	300.6	350.3	409.4
STARR CREEK	467	290.0	349.1	395.9	304.7	356.1	416.5
STARR CREEK	583	292.1	349.7	398.8	306.7	358.5	420.1
STARR CREEK	812	304.5	354.4	417.8	318.7	373.2	441.3
STARR CREEK	1034	308.3	355.6	425.5	322.7	377.5	449.5
STARR CREEK	1051	308.6	355.7	499.9	323.1	377.9	508.0
STARR CREEK	1075	308.9	355.8	425.6	323.4	378.4	454.2
STARR CREEK	1263	311.1	356.9	428.8	326.4	382.2	453.0
STARR CREEK	1632	316.5	358.7	436.9	331.5	389.8	461.2
STARR CREEK	1842	227.2	221.5	222.5	232.0	231.2	226.2
STARR CREEK	1877	227.4	220.5	240.3	248.9	231.3	241.3

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
STARR CREEK	1928	228.0	225.1	229.0	233.1	231.9	231.7
STARR CREEK	2082	229.6	215.0	223.4	234.0	231.5	230.9
STARR CREEK	2223	222.8	214.2	218.5	227.9	222.2	225.5
STARR CREEK	2279	494.6	525.9	646.1	474.3	539.2	602.4
STARR CREEK	2617	498.2	528.2	638.9	477.2	542.8	601.7
STARR CREEK	3077	503.4	531.2	640.5	482.9	547.5	602.4
STARR CREEK	3269	602.2	635.9	788.2	577.7	663.0	743.6
STARR CREEK	3571	593.4	620.3	736.1	572.3	641.4	704.4
STARR CREEK	4109	591.5	619.9	700.6	568.1	635.7	681.4
STARR CREEK	4558	604.1	633.8	791.5	579.5	657.8	748.8
STARR CREEK	4918	749.1	829.5	1042.7	728.3	858.4	995.6
STARR CREEK	5103	753.0	830.3	1050.5	733.4	858.9	999.8
STARR CREEK	5127	767.8	845.6	1064.5	746.3	876.8	1016.4
STARR CREEK	5148	768.4	846.4	1066.1	746.9	877.7	1018.0
STARR CREEK	5171	769.1	846.8	1067.1	747.6	878.6	1019.0
STARR CREEK	5333	773.8	849.8	1073.4	752.6	884.7	1025.9
STARR CREEK	5575	780.0	854.0	1082.7	758.8	893.0	1036.0
STARR CREEK	5814	785.8	857.9	1091.5	764.6	899.7	1045.3
STARR CREEK	6025	785.8	860.3	1094.8	763.2	894.5	1049.3
STARR CREEK	6229	788.7	863.2	1097.7	768.5	896.6	1053.2
STARR CREEK	6369	1210.5	1183.7	1097.4	1205.6	1209.3	1142.2
STARR CREEK	6390	788.7	865.5	1097.6	784.0	899.1	1052.7
STARR CREEK	6432	784.3	865.9	1098.1	764.0	899.4	1053.4
STARR CREEK	6466	1168.4	1325.6	1663.3	1143.0	1356.7	1617.0
STARR CREEK	6636	1169.6	1326.2	1663.0	1144.6	1357.7	1617.2
STARR CREEK	6960	1162.8	1320.3	1635.1	1135.8	1339.6	1589.9
STARR CREEK	7324	1149.3	1309.8	1607.2	1115.4	1310.9	1556.4
STARR CREEK	7631	1140.2	1304.0	1597.2	1098.0	1295.2	1538.5
STARR CREEK	7806	1143.2	1307.2	1601.9	1100.6	1298.6	1542.9
STARR CREEK	7975	1146.7	1310.8	1607.4	1104.2	1302.8	1548.5
STARR CREEK	8196	1149.5	1312.8	1612.1	1107.5	1301.7	1552.5
STARR CREEK	8452	1150.2	1314.6	1616.9	1109.2	1295.9	1555.5
STARR CREEK	8642	1144.8	1316.2	1620.0	1103.3	1289.8	1555.4
STARR CREEK	8834	1141.7	1321.7	1624.2	1098.4	1288.7	1558.3
STARR CREEK	9106	1147.1	1333.6	1630.3	1097.9	1291.7	1563.2
STARR CREEK	9247	1154.3	1339.8	1634.4	1102.6	1294.6	1566.5
STARR CREEK	9375	1163.1	1355.8	1638.6	1108.8	1298.6	1566.8
STARR CREEK	9482	1175.5	1375.6	1661.6	1117.0	1306.3	1571.1
STARR CREEK	9579	1184.2	1392.1	1693.8	1123.2	1314.8	1590.5
SC TRB T-6	79	279.2	294.6	320.3	255.4	281.0	298.9
SC TRB T-6	193	283.1	334.9	402.2	259.2	286.1	349.2
SC TRB T-6	247	285.0	335.6	404.5	261.2	288.6	351.4
SC TRB T-6	478	293.3	338.8	413.4	269.2	299.1	360.1

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
SC TRB T-6	875	311.5	347.2	431.1	286.6	322.1	379.8
SC TRB T-6	1251	322.2	351.8	448.0	296.7	337.5	395.5
SC TRB T-6	1469	328.6	354.5	456.7	302.1	345.0	403.5
SC TRB T-6	1538	329.3	354.8	457.4	302.9	346.2	404.3
SC TRB T-6	1605	330.5	355.3	459.6	304.0	348.1	406.1
SC TRB T-6	1815	334.0	357.1	465.2	307.1	353.6	411.1
SC TRB T-6	2142	336.2	356.6	469.8	310.9	354.2	413.1
SC TRB T-6	2323	334.4	355.8	473.1	309.3	352.2	416.0
SC TRB T-6	2400	334.3	355.7	472.0	308.9	351.8	415.7
SC TRB T-6	2680	334.6	355.7	467.4	308.5	351.8	414.6
SC TRB T-6	2937	335.9	356.6	466.5	309.0	353.5	415.6
SC TRB T-6	2986	336.4	357.0	467.1	309.4	353.9	416.5
SC TRB T-6	3046	336.9	357.4	467.8	309.9	354.5	417.4
SC TRB T-6	3202	338.3	358.2	469.6	311.2	356.4	419.7
WINDSOR CREEK	105	1312.0	1656.4	2149.8	1332.5	1676.4	2168.3
WINDSOR CREEK	345	1312.2	1664.5	2148.3	1332.3	1684.9	2169.1
WINDSOR CREEK	514	1312.2	1687.4	2147.2	1332.2	1725.6	2181.9
WINDSOR CREEK	569	1339.2	1636.1	2377.7	1332.2	1639.3	2377.0
WINDSOR CREEK	594	1312.2	2009.8	2458.0	1332.1	2122.7	2607.6
WINDSOR CREEK	706	1312.4	1691.9	2143.0	1332.3	1708.8	2181.4
WINDSOR CREEK	980	1313.7	1662.7	2151.3	1333.9	1683.8	2170.5
WINDSOR CREEK	1199	1314.6	1662.3	2151.4	1334.4	1678.0	2171.4
WINDSOR CREEK	1273	1314.8	1652.9	2104.0	1334.3	1667.1	2122.0
WINDSOR CREEK	1415	1314.6	1589.1	1852.1	1333.7	1602.9	1887.6
WINDSOR CREEK	1568	1315.7	1590.1	1852.4	1334.8	1603.4	1887.4
WINDSOR CREEK	1634	1316.2	1590.8	1853.0	1335.2	1603.7	1888.0
WINDSOR CREEK	1693	1316.6	1591.3	1853.5	1335.6	1604.1	1888.6
WINDSOR CREEK	2009	1317.5	1592.5	1854.8	1336.2	1604.6	1890.4
WINDSOR CREEK	2568	1317.8	1593.4	1856.4	1336.8	1605.9	1891.4
WINDSOR CREEK	2955	1319.1	1595.2	1857.9	1337.8	1607.3	1892.5
WINDSOR CREEK	3282	1319.9	1597.1	1860.2	1338.7	1608.9	1894.2
WINDSOR CREEK	3500	1342.0	1645.0	1911.3	1417.9	1717.9	2038.4
WINDSOR CREEK	3519	1342.0	1651.8	1910.1	1418.0	1713.2	2038.5
WINDSOR CREEK	3552	1342.1	1645.2	1913.2	1418.1	1718.1	2038.7
WINDSOR CREEK	3764	1345.5	1650.6	1919.7	1421.7	1722.7	2044.1
WINDSOR CREEK	4255	1349.5	1656.7	1924.8	1425.5	1727.3	2050.4
WINDSOR CREEK	4790	1350.0	1657.7	1924.9	1426.6	1728.9	2052.2
WINDSOR CREEK	5201	1351.1	1659.3	1925.6	1427.4	1729.5	2052.5
WINDSOR CREEK	5579	1351.6	1660.6	1927.1	1428.3	1730.9	2052.7
WINDSOR CREEK	5958	1360.9	1674.7	1938.5	1437.6	1741.5	2063.7
WINDSOR CREEK	6307	1361.4	1678.0	1946.8	1437.7	1741.6	2060.8
WINDSOR CREEK	6504	1365.7	1726.9	1994.7	1442.3	1747.3	2113.2
WINDSOR CREEK	6702	1382.1	2221.2	2596.6	1459.1	1766.8	2686.5

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
WINDSOR CREEK	6955	1395.2	1764.8	2006.8	1472.5	1783.9	2130.1
WINDSOR CREEK	7108	1403.9	1766.4	2017.9	1481.5	1794.9	2146.4
WINDSOR CREEK	7248	1403.6	1769.1	2020.6	1481.6	1794.4	2141.9
WINDSOR CREEK	7402	1403.3	1762.5	2004.8	1481.4	1793.3	2108.3
WINDSOR CREEK	7685	1424.8	1792.9	2028.8	1504.3	1818.2	2137.8
WINDSOR CREEK	8126	1425.1	1793.9	2031.3	1505.4	1816.3	2138.4
WINDSOR CREEK	8620	1042.9	1385.2	1625.0	940.4	1215.1	1553.4
WINDSOR CREEK	9087	1044.2	1375.4	1569.8	944.1	1277.6	1558.9
WINDSOR CREEK	9488	1418.6	1708.6	1888.1	1315.9	1623.7	1880.4
WINDSOR CREEK	9693	1429.0	1730.9	1984.8	1328.8	1640.2	1965.0
WINDSOR CREEK	10017	1432.3	1734.4	1989.1	1332.2	1643.4	1969.0
WINDSOR CREEK	10262	1434.6	1737.2	1992.5	1334.9	1646.2	1972.4
WINDSOR CREEK	10305	1435.0	1737.7	1993.1	1335.4	1646.7	1973.0
WINDSOR CREEK	10321	1435.2	1737.9	1993.3	1335.5	1646.9	1973.2
WINDSOR CREEK	10341	1435.3	1738.1	1993.6	1335.7	1647.1	1973.5
WINDSOR CREEK	10409	1435.9	1739.0	1994.6	1336.5	1648	1974.5
WINDSOR CREEK	10599	1438.2	1741.5	1997.6	1338.8	1650.7	1977.5
WINDSOR CREEK	10981	1444.1	1746.8	2004.9	1345.4	1657.9	1984.5
WINDSOR CREEK	11263	1452.2	1751.8	2011.5	1353.6	1665.7	1991.3
WINDSOR CREEK	11313	2603.0	3187.9	3583.1	2558.3	2973.9	3534.7
WINDSOR CREEK	11338	2603.3	3188.3	3583.8	2558.7	2974.4	3535.2
WINDSOR CREEK	11397	2604.2	3186.1	3571.9	2559.7	2975.1	3524.3
WINDSOR CREEK	11551	2596.4	3152.8	3506.8	2554.0	2954.9	3463.5
WINDSOR CREEK	11793	2463.6	2920.5	3211.1	2428.4	2757.8	3173.8
WINDSOR CREEK	12136	1964.1	2102.2	2163.3	1949.2	2050.1	2147.5
WINDSOR CREEK	12609	2041.3	2207.1	2277.1	2025.2	2151.4	2262.4
WINDSOR CREEK	12962	2497.2	3161.3	3625.1	2440.7	2963.1	3573.2
WINDSOR CREEK	13213	2611.6	3251.9	3708.7	2555.9	3062.8	3662.6
WINDSOR CREEK	13588	2615.8	3256.7	3717.9	2560.3	3068.6	3670.3
WINDSOR CREEK	13985	2620.0	3260.6	3727.3	2564.5	3074.5	3678.1
WINDSOR CREEK	14342	2623.4	3265.6	3735.4	2568.8	3080.4	3685.3
WINDSOR CREEK	14666	2627.5	3270.0	3742.7	2572.7	3085.6	3691.9
WINDSOR CREEK	14978	2631.5	3274.1	3749.6	2576.6	3090.6	3698.1
WINDSOR CREEK	15292	2635.3	3278.2	3756.6	2580.7	3095.5	3703.3
WINDSOR CREEK	15632	2636.1	3279.0	3762.3	2582.1	3099.2	3722.8
WINDSOR CREEK	15956	2639.1	3282.7	3782.1	2586.0	3103.4	3709.1
WINDSOR CREEK	16224	2642.0	3286.1	3771.6	2589.0	3107.3	3713.3
WINDSOR CREEK	16407	2644.2	3288.3	13631.6	2591.1	3109.9	11576.3
WINDSOR CREEK	16518	2630.7	3272.9	3930.6	2577.8	3096.6	3692.7
WINDSOR CREEK	16612	2630.0	3272.2	3872.2	2577.2	3096.1	3823.2
WINDSOR CREEK	16671	3663.3	4374.9	5259.2	3586.1	4261.3	5189.0
WINDSOR CREEK	16683	3662.3	4373.7	5225.5	3585.2	4260	5168.2
WINDSOR CREEK	16794	3662.3	4373.5	5221.2	3585.3	4259.9	5145.6

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
WINDSOR CREEK	17017	3636.4	4349.8	5195.8	3561.1	4235	5131.3
WINDSOR CREEK	17235	3617.4	4336.3	5184.1	3543.2	4222.2	5118.8
WINDSOR CREEK	17748	3578.6	4314.0	5161.3	3504.2	4199.4	5092.0
WINDSOR CREEK	19054	3415.5	4258.9	5068.7	3329.4	4134.9	4999.6
WINDSOR CREEK	20107	4715.8	6039.1	7914.3	4791.2	6075.9	7966.7
WINDSOR CREEK	20271	4714.9	6027.4	7901.3	4790.1	6065.8	7958.2
WINDSOR CREEK	20327	4714.5	6023.3	7896.7	4789.8	6062.9	7955.2
WINDSOR CREEK	20494	5463.1	6815.3	8792.7	5537.8	6868.2	8830.8
WINDSOR CREEK	21641	5508.4	6800.9	8750.8	5583.1	6858.7	8790.8
WINDSOR CREEK	23333	5266.9	6368.6	8143.2	5338.8	6440.5	8201.8
WINDSOR CREEK	24614	5180.4	6249.2	7886.5	5253.7	6318.7	7963.4
WINDSOR CREEK	25245	5174.6	6241.4	7852.6	5244.0	6309.6	7934.4
WINDSOR CREEK	26481	5222.7	6298.0	7922.1	5292.0	6367.4	8003.4
WINDSOR CREEK	28982	5320.2	6414.5	8067.1	5389.3	6486.5	8147.6
WINDSOR CREEK	31126	5402.9	6513.3	8190.6	5472.0	6587.3	8270.5
WINDSOR CREEK	31999	5435.8	6552.4	8239.6	5504.9	6627.3	8319.3
WINDSOR CREEK	32279	5435.9	6552.5	8239.8	5504.9	6627.4	8319.5
WINDSOR CREEK	33468	5436.1	6552.8	8240.2	5505.1	6627.8	8319.8
EW_US	8	93.1	121.0	160.9	93.4	121.3	161.2
EW_US	35	81.9	101.3	129.7	82.6	101.5	130.0
EW_US	57	69.6	82.1	101.9	69.5	82.3	102.1
EW_US	69	68.7	81.2	100.1	68.7	81.3	100.2
EW_US	90	68.9	81.6	101.4	68.8	81.8	101.5
EW_US	111	69.2	82.3	102.6	69.1	82.4	102.7
EW_US	160	72.4	87.8	110.2	72.5	87.9	110.4
EW_US	210	79.4	101.4	132.6	79.6	101.6	132.9
EW_US	480	92.0	119.6	158.0	92.2	119.9	158.4
EW_US	1021	77.8	92.2	101.5	77.8	87.9	101.6
EW_US	1329	146.3	219.3	256.5	147.1	191.2	257.2
EW_US	1399	146.5	219.8	256.8	147.2	191.5	257.5
EW_US	1490	146.9	220.4	257.7	147.8	192.3	258.3
EW_US	1654	148.0	219.5	259.2	148.9	193.4	259.7
EW_US	1773	154.2	228.8	268.1	155.0	200.6	268.5
EW_US	2471	168.5	240.3	263.6	168.9	217.9	263.6
EW_US	3167	173.8	249.4	299.3	174.1	226.3	299.2
FAUGHT_US	30	275.2	381.9	412.1	420.6	510.8	660.3
FAUGHT_US	90	109.4	183.1	212.5	214.1	311.4	462.4
FAUGHT_US	150	109.3	182.7	212.5	214.2	311.3	461.9
FAUGHT_US	209	109.1	182.3	215.4	214.3	311.2	462.9
FAUGHT_US	269	108.9	181.8	215.1	214.4	311.2	462.8
FAUGHT_US	329	109.1	181.2	215.1	214.5	311.1	461.7
FAUGHT_US	389	109.4	181.2	215.3	214.6	311.0	461.2
FAUGHT_US	449	109.6	181.3	215.5	214.7	310.9	461.1

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
FAUGHT_US	509	109.8	181.5	215.5	214.9	310.9	461.0
FAUGHT_US	568	110.0	181.6	215.3	215.1	310.9	460.9
FAUGHT_US	630	110.2	181.6	215.4	215.2	310.9	460.6
FAUGHT_US	693	110.4	181.6	215.7	215.4	311.1	460.3
FAUGHT_US	756	119.0	191.6	222.3	219.0	315.3	465.3
FAUGHT_US	819	119.0	191.4	222.4	219.2	315.4	465.1
FAUGHT_US	882	118.9	191.1	222.6	219.3	315.4	465.0
FAUGHT_US	945	119.0	190.6	222.9	219.6	315.4	464.9
FAUGHT_US	1008	119.2	190.0	223.2	219.8	315.5	462.2
FAUGHT_US	1071	119.3	189.7	223.4	220.0	315.6	457.2
FAUGHT_US	1134	119.4	189.7	223.6	220.3	315.6	455.8
FAUGHT_US	1197	119.5	189.7	223.7	220.5	315.6	455.8
FAUGHT_US	1259	120.0	189.6	224.3	220.8	315.9	455.3
FAUGHT_US	1322	120.5	189.5	225.0	221.2	316.5	455.1
FAUGHT_US	1386	121.1	189.4	225.8	221.5	317.2	455.0
FAUGHT_US	1450	121.9	189.8	226.8	222.0	316.7	450.2
FAUGHT_US	1512	122.8	190.8	227.8	222.5	317.5	436.5
FAUGHT_US	1566	339.7	447.8	481.2	460.5	548.9	625.1
FAUGHT_US	1606	339.9	447.8	481.4	460.6	549.0	624.9
EWTRB_X	796	357.7	390.1	418.3	363.8	400.1	419.5
EWTRB_X	1606	379.2	420.3	481.8	385.9	439.0	483.7
EWTRB_X	1636	379.6	424.4	486.2	386.3	442.4	488.4
EWTRB_X	1668	380.0	430.0	498.1	386.7	448.9	501.3
EWTRB_X	1797	381.0	432.9	503.8	387.8	453.3	507.6
POOLGOLFTRB	133	110.2	162.8	200.2	121.6	161.7	210.1
POOLGOLFTRB	298	106.7	162.3	199.9	120.3	160.8	215.0
STARRTRB	17	77.1	86.4	99.0	69.4	81.0	94.7
STARRTRB	261	78.7	87.9	104.4	72.7	85.6	100.8
STARRTRB	656	82.2	90.5	111.9	78.1	92.1	107.3
STARRTRB	882	85.8	92.2	117.1	81.8	96.3	112.3
STARRTRB	968	96.8	103.0	133.0	93.3	109.8	128.9
STARRTRB	1023	97.5	103.5	134.1	94.1	110.8	130.1
STARRTRB	1233	100.2	105	138.3	96.8	114.3	134.3
STARRTRB	1638	102.6	105.9	144.3	99.6	116.2	139.8
EW_OD	7	0.3	0.2	0.2	0.3	0.2	0.2
EW_OD	404	104.1	102.8	107.7	104.4	104.5	107.8
EW_OD	817	95.6	104.9	123.6	95.8	109.7	123.6
EW_OD	881	95.8	104.5	123.5	96.0	109.5	123.4
EW_OD	948	95.9	104.6	130.2	96.2	109.6	130.2
EW_OD	1065	108.2	121.8	149.5	108.5	126.7	149.8
EW_OD	1167	107.9	121.2	148.1	108.2	125.4	148.4
FAUGHT_WALMART	65	339.9	447.7	481.6	460.7	548.9	624.2
FAUGHT_WALMART	195	339.9	447.8	481.6	460.7	548.9	624.1

		Baseline Condition			Future Condition (assumes Existing SDIPs implemented)		
M11 Creek Name	Station	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q	10-yr Peak Q	25-yr Peak Q	100-yr Peak Q
	(feet)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
FAUGHT_WALMART	266	339.9	447.8	481.7	460.8	548.9	624.0
FAUGHT_WALMART	325	346.0	455.0	488.4	464.8	552.5	626.7
FAUGHT_WALMART	429	346.0	455.0	488.5	464.9	552.5	626.8
FAUGHT_WALMART	534	345.9	454.9	488.5	464.9	552.5	627.0
FAUGHT_WALMART	638	345.9	454.9	488.5	465.0	552.5	626.5
FAUGHT_WALMART	697	345.9	454.9	488.5	465.0	552.5	626.5
FAUGHT_WALMART	768	346.0	454.9	488.5	465.1	552.5	626.4
FAUGHT_WALMART	897	346.3	454.7	488.5	465.1	552.5	626.7
FAUGHT_WALMART	1027	346.6	454.9	488.5	465.2	552.5	626.4
FAUGHT_WALMART	1098	356.1	466.7	500.3	472.3	558.8	633.6
FAUGHT_WALMART	1147	356.2	466.6	500.3	472.3	558.9	633.7
FAUGHT_WALMART	1233	356.4	466.5	500.3	472.4	559.2	633.7
FAUGHT_WALMART	1282	356.5	466.4	500.3	472.5	559.3	633.7
FAUGHT_WALMART	1335	439.2	564.5	612.7	551.8	638.0	792.5
FAUGHT_WALMART	1426	439.0	564.5	612.8	551.7	638.0	792.5
STARRTRB_UPPER	5	22.0	24.3	29.0	20.0	23.3	28.4
STARRTRB_UPPER	28	21.9	24.3	28.6	19.9	23.2	27.9
STARRTRB_UPPER	73	21.9	24.2	27.6	19.8	23.0	26.7
STARRTRB_UPPER	120	21.9	24.2	27.5	19.7	22.8	26.6
STARRTRB_UPPER	213	21.9	24.2	27.6	19.8	22.9	26.4
STARRTRB_UPPER	333	22.1	24.4	27.7	20.2	23.3	26.6
STARRTRB_UPPER	381	22.2	24.4	27.8	20.3	23.4	26.7

Appendix 6E – Development Review Look-Up Table

Table 6E-1 and Table 6E-2 below present final model results for the maximum hydraulic gradient line (HGL) and peak discharge under Baseline Hydrologic and Hydraulic conditions for the Town of Windsor Storm Drain Master Plan. The vertical datum for the HGL is NAVD 88. The information in the two tables is the same, Table 6E-1 is sorted in order of increasing Sub-Basin ID while Table 6E-2 is sorted by increasing Sub-Basin Connection Node ID. The tables are intended to be used during land development review to evaluate impacts to the existing storm drain.

Figure 6E-1 (provided at the end of Appendix 6E) shows the locations of the Sub-Basin Connection Nodes.

Table 6E-1. Summary of Peak Discharge and Maximum HGL for Sub-Basin Connection Points (Sorted by Sub-Basin)

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_1	IN 1811	GM 34	1.165	1.942	3.567	135.469	133.140	133.573
BASIN_2	IN 12644	GM 64	85.108	88.958	95.985	123.891	124.190	124.475
BASIN_3	MH 13593	GM 99	166.120	179.928	192.430	113.415	113.845	114.255
BASIN_4	IN 2692	GM 219	91.783	106.403	122.153	125.377	126.089	126.588
BASIN_5	MH 58	GM 216	63.637	57.810	54.526	124.875	125.295	125.495
BASIN_6	IN 77	GM 3903	11.089	13.384	16.492	119.823	119.987	120.259
BASIN_8	IN 2813	GM 502	15.644	18.717	22.778	101.558	102.136	104.449
BASIN_9	MH 147	GM 697	21.153	25.038	30.583	101.335	103.488	106.053
BASIN_10	MH 149	GM 707	6.604	7.875	9.182	100.981	101.083	101.932
BASIN_11	IN 2670	GM 87	21.436	21.507	21.330	123.248	123.228	124.180
BASIN_12	IN 10243	GM 3965	13.031	15.574	17.375	114.472	115.066	116.250
BASIN_13	MH 138	GM 655	25.956	25.674	24.579	99.777	99.747	100.994
BASIN_14	MH 139	GM 654	30.088	29.135	29.029	96.949	97.451	97.854
BASIN_15	IN 1974	GM 736	134.796	140.941	140.941	93.163	93.455	93.642
BASIN_16	IN 2828	GM 3694	39.129	45.874	57.351	97.375	98.563	99.738
BASIN_17	IN 1992	GM 722	28.358	34.714	45.485	102.556	106.089	107.425
BASIN_18	MH 13592	GM 2203	11.195	13.561	16.774	112.280	113.002	115.787
BASIN_19	MH 456	GM 2230	20.235	23.979	28.605	109.662	110.348	111.332
BASIN_20	MH 318	GM 1428	7.557	8.228	10.135	90.036	91.739	93.386
BASIN_21	MH 311	GM 1407	78.399	91.606	106.015	89.167	90.994	92.123
BASIN_22	MH 328	GM 1493	14.832	17.622	19.953	91.719	94.400	94.816
BASIN_23	MH 335	GM 1522	16.810	20.165	19.141	102.907	106.201	106.890
BASIN_24	MH 167	GM 779	47.357	56.468	69.111	94.787	95.358	95.689
BASIN_25	IN 2114	GM 1461	12.925	15.362	18.717	94.823	95.787	96.706
BASIN_26	IN 424	GM 741	21.789	25.886	31.571	92.503	93.510	95.259

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_27	IN 2713	#N/A	#N/A	#N/A	#N/A	124.386	126.175	127.382
BASIN_28	IN 3281	GM 1856	69.464	76.845	81.259	119.301	119.455	119.606
BASIN_29	MH 91	GM 3971	130.911	164.319	179.575	118.871	120.912	121.962
BASIN_30	IN 2846	GM 791	10.135	12.148	15.009	135.554	137.628	139.150
BASIN_31	IN 815	GM 900	7.734	9.217	11.442	134.564	136.329	137.730
BASIN_32	MH 205	GM 925	18.187	18.470	18.222	136.365	135.853	138.028
BASIN_33	IN 2884	GM 946	6.145	7.416	8.899	129.987	130.420	130.892
BASIN_34	IN 2154	GM 954	4.873	5.862	7.310	132.067	132.700	133.806
BASIN_35	IN 2890	GM 968	10.630	10.277	12.784	128.570	129.186	129.009
BASIN_36	MH 215	GM 974	33.231	32.772	34.820	128.241	128.698	130.863
BASIN_39	IN 2912	GM 3960	29.558	35.809	43.755	119.485	120.518	120.728
BASIN_40	IN 2230	GM 2871	18.505	21.966	21.118	119.980	121.860	122.825
BASIN_41	IN 3734	GM 2851	13.808	15.821	19.141	115.833	117.283	118.369
BASIN_42	IN 3753	GM 3954	19.847	19.847	19.812	125.335	125.564	125.801
BASIN_43	IN 3800	GM 2982	20.235	22.919	22.955	130.531	132.785	133.035
BASIN_44	IN 2518	GM 2494	14.302	17.092	20.765	132.543	133.924	136.207
BASIN_45	IN 2517	GM 2470	31.713	38.599	48.381	128.350	128.563	128.825
BASIN_46	IN 3623	GM 2610	88.816	112.018	141.188	139.948	142.815	144.688
BASIN_47	MH 13600	GM 2607	104.425	120.423	123.001	136.857	138.323	138.563
BASIN_48	IN 3586	GM 2525	14.196	14.726	14.691	124.311	124.026	123.963
BASIN_49	MH 677	GM 3330	7.275	8.758	10.912	117.713	118.087	118.717
BASIN_50	MH 560	GM 2661	32.136	27.545	29.947	117.677	118.120	118.232
BASIN_51	MH 756	GM 2562	13.455	17.057	21.966	132.513	132.690	133.806
BASIN_52	IN 2953	GM 1204	15.291	18.258	19.847	123.114	126.125	127.169
BASIN_54	IN 3106	GM 1535	14.620	17.445	21.507	123.999	124.203	124.459
BASIN_55	IN 3155	GM 2812	28.040	30.477	31.501	120.515	121.808	122.008
BASIN_56	IN 2276	GM 3885	6.145	7.134	8.829	100.630	101.388	102.211
BASIN_57	MH 13631	GM 3990	84.720	90.264	102.624	100.630	101.388	102.211
BASIN_58	IN 2380	GM 1625	14.726	17.445	21.118	103.130	103.304	103.428
BASIN_59	IN 5043	GM 3898	29.099	34.396	42.660	103.189	103.747	104.521
BASIN_60	IN 2390	GM 3507	13.314	16.174	20.306	103.888	104.596	105.682
BASIN_61	IN 3647	GM 2674	30.017	37.751	43.790	122.188	123.750	123.799
BASIN_62	IN 3129	GM 1579	18.752	22.672	27.475	140.059	142.828	145.069
BASIN_63	MH 267	GM 1241	189.463	216.338	252.182	125.833	126.299	126.631
BASIN_64	IN 3127	GM 1575	14.867	17.869	22.248	137.972	138.622	141.155
BASIN_65	IN 3122	GM 1563	8.299	9.994	12.537	135.912	136.263	137.523

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_66	IN 2591	GM 2486	12.855	15.680	17.763	141.181	142.113	144.957
BASIN_67	IN 2934	GM 1140	94.679	119.328	153.866	140.787	141.594	145.807
BASIN_68	MH 745	GM 1143	106.968	133.207	168.910	136.627	139.426	143.219
BASIN_69	MH 609	GM 2907	119.681	148.251	158.598	131.519	133.694	135.833
BASIN_70	IN 3524	GM 2399	10.700	17.410	21.507	149.777	152.477	155.751
BASIN_71	MH 494	GM 2388	50.217	65.262	66.533	153.688	160.909	159.409
BASIN_72	IN 7044	GM 3912	103.719	108.381	105.944	139.751	140.400	140.200
BASIN_73	MH 13611	GM 3909	241.093	276.620	290.251	130.719	131.033	131.260
BASIN_74	MH 491	GM 3906	45.097	47.710	51.418	141.490	143.409	145.056
BASIN_75	IN 3349	GM 1989	26.380	33.937	44.744	202.523	202.766	206.693
BASIN_76	MH 511	GM 2432	47.534	59.364	61.412	174.337	175.413	176.854
BASIN_77	MH 512	GM 2434	56.998	70.523	77.092	169.921	173.950	175.331
BASIN_79	IN 3330	GM 1957	34.714	45.909	59.894	162.260	162.628	162.989
BASIN_80	IN 2928	GM 1109	13.702	17.481	23.484	188.189	188.356	190.446
BASIN_81	IN 2926	GM 1110	22.637	28.146	33.337	183.025	183.622	187.129
BASIN_82	IN 2924	GM 1103	31.924	32.701	34.891	176.047	175.820	178.304
BASIN_84	IN 3364	GM 2025	14.126	17.340	21.719	152.648	153.819	154.721
BASIN_85	IN 3374	GM 2038	22.319	26.663	32.878	139.977	140.755	141.818
BASIN_86	MH 467	GM 2259	30.724	31.960	32.878	134.196	134.921	134.570
BASIN_87	IN 12709	GM 2254	34.714	34.785	34.538	128.136	128.501	128.717
BASIN_88	IN 3857	GM 3060	25.356	30.194	33.266	104.987	105.686	106.181
BASIN_89	IN 3966	GM 3299	53.643	56.539	58.163	114.895	115.148	115.476
BASIN_90	IN 3931	GM 3216	72.925	73.525	76.739	110.814	111.542	111.818
BASIN_91	IN 3967	GM 3307	132.289	148.887	172.865	107.949	108.127	108.415
BASIN_92	MH 9986	GM 3477	75.785	55.515	61.200	97.854	98.196	98.215
BASIN_93	IN 2310	GM 3455	14.302	16.916	20.659	98.852	100.236	100.840
BASIN_95	IN 2073	GM 1485	35.527	42.801	43.967	90.085	92.264	93.360
BASIN_96	IN 339	GM 514	12.466	15.150	18.823	109.993	110.919	112.343
BASIN_98	IN 2810	GM 564	11.901	14.373	17.445	104.042	108.209	110.157
BASIN_99	IN 3493	GM 3956	19.317	19.317	19.388	129.833	129.888	129.954
BASIN_100	IN 3498	GM 2331	29.276	33.514	35.597	135.253	135.617	135.748
BASIN_101	MH 477	GM 3958	36.974	17.622	39.870	135.082	135.338	135.673
BASIN_102	IN 3778	GM 2924	11.089	5.686	4.626	129.852	129.633	129.347
BASIN_103	IN 892	GM 3421	109.370	107.498	113.537	95.085	95.571	95.797
BASIN_104	IN 2193	GM 3153	165.131	174.419	180.281	100.220	101.368	101.965
BASIN_105	IN 2193	GM 3153	165.131	174.419	180.281	100.220	101.368	101.965

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_107	MH 424	GM 2082	15.856	17.092	16.598	115.279	119.045	119.259
BASIN_108	IN 12655	CU 192	37.999	39.800	40.082	127.060	127.133	127.234
BASIN_109	IN 3785	GM 4002	7.593	8.440	10.594	109.232	109.738	110.568
BASIN_110	IN 4226	GM 3878	13.384	12.890	18.046	123.038	122.149	123.809
BASIN_111	IN 2425	GM 2995	11.230	13.066	13.985	127.477	130.016	130.210
BASIN_113	IN 2866	GM 854	10.171	12.290	15.221	135.758	136.175	136.617
BASIN_115	IN 12707	CU 201	86.556	98.139	103.719	136.342	136.801	137.057
BASIN_116	IN 12653	GM 3968	96.727	105.979	111.347	117.461	118.409	119.226
BASIN_117	IN 12676	GM 76	140.588	148.392	156.479	114.698	115.358	115.850
BASIN_118	MH 403	GM 1962	21.507	25.815	27.334	158.589	162.841	164.281
BASIN_119	IN 3541	GM 2427	21.789	26.486	32.913	165.154	167.900	167.969
BASIN_120	IN 2536	GM 1184	8.299	10.383	13.066	133.944	136.020	137.897
BASIN_121	IN 2686	GM 163	12.784	21.153	32.419	127.372	129.022	130.335
BASIN_122	MH 125	GM 575	128.439	166.332	179.787	147.743	151.490	154.045
BASIN_123	IN 12710	GM 4006	#N/A	#N/A	#N/A	137.579	137.956	138.438
BASIN_124	IN 264	GM 119	7.204	8.476	10.559	136.348	137.110	137.398
BASIN_125	MH 27	GM 124	56.609	62.754	64.131	135.791	136.001	135.928
BASIN_126	MH 53	GM 210	33.196	35.738	37.681	137.785	138.150	138.635
BASIN_127	MH 71	GM 271	37.751	47.781	46.368	132.913	134.232	135.236
BASIN_128	IN 3384	GM 2057	10.700	12.996	16.209	153.802	154.163	155.404
BASIN_129	IN 3385	GM 2684	54.632	59.894	66.886	153.261	153.970	155.318
BASIN_130	IN 2353	GM 2012	42.307	44.708	48.134	150.551	151.017	151.640
BASIN_131	MH 411	GM 1987	10.277	13.137	17.304	199.390	199.501	199.656
BASIN_132	IN 3346	GM 1982	43.826	52.866	53.431	184.672	189.442	189.977
BASIN_133	IN 2646	GM 14	55.409	57.810	58.516	130.476	130.558	131.106
BASIN_134	IN 1941	GM 186	12.890	15.115	18.752	127.543	128.074	129.646
BASIN_135	IN 4148	GM 308	122.577	154.572	160.364	122.451	126.056	127.208
BASIN_136	IN 2729	GM 349	12.996	15.715	19.458	119.147	120.965	122.605
BASIN_137	IN 2719	GM 328	12.501	14.726	18.258	120.715	122.461	123.402
BASIN_138	MH 13620	GM 3980	136.527	171.276	187.450	116.217	116.732	117.083
BASIN_139	IN 12649	GM 337	129.852	163.224	173.642	119.058	121.132	121.913
BASIN_140	IN 2742	GM 368	16.845	19.812	19.564	118.593	119.623	119.925
BASIN_141	MH 42	GM 166	0.530	0.706	0.636	127.467	129.035	130.669
BASIN_142	IN 4196	GM 3865	49.087	59.187	66.568	131.982	132.188	132.438
BASIN_143	IN 12692	OD 373	213.654	241.800	245.260	123.327	123.671	123.770
BASIN_144	MH 190	GM 853	66.038	68.899	76.880	133.438	134.980	135.115

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_145	IN 12648	OD 184	1.165	4.450	13.243	157.493	157.904	158.392
BASIN_146	IN 3538	GM 2423	12.713	15.715	18.540	163.780	165.341	165.381
BASIN_147	IN 12687	CU 198	15.115	18.116	22.531	116.073	116.253	116.572
BASIN_148	IN 3729	GM 2845	4.909	5.827	7.063	117.848	117.946	118.438
BASIN_150	IN 3424	GM 2167	4.873	5.615	6.922	108.284	109.321	109.944
BASIN_151	MH 373	GM 1791	82.884	106.191	125.014	112.205	113.340	114.012
BASIN_152	IN 2127	GM 1795	65.262	82.177	90.123	112.290	115.121	115.751
BASIN_153	IN 3578	GM 2511	6.039	7.028	8.793	130.896	132.162	134.055
BASIN_154	IN 2340	GM 3033	172.971	202.742	229.475	120.643	123.625	125.886
BASIN_155	IN 3814	GM 2823	35.421	39.164	40.753	116.864	118.593	120.164
BASIN_156	IN 2596	GM 1137	14.479	15.327	17.128	140.325	141.089	141.690
BASIN_157	MH 143	GM 676	64.661	73.631	81.047	97.717	98.166	98.333
BASIN_158	MH 147	GM 697	21.153	25.038	30.583	101.335	103.488	106.053
BASIN_159	IN 2218	GM 2138	13.066	15.609	19.494	103.369	104.226	105.026
BASIN_161	MH 321	GM 1462	8.793	10.559	12.925	94.829	95.974	96.995
BASIN_162	MH 310	GM 1436	88.958	103.543	118.304	88.730	90.390	91.381
BASIN_163	IN 3930	GM 3202	9.464	11.018	10.806	107.546	109.882	110.203
BASIN_164	IN 4184	GM 3187	127.627	131.512	132.465	106.772	108.314	109.019
BASIN_165	IN 3894	GM 3136	51.348	60.106	71.724	112.493	112.799	113.376
BASIN_166	IN 2419	GM 3132	15.786	18.964	23.484	116.519	117.028	117.674
BASIN_167	MH 522	GM 2472	72.889	87.580	108.134	127.526	127.818	128.238
BASIN_168	IN 3557	GM 2463	11.089	13.208	16.386	128.993	129.213	130.148
BASIN_169	MH 718	GM 2555	90.617	108.663	123.672	128.205	128.392	128.553
BASIN_170	MH 635	GM 3092	32.101	30.653	30.724	122.805	122.300	122.356
BASIN_171	MH 531	GM 2549	22.672	24.685	27.016	124.245	124.406	124.593
BASIN_172	IN 4230	CU 134	136.456	154.608	166.156	100.318	101.079	101.516
BASIN_173	IN 3659	GM 2703	53.078	53.431	53.502	122.306	122.490	122.579
BASIN_174	IN 3660	GM 2704	61.659	63.284	63.602	121.375	121.749	121.775
BASIN_175	MH 558	GM 2639	61.200	53.996	61.907	114.521	116.119	116.325
BASIN_176	IN 3675	GM 2729	6.604	8.193	9.888	106.821	109.439	109.938
BASIN_177	MH 668	GM 3320	15.680	18.328	22.566	107.231	109.859	110.528
BASIN_178	MH 567	GM 2676	15.362	17.304	18.046	125.003	128.875	128.720
BASIN_179	MH 346	GM 1617	22.637	28.216	27.086	122.549	123.934	124.193
BASIN_180	IN 3644	GM 2666	9.500	11.407	14.444	117.867	118.930	119.656
BASIN_181	IN 3139	GM 1588	21.471	21.224	21.083	147.444	147.769	148.524
BASIN_182	IN 2994	GM 1258	10.630	12.890	16.139	157.723	158.294	159.377

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_183	IN 1341	GM 1677	8.652	10.029	12.466	107.602	108.009	108.356
BASIN_184	IN 1330	GM 1685	28.852	28.464	28.005	108.297	110.098	108.930
BASIN_185	MH 364	GM 1721	21.153	17.410	24.120	114.846	115.574	115.741
BASIN_186	MH 730	MH 730 Dummy Link	88.145	108.946	185.261	112.917	113.724	114.062
BASIN_187	MH 276	GM 1286	35.809	35.950	35.774	131.191	131.388	131.391
BASIN_188	MH 367	GM 1731	60.000	73.596	83.978	115.423	116.847	118.428
BASIN_189	MH 730	MH 730 Dummy Link	88.145	108.946	185.261	112.917	113.724	114.062
BASIN_190	IN 4186	GM 3991	34.573	41.848	52.054	102.684	103.688	104.478
BASIN_191	MH 291	GM 1319	42.660	44.602	46.086	109.229	109.646	109.738
BASIN_192	IN 3022	GM 1339	10.665	12.572	15.397	109.180	109.436	110.518
BASIN_194	IN 3011	GM 3926	67.592	67.098	70.806	103.799	104.491	105.240
BASIN_195	MH 709	GM 794	7.734	9.146	11.795	135.682	137.927	139.058
BASIN_196	MH 176	GM 824	125.438	151.924	162.306	136.916	140.512	142.247
BASIN_197	MH 172	GM 816	111.241	156.479	171.311	135.171	138.517	140.266
BASIN_198	MH 739	GM 897	129.923	163.048	171.629	134.423	136.650	137.953
BASIN_199	IN 2048	GM 906	7.699	9.041	11.477	133.947	136.257	137.497
BASIN_200	MH 181	GM 837	14.656	17.728	19.564	146.877	148.389	149.275
BASIN_201	MH 184	GM 842	29.841	26.804	27.651	143.255	144.006	145.102
BASIN_202	MH 185	GM 845	40.894	38.670	40.541	141.683	142.254	144.829
BASIN_203	IN 123	GM 965	9.817	11.866	14.691	135.092	135.384	135.430
BASIN_204	MH 212	GM 956	15.503	18.505	23.060	131.896	132.454	133.428
BASIN_205	MH 226	GM 1022	25.073	28.958	30.830	126.093	129.793	130.584
BASIN_206	MH 211	GM 3967	67.734	72.360	77.339	129.216	129.505	129.770
BASIN_207	MH 216	GM 986	36.127	35.668	36.515	127.251	127.982	128.291
BASIN_208	MH 202	CU 186	252.323	338.244	376.313	132.835	134.032	134.944
BASIN_209	MH 545	GM 2590	28.146	34.291	36.904	131.411	132.602	132.959
BASIN_210	IN 3871	GM 3091	14.973	14.267	13.490	124.770	123.530	126.588
BASIN_211	MH 214	GM 962	9.464	11.230	13.879	131.962	133.904	133.944
BASIN_212	MH 61	GM 224	60.353	70.100	79.988	126.841	127.949	128.481
BASIN_213	IN 383	GM 118	58.199	72.360	57.881	139.993	145.020	139.288
BASIN_214	MH 31	GM 141	15.892	17.092	16.774	138.770	139.058	139.406
BASIN_215	MH 197	GM 893	131.017	164.884	173.430	134.393	136.604	137.900
BASIN_216	IN 1858	GM 174	16.209	18.999	22.955	125.945	126.368	127.064
BASIN_217	MH 237	GM 1095	37.222	34.926	36.480	157.812	158.048	159.226
BASIN_218	MH 419	GM 2059	43.260	48.946	48.275	155.085	156.591	156.903

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_219	MH 413	GM 2006	38.281	38.705	38.528	172.959	173.642	174.137
BASIN_220	IN 1471	GM 2020	11.336	13.490	16.598	153.517	153.704	153.793
BASIN_221	IN 2463	GM 2026	15.715	19.211	23.943	152.083	152.887	153.281
BASIN_222	IN 3320	GM 1943	29.735	36.904	40.117	179.701	185.200	187.064
BASIN_223	IN 2656	GM 51	60.035	61.589	61.059	128.583	128.796	129.045
BASIN_224	MH 13671	OD 248	183.601	214.748	255.043	120.157	120.243	120.341
BASIN_225	MH 13671	OD 248	183.601	214.748	255.043	120.157	120.243	120.341
BASIN_226	IN 4166	GM 221	22.601	22.107	21.153	127.234	128.291	127.500
BASIN_227	IN 2707	GM 287	9.535	11.336	8.334	124.711	123.323	128.435
BASIN_228	MH 777	GM 3871	276.231	291.240	296.255	121.749	121.985	122.149
BASIN_229	MH 725	GM 298	246.249	318.362	367.273	126.775	128.025	128.881
BASIN_230	MH 83	GM 312	125.579	157.821	170.005	121.896	125.131	126.411
BASIN_231	MH 83	GM 312	125.579	157.821	170.005	121.896	125.131	126.411
BASIN_232	IN 2730	GM 350	10.842	12.996	16.139	119.459	120.981	122.874
BASIN_233	IN 4167	GM 3966	5.015	6.039	7.593	120.413	120.600	120.827
BASIN_234	IN 2757	GM 404	18.787	22.990	28.570	119.163	120.187	121.824
BASIN_235	MH 733	GM 378	10.736	12.678	16.315	120.453	120.778	121.995
BASIN_236	MH 383	GM 1838	5.262	6.321	10.736	119.196	119.350	120.039
BASIN_237	MH 13650	OD 376	66.286	73.490	84.014	123.150	123.241	123.360
BASIN_238	IN 4219	CU 207	66.392	72.748	78.858	125.016	125.505	125.889
BASIN_239	IN 4238	OD 358	33.125	39.376	47.851	125.269	125.344	125.440
BASIN_240	IN 2126	GM 1814	3.920	4.485	5.792	112.520	113.973	114.590
BASIN_242	MH 472	GM 2297	12.819	15.503	18.717	125.112	127.267	128.199
BASIN_243	MH 482	GM 2358	120.776	121.129	120.988	151.621	151.932	152.014
BASIN_244	MH 491	GM 3906	45.097	47.710	51.418	141.490	143.409	145.056
BASIN_245	IN 2533	GM 1168	88.322	104.108	103.613	140.915	142.654	142.907
BASIN_246	MH 493	GM 2396	71.336	86.097	84.155	144.905	148.819	149.163
BASIN_247	IN 2673	GM 94	55.338	51.665	48.911	116.959	117.438	117.963
BASIN_248	IN 12690	GM 3984	129.146	137.515	144.825	116.568	117.490	118.228
BASIN_249	IN 4170	GM 465	41.071	46.368	53.007	114.275	114.423	114.616
BASIN_250	MH 13632	GM 4023	55.162	62.260	72.077	111.772	111.949	112.231
BASIN_251	MH 22	GM 91	24.897	25.144	26.874	121.375	121.670	125.164
BASIN_252	IN 346	GM 517	16.492	20.518	26.451	109.190	109.764	110.558
BASIN_253	MH 450	GM 2218	33.443	40.718	52.336	110.253	110.794	112.152
BASIN_254	MH 447	GM 2211	21.224	25.568	32.984	111.444	112.536	115.016
BASIN_255	MH 427	GM 2094	55.868	66.921	72.501	114.262	118.540	118.852

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_256	MH 431	GM 2124	11.936	14.161	17.657	112.215	113.369	114.035
BASIN_257	IN 3420	GM 2165	15.397	13.843	20.447	108.278	109.308	109.934
BASIN_258	MH 464	GM 2251	47.357	46.757	47.180	124.934	126.014	127.129
BASIN_259	MH 598	GM 2857	7.840	9.323	11.336	116.089	117.552	118.773
BASIN_260	MH 13186	GM 2852	76.244	82.071	85.108	116.152	117.608	118.852
BASIN_262	MH 631	GM 2819	189.781	217.538	259.316	118.156	120.778	122.667
BASIN_263	MH 13583	GM 3001	30.371	31.713	29.276	124.331	126.673	127.051
BASIN_264	IN 3807	GM 2996	15.856	17.869	18.152	126.375	128.793	128.665
BASIN_265	IN 1198	GM 3935	6.569	7.840	9.959	118.383	119.131	119.390
BASIN_266	IN 3790	GM 3933	14.126	16.280	18.116	118.068	118.540	118.743
BASIN_267	IN 4182	GM 2968	23.555	24.191	27.651	123.048	122.385	122.028
BASIN_268	IN 793	GM 3857	6.215	7.169	9.111	108.271	109.298	109.925
BASIN_269	MH 393	GM 2095	34.926	41.813	51.206	115.653	120.433	121.591
BASIN_270	MH 433	GM 2128	5.297	6.251	7.840	112.221	113.379	114.045
BASIN_271	MH 617	GM 2943	118.516	133.489	162.553	131.293	131.772	132.093
BASIN_272	MH 264	GM 1179	112.265	121.800	158.422	131.972	132.615	133.130
BASIN_273	IN 2451	GM 1188	14.867	19.564	21.754	132.986	134.810	136.115
BASIN_274	MH 585	GM 2936	122.542	123.036	122.966	139.255	139.469	139.685
BASIN_275	MH 616	GM 3949	123.248	126.215	124.520	131.119	131.325	131.486
BASIN_276	MH 253	GM 1155	117.245	144.931	153.089	134.068	137.608	140.226
BASIN_277	MH 255	GM 1153	12.501	14.903	20.129	134.354	138.012	140.991
BASIN_278	IN 3574	GM 2513	49.335	51.948	54.420	131.050	132.287	134.163
BASIN_279	IN 2529	GM 2518	33.902	34.750	34.043	135.410	136.388	137.274
BASIN_280	MH 525	GM 3692	31.218	29.735	26.804	138.799	138.917	139.206
BASIN_281	MH 526	GM 2520	37.434	39.729	40.965	132.425	133.399	135.203
BASIN_282	IN 3820	GM 3014	83.272	98.740	110.994	125.600	126.421	128.665
BASIN_283	IN 4221	GM 3877	214.819	239.010	277.891	115.551	117.162	118.222
BASIN_284	MH 9983	GM 3988	9.712	12.254	16.527	103.094	103.704	104.193
BASIN_285	MH 521	GM 2483	25.356	30.830	38.599	129.528	129.682	129.895
BASIN_286	MH 130	GM 606	29.876	35.315	44.214	99.268	100.633	102.198
BASIN_287	MH 151	GM 712	15.856	19.317	23.308	100.266	100.630	101.716
BASIN_288	MH 142	GM 679	49.017	57.457	67.769	99.012	99.642	100.364
BASIN_289	IN 2809	GM 719	27.828	34.608	38.387	103.668	107.589	108.743
BASIN_290	IN 1992	GM 722	28.358	34.714	45.485	102.556	106.089	107.425
BASIN_291	IN 1883	GM 633	14.055	16.527	18.787	99.455	99.715	101.260
BASIN_292	IN 2831	GM 733	16.739	19.847	24.155	98.606	100.056	101.854

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_293	IN 2829	GM 3708	15.362	18.152	22.178	95.052	95.351	95.561
BASIN_294	MH 13670	OD 390	51.736	69.040	69.287	91.637	92.090	92.303
BASIN_295	MH 13615	GM 3913	106.968	96.586	97.186	91.946	92.375	92.612
BASIN_296	MH 137	GM 660	15.786	18.328	23.166	99.869	100.354	101.017
BASIN_297	MH 166	GM 771	37.681	44.850	54.914	94.790	95.364	95.696
BASIN_298	IN 3047	GM 1455	7.734	9.394	11.901	88.642	89.498	90.154
BASIN_304	MH 765	GM 3080	126.427	153.089	186.744	122.264	122.674	123.189
BASIN_312	IN 4189	GM 3924	0.424	0.106	0.106	110.991	111.112	111.296
BASIN_314	MH 153	GM 3699	44.355	52.372	66.109	96.913	98.031	98.737
BASIN_315	IN 4171	GM 784	48.205	57.492	70.382	94.770	95.335	95.653
BASIN_316	MH 454	GM 2223	48.099	58.305	78.399	108.862	109.144	109.760
BASIN_320	IN 3858	GM 3061	12.148	22.813	38.034	111.280	111.808	114.482
BASIN_321	IN 3859	GM 3062	12.325	22.778	38.281	110.423	110.991	113.442
BASIN_322	IN 939	GM 2965	27.228	27.510	27.899	109.849	109.967	110.144
BASIN_323	IN 1176	GM 3057	12.819	23.414	34.926	107.254	108.789	111.886
BASIN_324	IN 3855	GM 3058	16.245	26.627	31.042	105.377	106.946	107.710
BASIN_325	IN 1220	GM 2955	16.209	17.198	17.657	116.923	117.211	117.418
BASIN_326	IN 4224	CU 132	2.543	2.825	3.037	119.131	119.088	119.157
BASIN_327	IN 4229	GM 3882	41.883	42.413	42.766	119.888	120.069	120.256
BASIN_328	IN 3880	GM 3105	3.178	3.779	4.591	116.371	116.998	117.677
BASIN_329	MH 664	GM 3302	60.847	62.578	64.379	111.873	112.277	112.484
BASIN_330	IN 3865	GM 3076	40.117	49.370	52.937	123.701	124.544	125.384
BASIN_331	MH 753	GM 2559	104.249	126.850	157.927	123.255	123.885	124.885
BASIN_332	IN 3670	GM 2718	45.167	50.500	56.433	120.673	120.869	121.083
BASIN_333	MH 638	GM 3099	36.551	36.727	36.763	120.597	120.774	120.860
BASIN_334	IN 2432	GM 2460	31.006	36.056	36.763	126.007	127.759	128.632
BASIN_335	IN 4177	GM 2544	15.115	18.116	20.906	126.532	126.798	127.231
BASIN_336	IN 3600	GM 2546	22.495	28.499	26.521	124.865	126.877	127.592
BASIN_337	MH 550	GM 2611	93.301	118.269	138.363	139.820	142.605	143.402
BASIN_338	MH 533	GM 2556	75.750	90.759	112.407	126.286	126.634	127.178
BASIN_339	MH 315	GM 1420	33.831	40.223	50.359	89.741	91.483	93.005
BASIN_340	MH 323	GM 1468	23.237	29.912	29.947	100.020	101.699	102.001
BASIN_341	MH 649	GM 3158	174.101	187.662	197.480	98.661	99.764	100.230
BASIN_342	MH 661	GM 3494	14.196	16.951	20.977	99.593	100.427	100.994
BASIN_343	IN 4031	GM 3474	57.104	63.249	67.486	98.757	99.350	99.528
BASIN_344	IN 4027	GM 3471	110.782	122.507	129.322	99.259	99.961	100.210

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_345	MH 687	GM 3486	46.156	52.831	58.340	98.448	98.917	99.094
BASIN_346	MH 691	GM 3459	18.010	21.330	23.908	98.845	99.911	100.712
BASIN_347	MH 692	GM 3461	4.732	5.650	6.992	98.852	100.108	100.722
BASIN_348	MH 723	GM 3215	82.036	82.389	84.755	107.575	108.806	108.980
BASIN_349	IN 4184	GM 3187	127.627	131.512	132.465	106.772	108.314	109.019
BASIN_350	MH 13665	OD 217	119.293	123.425	133.737	107.720	107.858	108.051
BASIN_351	IN 3945	GM 3919	10.983	12.925	15.786	112.064	112.188	112.356
BASIN_352	MH 1182	GM 3233	21.507	23.096	26.733	107.421	111.234	110.827
BASIN_353	MH 13661	OD 356	123.778	129.358	124.096	115.827	115.860	115.922
BASIN_354	MH 673	GM 3337	18.964	23.873	29.029	117.234	117.392	117.740
BASIN_355	MH 576	GM 2715	62.507	66.215	70.276	116.325	116.375	116.506
BASIN_356	MH 562	GM 2650	15.327	13.066	12.148	118.127	120.778	120.827
BASIN_357	IN 3873	GM 3093	33.337	33.902	34.644	121.509	121.575	121.699
BASIN_358	IN 3655	GM 2694	24.579	27.298	28.464	123.973	124.259	124.308
BASIN_359	IN 2568	GM 2677	18.717	22.213	23.908	123.763	127.126	126.972
BASIN_360	IN 3137	GM 1587	22.001	21.542	21.365	147.753	147.979	148.504
BASIN_361	IN 2996	GM 1261	42.766	44.885	46.439	146.007	146.555	147.411
BASIN_362	IN 2641	GM 1577	29.558	35.244	39.446	135.830	136.647	137.694
BASIN_363	IN 3121	GM 1567	27.722	33.125	42.695	135.564	135.879	136.962
BASIN_364	MH 274	GM 1281	22.213	22.319	22.389	139.419	139.475	139.531
BASIN_365	MH 341	GM 1572	141.223	158.845	180.493	129.760	130.135	130.732
BASIN_367	MH 294	GM 1315	23.520	28.817	30.971	109.892	110.581	110.955
BASIN_368	IN 1317	GM 1334	8.334	9.888	12.148	109.698	110.141	110.564
BASIN_369	MH 350	GM 1672	60.423	62.118	68.510	100.696	102.221	102.313
BASIN_370	IN 4236	CU 57	29.664	28.570	28.499	119.911	120.512	121.007
BASIN_371	MH 336	GM 1527	51.489	67.557	73.737	118.015	120.098	122.244
BASIN_372	MH 594	GM 2787	62.083	82.001	109.511	113.776	115.144	116.903
BASIN_373	MH 284	GM 1293	32.807	48.946	49.476	120.226	124.708	125.827
BASIN_374	IN 2985	GM 1249	20.306	22.389	23.555	153.278	154.498	155.121
BASIN_375	IN 2989	GM 1253	22.884	29.241	38.140	156.512	156.716	157.001
BASIN_376	MH 12382	GM 1592	7.699	9.146	11.830	124.911	127.090	128.730
BASIN_379	IN 2262	GM 2262	18.434	19.176	28.923	138.068	138.373	141.001
BASIN_380	MH 9583	GM 2271	1.872	2.825	4.097	138.222	138.560	139.026
BASIN_381	MH 475	GM 2302	16.492	20.129	31.183	138.504	139.409	141.083
BASIN_382	MH 380	GM 4014	56.892	57.069	61.907	120.003	122.736	123.435
BASIN_383	MH 215	GM 974	33.231	32.772	34.820	128.241	128.698	130.863

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_384	IN 2038	GM 924	27.192	28.110	29.311	133.612	133.825	136.201
BASIN_385	MH 206	GM 934	42.554	43.331	43.049	131.319	131.680	131.988
BASIN_386	MH 81	GM 294	7.310	8.970	11.230	125.571	126.542	127.234
BASIN_387	IN 1937	GM 292	9.959	11.336	15.362	125.551	126.519	127.182
BASIN_388	IN 2693	GM 175	77.374	89.028	99.164	125.984	126.811	127.405
BASIN_389	IN 12726	OD 374	148.428	159.622	175.690	130.722	130.784	130.853
BASIN_392	IN 2556	GM 1371	19.105	18.858	18.364	121.309	114.570	114.311
BASIN_393	IN 4191	GM 3842	37.292	45.803	57.634	114.127	115.233	117.497
BASIN_394	MH 305	GM 3835	36.374	43.260	52.195	111.690	111.939	112.405
BASIN_396	IN 3658	GM 2701	9.323	12.325	13.631	123.097	123.852	124.157
BASIN_397	MH 28	GM 126	11.760	11.972	11.830	139.134	139.524	139.137
BASIN_398	IN 2684	GM 165	7.451	8.829	10.806	130.036	130.118	130.230
BASIN_399	MH 13595	GM 154	24.862	25.391	24.508	134.688	135.069	135.164
BASIN_400	IN 2694	GM 182	23.696	28.781	37.398	125.456	126.312	126.962
BASIN_401	IN 32	GM 250	12.219	16.386	16.174	133.005	134.360	135.344
BASIN_402	IN 2054	GM 242	19.176	22.637	24.614	133.488	134.865	137.090
BASIN_403	MH 738	GM 584	104.602	146.521	164.814	138.973	141.903	144.127
BASIN_405	IN 3	GM 43	47.463	47.675	47.957	130.207	130.262	130.335
BASIN_406	IN 849	GM 59	67.628	69.323	71.230	127.844	127.185	127.536
BASIN_407	IN 1854	GM 394	6.604	7.981	10.135	113.780	113.848	113.927
BASIN_409	IN 867	GM 107	21.295	25.462	31.359	114.373	115.194	116.631
BASIN_410	MH 776	GM 3869	211.076	214.784	210.864	122.438	122.674	122.812
BASIN_411	IN 43	GM 302	4.061	4.838	6.074	127.293	128.045	128.885
BASIN_412	MH 95	GM 3978	136.244	170.923	186.815	117.388	118.501	119.196
BASIN_413	MH 95	GM 3978	136.244	170.923	186.815	117.388	118.501	119.196
BASIN_414	IN 2039	GM 940	11.760	12.290	11.901	133.301	133.563	133.694
BASIN_415	IN 2040	GM 937	14.020	16.739	19.423	131.234	132.008	133.202
BASIN_416	MH 213	GM 963	13.455	16.457	20.483	131.936	133.196	133.323
BASIN_417	IN 2349	GM 2304	7.310	8.829	25.956	138.143	138.825	143.465
BASIN_418	IN 3481	GM 2299	5.085	6.604	7.805	125.367	127.608	129.446
BASIN_419	MH 386	GM 1876	65.473	68.793	76.456	116.178	118.917	118.937
BASIN_422	MH 422	GM 2074	9.606	10.241	11.336	116.070	119.357	120.755
BASIN_423	MH 117	GM 557	15.786	18.858	25.179	104.954	107.300	112.014
BASIN_424	IN 3352	GM 1999	114.031	118.410	126.038	147.979	148.114	148.274
BASIN_425	MH 401	GM 1949	42.166	41.318	43.296	168.022	168.212	168.320
BASIN_426	MH 398	GM 1951	45.415	51.630	52.689	172.241	173.757	174.639

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_427	MH 516	GM 2446	35.915	44.779	45.450	181.965	184.524	185.066
BASIN_428	MH 507	GM 2421	85.214	84.614	83.872	162.297	162.533	162.372
BASIN_429	MH 496	GM 2393	58.269	70.100	71.300	147.054	151.709	152.228
BASIN_430	MH 499	GM 2405	11.654	10.383	9.676	151.424	149.101	149.226
BASIN_431	MH 500	GM 2413	21.648	21.577	21.542	148.852	149.035	149.403
BASIN_432	MH 504	GM 2419	110.817	120.035	112.618	154.751	154.997	155.108
BASIN_433	MH 612	GM 2931	132.889	146.026	145.214	138.812	140.249	140.722
BASIN_434	IN 3493	GM 3956	19.317	19.317	19.388	129.833	129.888	129.954
BASIN_435	MH 629	GM 3023	158.139	188.933	202.494	130.062	131.447	133.268
BASIN_436	IN 3820	GM 3014	83.272	98.740	110.994	125.600	126.421	128.665
BASIN_437	MH 13184	GM 2999	34.467	36.974	36.692	120.299	122.369	123.068
BASIN_438	MH 248	GM 1139	13.102	13.843	13.914	139.203	139.406	139.603
BASIN_439	IN 2593	GM 1144	7.063	8.440	10.559	136.496	139.075	142.615
BASIN_440	MH 142	GM 679	49.017	57.457	67.769	99.012	99.642	100.364
BASIN_441	IN 1901	GM 624	3.531	4.167	5.191	101.824	101.886	101.982
BASIN_442	MH 136	GM 638	5.403	6.392	7.910	102.579	102.651	102.759
BASIN_446	IN 4155	GM 3134	37.681	43.331	50.924	114.209	114.383	114.642
BASIN_447	IN 3881	GM 3107	2.684	3.178	4.450	116.224	116.906	117.664
BASIN_448	IN 4229	GM 3882	41.883	42.413	42.766	119.888	120.069	120.256
BASIN_449	MH 642	GM 3112	10.453	11.830	16.103	116.099	116.699	117.638
BASIN_450	IN 4159	GM 3604	6.674	18.258	26.804	91.768	92.959	93.593
BASIN_451	MH 12782	GM 4001	98.351	114.349	130.806	88.678	90.049	90.351
BASIN_452	MH 311	GM 1407	78.399	91.606	106.015	89.167	90.994	92.123
BASIN_453	MH 315	GM 1420	33.831	40.223	50.359	89.741	91.483	93.005
BASIN_454	MH 329	GM 1489	19.882	23.767	24.897	91.129	93.570	94.285
BASIN_455	MH 683	GM 3417	177.209	192.853	205.108	96.309	97.195	97.461
BASIN_457	MH 679	GM 3999	19.776	23.025	28.287	100.636	101.398	102.221
BASIN_458	IN 2381	GM 1676	74.655	78.399	88.428	100.682	102.044	102.300
BASIN_459	IN 3973	GM 3410	11.053	13.031	15.998	101.736	104.209	105.883
BASIN_460	IN 3936	GM 3232	13.843	17.057	19.458	108.570	111.680	112.467
BASIN_462	MH 757	GM 2712	50.182	50.500	50.641	119.501	119.619	119.724
BASIN_463	IN 1336	GM 1687	43.084	41.954	43.013	106.083	107.057	107.434
BASIN_464	MH 292	GM 1324	56.963	55.303	56.857	107.421	107.835	108.153
BASIN_466	MH 300	GM 1359	24.014	28.358	35.915	106.444	106.608	106.896
BASIN_467	MH 538	GM 3905	21.824	27.404	33.690	129.531	129.744	132.277
BASIN_468	IN 2571	GM 2689	0.459	0.424	6.427	125.112	128.921	128.537

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_469	IN 2499	GM 2658	16.386	16.527	16.633	120.390	120.584	120.482
BASIN_471	IN 2610	GM 1615	28.287	31.819	33.196	121.903	125.305	124.416
BASIN_472	MH 581	GM 2747	15.574	14.973	15.538	118.497	118.609	121.047
BASIN_473	IN 2988	GM 1252	1.059	0.918	0.883	155.948	155.978	156.017
BASIN_474	IN 1801	GM 1570	108.239	123.884	144.119	134.452	134.734	135.528
BASIN_475	IN 2990	GM 1568	79.705	90.582	104.355	142.736	142.969	143.353
BASIN_476	MH 271	GM 1270	38.316	39.835	41.106	144.600	145.003	145.341
BASIN_477	IN 3143	GM 1590	21.471	25.179	25.992	146.493	146.890	147.185
BASIN_478	MH 3183	GM 1268	0.565	0.459	0.388	145.118	146.624	148.819
BASIN_479	MH 275	GM 1273	48.770	51.383	53.996	143.107	143.504	143.875
BASIN_480	IN 3703	GM 3808	9.429	11.089	13.737	116.407	116.545	116.690
BASIN_481	IN 4237	CU 180	63.920	74.726	83.131	119.751	120.308	120.801
BASIN_482	IN 4236	CU 57	29.664	28.570	28.499	119.911	120.512	121.007
BASIN_483	MH 283	GM 1297	36.621	37.080	37.928	126.283	126.335	126.440
BASIN_484	IN 2494	GM 3929	12.219	14.550	30.053	112.306	112.605	113.379
BASIN_485	IN 2560	GM 4011	0.071	1.059	3.072	113.432	113.819	114.232
BASIN_486	IN 1665	GM 1720	15.150	12.819	15.892	114.882	116.919	117.411
BASIN_487	MH 302	GM 1368	17.693	8.899	8.440	116.119	117.067	116.214
BASIN_488	IN 2708	GM 3620	2.755	13.278	28.958	123.337	123.678	123.829
BASIN_490	MH 739	GM 897	129.923	163.048	171.629	134.423	136.650	137.953
BASIN_492	MH 586	GM 2810	188.157	229.863	236.396	119.970	121.030	121.496
BASIN_493	MH 339	GM 2808	166.261	197.939	204.754	120.636	121.923	122.372
BASIN_494	IN 2984	GM 1248	16.563	17.622	17.728	153.196	153.186	152.831
BASIN_495	IN 3456	GM 3959	32.172	32.666	33.125	132.211	132.244	132.339
BASIN_496	MH 468	GM 2269	27.651	29.276	32.066	135.610	135.797	136.060
BASIN_497	MH 326	GM 1475	29.770	35.774	35.986	90.374	92.657	93.694
BASIN_498	MH 326	GM 1475	29.770	35.774	35.986	90.374	92.657	93.694
BASIN_499	IN 2073	GM 1485	35.527	42.801	43.967	90.085	92.264	93.360
BASIN_500	MH 410	GM 1985	50.712	61.659	65.897	176.660	177.881	178.376
BASIN_501	IN 2058	GM 243	8.546	10.171	13.773	133.891	135.505	136.220
BASIN_502	IN 2918	GM 1091	1.836	2.260	2.755	153.524	154.327	155.223
BASIN_503	IN 1293	GM 2063	2.613	3.072	10.383	151.916	152.871	154.216
BASIN_504	IN 8	GM 46	48.522	49.405	49.511	129.354	129.390	129.498
BASIN_506	MH 13626	GM 2163	21.118	19.494	27.722	108.271	109.291	109.921
BASIN_507	IN 1377	GM 3566	6.957	7.593	9.182	103.212	103.750	104.521
BASIN_508	IN 3677	GM 2740	71.936	63.390	74.337	113.228	114.386	115.197

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_509	IN 3205	GM 3927	26.203	26.380	33.867	114.829	115.551	116.060
BASIN_510	MH 2783	GM 1713	9.535	11.301	29.346	112.306	112.641	113.720
BASIN_511	MH 278	GM 1290	10.736	15.256	24.650	123.606	125.853	128.360
BASIN_512	MH 13601	GM 2807	12.855	15.856	19.564	113.862	114.698	114.970
BASIN_513	MH 4389	MH 4389 Dummy Link	14.656	17.234	21.259	116.191	117.228	117.566
BASIN_515	MH 297	GM 1347	13.737	16.315	21.048	106.919	107.129	107.585
BASIN_516	MH 756	GM 2562	13.455	17.057	21.966	132.513	132.690	133.806
BASIN_517	MH 13658	OD 186	109.193	128.122	139.740	132.756	132.972	133.091
BASIN_518	IN 1807	GM 23	41.036	42.907	44.143	132.034	133.153	132.326
BASIN_519	MH 40	GM 164	34.856	42.695	52.019	127.349	128.967	130.102
BASIN_520	IN 2061	GM 799	20.094	23.802	30.123	135.282	137.707	138.839
BASIN_521	IN 4200	GM 3868	212.877	218.880	216.196	123.219	123.494	123.586
BASIN_522	MH 777	GM 3871	276.231	291.240	296.255	121.749	121.985	122.149
BASIN_523	MH 86	GM 323	127.733	160.152	169.652	121.506	124.560	125.856
BASIN_524	MH 492	GM 2383	74.902	91.606	95.985	143.921	147.372	147.733
BASIN_525	MH 113	GM 469	53.007	59.752	68.263	112.192	112.451	112.822
BASIN_527	MH 604	GM 2862	67.204	70.982	73.172	119.341	120.925	122.297
BASIN_528	MH 605	GM 2866	1.377	1.872	1.978	119.455	121.260	122.333
BASIN_529	MH 601	GM 2853	81.648	90.653	95.738	116.079	117.536	118.743
BASIN_530	IN 12728	OD 353	2.578	3.072	3.814	120.187	120.220	120.266
BASIN_531	MH 435	GM 3938	0	0	0	104.255	105.167	106.647
BASIN_532	IN 1975	GM 3716	106.050	110.641	112.442	94.875	95.167	95.315
BASIN_533	IN 1958	GM 1448	11.371	14.373	18.116	88.635	89.600	90.148
BASIN_535	IN 3244	GM 3947	1.201	1.377	1.730	112.208	113.353	114.022
BASIN_536	IN 2221	GM 1779	11.972	14.126	17.304	112.224	113.517	114.052
BASIN_538	MH 1584	GM 3891	32.525	34.432	34.291	129.790	130.223	130.564
BASIN_539	MH 13659	OD 185	34.926	37.787	39.305	126.293	126.407	126.490
BASIN_540	MH 334	GM 1512	19.176	22.389	22.778	101.440	103.576	103.953
BASIN_541	IN 2169	GM 1088	31.607	30.971	36.127	97.559	97.152	99.308
BASIN_542	MH 575	GM 2713	50.500	50.641	50.712	117.484	117.575	117.723
BASIN_543	IN 1288	GM 2047	14.126	17.340	21.930	138.717	139.698	141.539
BASIN_544	MH 66	GM 247	8.511	9.994	12.996	133.474	134.839	136.024
BASIN_545	MH 13599	GM 249	19.953	19.917	19.917	133.156	134.488	135.436
BASIN_546	IN 89	GM 4010	23.096	24.932	25.638	146.778	148.025	147.349
BASIN_548	MH 145	GM 690	8.122	12.855	13.561	98.907	99.993	100.092
BASIN_549	IN 3986	GM 4027	15.397	17.905	21.860	100.942	103.140	104.357

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_554	MH 714	GM 3675	12.925	15.362	18.293	110.968	112.139	113.812
BASIN_555	MH 699	GM 3554	29.382	36.657	41.883	105.223	109.291	109.751
BASIN_556	MH 697	GM 3532	32.489	41.883	48.416	104.738	107.372	107.552

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Table 6E-2. Summary of Peak Discharge and Maximum HGL for Sub-Basin Connection Points (Sorted by Sub-Basin Connection Node)

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_405	IN 3	GM 43	47.463	47.675	47.957	130.207	130.262	130.335
BASIN_504	IN 8	GM 46	48.522	49.405	49.511	129.354	129.390	129.498
BASIN_401	IN 32	GM 250	12.219	16.386	16.174	133.005	134.360	135.344
BASIN_411	IN 43	GM 302	4.061	4.838	6.074	127.293	128.045	128.885
BASIN_6	IN 77	GM 3903	11.089	13.384	16.492	119.823	119.987	120.259
BASIN_546	IN 89	GM 4010	23.096	24.932	25.638	146.778	148.025	147.349
BASIN_203	IN 123	GM 965	9.817	11.866	14.691	135.092	135.384	135.430
BASIN_124	IN 264	GM 119	7.204	8.476	10.559	136.348	137.110	137.398
BASIN_96	IN 339	GM 514	12.466	15.150	18.823	109.993	110.919	112.343
BASIN_252	IN 346	GM 517	16.492	20.518	26.451	109.190	109.764	110.558
BASIN_213	IN 383	GM 118	58.199	72.360	57.881	139.993	145.020	139.288
BASIN_26	IN 424	GM 741	21.789	25.886	31.571	92.503	93.510	95.259
BASIN_268	IN 793	GM 3857	6.215	7.169	9.111	108.271	109.298	109.925
BASIN_31	IN 815	GM 900	7.734	9.217	11.442	134.564	136.329	137.730
BASIN_406	IN 849	GM 59	67.628	69.323	71.230	127.844	127.185	127.536
BASIN_409	IN 867	GM 107	21.295	25.462	31.359	114.373	115.194	116.631
BASIN_103	IN 892	GM 3421	109.370	107.498	113.537	95.085	95.571	95.797
BASIN_322	IN 939	GM 2965	27.228	27.510	27.899	109.849	109.967	110.144
BASIN_323	IN 1176	GM 3057	12.819	23.414	34.926	107.254	108.789	111.886
BASIN_265	IN 1198	GM 3935	6.569	7.840	9.959	118.383	119.131	119.390
BASIN_325	IN 1220	GM 2955	16.209	17.198	17.657	116.923	117.211	117.418
BASIN_543	IN 1288	GM 2047	14.126	17.340	21.930	138.717	139.698	141.539
BASIN_503	IN 1293	GM 2063	2.613	3.072	10.383	151.916	152.871	154.216
BASIN_368	IN 1317	GM 1334	8.334	9.888	12.148	109.698	110.141	110.564
BASIN_184	IN 1330	GM 1685	28.852	28.464	28.005	108.297	110.098	108.930
BASIN_463	IN 1336	GM 1687	43.084	41.954	43.013	106.083	107.057	107.434
BASIN_183	IN 1341	GM 1677	8.652	10.029	12.466	107.602	108.009	108.356
BASIN_507	IN 1377	GM 3566	6.957	7.593	9.182	103.212	103.750	104.521
BASIN_220	IN 1471	GM 2020	11.336	13.490	16.598	153.517	153.704	153.793
BASIN_486	IN 1665	GM 1720	15.150	12.819	15.892	114.882	116.919	117.411
BASIN_474	IN 1801	GM 1570	108.239	123.884	144.119	134.452	134.734	135.528
BASIN_518	IN 1807	GM 23	41.036	42.907	44.143	132.034	133.153	132.326
BASIN_1	IN 1811	GM 34	1.165	1.942	3.567	135.469	133.140	133.573
BASIN_407	IN 1854	GM 394	6.604	7.981	10.135	113.780	113.848	113.927
BASIN_216	IN 1858	GM 174	16.209	18.999	22.955	125.945	126.368	127.064

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_291	IN 1883	GM 633	14.055	16.527	18.787	99.455	99.715	101.260
BASIN_441	IN 1901	GM 624	3.531	4.167	5.191	101.824	101.886	101.982
BASIN_387	IN 1937	GM 292	9.959	11.336	15.362	125.551	126.519	127.182
BASIN_134	IN 1941	GM 186	12.890	15.115	18.752	127.543	128.074	129.646
BASIN_533	IN 1958	GM 1448	11.371	14.373	18.116	88.635	89.600	90.148
BASIN_15	IN 1974	GM 736	134.796	140.941	140.941	93.163	93.455	93.642
BASIN_532	IN 1975	GM 3716	106.050	110.641	112.442	94.875	95.167	95.315
BASIN_17	IN 1992	GM 722	28.358	34.714	45.485	102.556	106.089	107.425
BASIN_290	IN 1992	GM 722	28.358	34.714	45.485	102.556	106.089	107.425
BASIN_384	IN 2038	GM 924	27.192	28.110	29.311	133.612	133.825	136.201
BASIN_414	IN 2039	GM 940	11.760	12.290	11.901	133.301	133.563	133.694
BASIN_415	IN 2040	GM 937	14.020	16.739	19.423	131.234	132.008	133.202
BASIN_199	IN 2048	GM 906	7.699	9.041	11.477	133.947	136.257	137.497
BASIN_402	IN 2054	GM 242	19.176	22.637	24.614	133.488	134.865	137.090
BASIN_501	IN 2058	GM 243	8.546	10.171	13.773	133.891	135.505	136.220
BASIN_520	IN 2061	GM 799	20.094	23.802	30.123	135.282	137.707	138.839
BASIN_95	IN 2073	GM 1485	35.527	42.801	43.967	90.085	92.264	93.360
BASIN_499	IN 2073	GM 1485	35.527	42.801	43.967	90.085	92.264	93.360
BASIN_25	IN 2114	GM 1461	12.925	15.362	18.717	94.823	95.787	96.706
BASIN_240	IN 2126	GM 1814	3.920	4.485	5.792	112.520	113.973	114.590
BASIN_152	IN 2127	GM 1795	65.262	82.177	90.123	112.290	115.121	115.751
BASIN_34	IN 2154	GM 954	4.873	5.862	7.310	132.067	132.700	133.806
BASIN_541	IN 2169	GM 1088	31.607	30.971	36.127	97.559	97.152	99.308
BASIN_104	IN 2193	GM 3153	165.131	174.419	180.281	100.220	101.368	101.965
BASIN_105	IN 2193	GM 3153	165.131	174.419	180.281	100.220	101.368	101.965
BASIN_159	IN 2218	GM 2138	13.066	15.609	19.494	103.369	104.226	105.026
BASIN_536	IN 2221	GM 1779	11.972	14.126	17.304	112.224	113.517	114.052
BASIN_40	IN 2230	GM 2871	18.505	21.966	21.118	119.980	121.860	122.825
BASIN_379	IN 2262	GM 2262	18.434	19.176	28.923	138.068	138.373	141.001
BASIN_56	IN 2276	GM 3885	6.145	7.134	8.829	100.630	101.388	102.211
BASIN_93	IN 2310	GM 3455	14.302	16.916	20.659	98.852	100.236	100.840
BASIN_154	IN 2340	GM 3033	172.971	202.742	229.475	120.643	123.625	125.886
BASIN_417	IN 2349	GM 2304	7.310	8.829	25.956	138.143	138.825	143.465
BASIN_130	IN 2353	GM 2012	42.307	44.708	48.134	150.551	151.017	151.640
BASIN_58	IN 2380	GM 1625	14.726	17.445	21.118	103.130	103.304	103.428
BASIN_458	IN 2381	GM 1676	74.655	78.399	88.428	100.682	102.044	102.300

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_60	IN 2390	GM 3507	13.314	16.174	20.306	103.888	104.596	105.682
BASIN_166	IN 2419	GM 3132	15.786	18.964	23.484	116.519	117.028	117.674
BASIN_111	IN 2425	GM 2995	11.230	13.066	13.985	127.477	130.016	130.210
BASIN_334	IN 2432	GM 2460	31.006	36.056	36.763	126.007	127.759	128.632
BASIN_273	IN 2451	GM 1188	14.867	19.564	21.754	132.986	134.810	136.115
BASIN_221	IN 2463	GM 2026	15.715	19.211	23.943	152.083	152.887	153.281
BASIN_484	IN 2494	GM 3929	12.219	14.550	30.053	112.306	112.605	113.379
BASIN_469	IN 2499	GM 2658	16.386	16.527	16.633	120.390	120.584	120.482
BASIN_45	IN 2517	GM 2470	31.713	38.599	48.381	128.350	128.563	128.825
BASIN_44	IN 2518	GM 2494	14.302	17.092	20.765	132.543	133.924	136.207
BASIN_279	IN 2529	GM 2518	33.902	34.750	34.043	135.410	136.388	137.274
BASIN_245	IN 2533	GM 1168	88.322	104.108	103.613	140.915	142.654	142.907
BASIN_120	IN 2536	GM 1184	8.299	10.383	13.066	133.944	136.020	137.897
BASIN_392	IN 2556	GM 1371	19.105	18.858	18.364	121.309	114.570	114.311
BASIN_485	IN 2560	GM 4011	0.071	1.059	3.072	113.432	113.819	114.232
BASIN_359	IN 2568	GM 2677	18.717	22.213	23.908	123.763	127.126	126.972
BASIN_468	IN 2571	GM 2689	0.459	0.424	6.427	125.112	128.921	128.537
BASIN_66	IN 2591	GM 2486	12.855	15.680	17.763	141.181	142.113	144.957
BASIN_439	IN 2593	GM 1144	7.063	8.440	10.559	136.496	139.075	142.615
BASIN_156	IN 2596	GM 1137	14.479	15.327	17.128	140.325	141.089	141.690
BASIN_471	IN 2610	GM 1615	28.287	31.819	33.196	121.903	125.305	124.416
BASIN_362	IN 2641	GM 1577	29.558	35.244	39.446	135.830	136.647	137.694
BASIN_133	IN 2646	GM 14	55.409	57.810	58.516	130.476	130.558	131.106
BASIN_223	IN 2656	GM 51	60.035	61.589	61.059	128.583	128.796	129.045
BASIN_11	IN 2670	GM 87	21.436	21.507	21.330	123.248	123.228	124.180
BASIN_247	IN 2673	GM 94	55.338	51.665	48.911	116.959	117.438	117.963
BASIN_398	IN 2684	GM 165	7.451	8.829	10.806	130.036	130.118	130.230
BASIN_121	IN 2686	GM 163	12.784	21.153	32.419	127.372	129.022	130.335
BASIN_4	IN 2692	GM 219	91.783	106.403	122.153	125.377	126.089	126.588
BASIN_388	IN 2693	GM 175	77.374	89.028	99.164	125.984	126.811	127.405
BASIN_400	IN 2694	GM 182	23.696	28.781	37.398	125.456	126.312	126.962
BASIN_227	IN 2707	GM 287	9.535	11.336	8.334	124.711	123.323	128.435
BASIN_488	IN 2708	GM 3620	2.755	13.278	28.958	123.337	123.678	123.829
BASIN_27	IN 2713	#N/A	#N/A	#N/A	#N/A	124.386	126.175	127.382
BASIN_137	IN 2719	GM 328	12.501	14.726	18.258	120.715	122.461	123.402
BASIN_136	IN 2729	GM 349	12.996	15.715	19.458	119.147	120.965	122.605

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_232	IN 2730	GM 350	10.842	12.996	16.139	119.459	120.981	122.874
BASIN_140	IN 2742	GM 368	16.845	19.812	19.564	118.593	119.623	119.925
BASIN_234	IN 2757	GM 404	18.787	22.990	28.570	119.163	120.187	121.824
BASIN_289	IN 2809	GM 719	27.828	34.608	38.387	103.668	107.589	108.743
BASIN_98	IN 2810	GM 564	11.901	14.373	17.445	104.042	108.209	110.157
BASIN_8	IN 2813	GM 502	15.644	18.717	22.778	101.558	102.136	104.449
BASIN_16	IN 2828	GM 3694	39.129	45.874	57.351	97.375	98.563	99.738
BASIN_293	IN 2829	GM 3708	15.362	18.152	22.178	95.052	95.351	95.561
BASIN_292	IN 2831	GM 733	16.739	19.847	24.155	98.606	100.056	101.854
BASIN_30	IN 2846	GM 791	10.135	12.148	15.009	135.554	137.628	139.150
BASIN_113	IN 2866	GM 854	10.171	12.290	15.221	135.758	136.175	136.617
BASIN_33	IN 2884	GM 946	6.145	7.416	8.899	129.987	130.420	130.892
BASIN_35	IN 2890	GM 968	10.630	10.277	12.784	128.570	129.186	129.009
BASIN_39	IN 2912	GM 3960	29.558	35.809	43.755	119.485	120.518	120.728
BASIN_502	IN 2918	GM 1091	1.836	2.260	2.755	153.524	154.327	155.223
BASIN_82	IN 2924	GM 1103	31.924	32.701	34.891	176.047	175.820	178.304
BASIN_81	IN 2926	GM 1110	22.637	28.146	33.337	183.025	183.622	187.129
BASIN_80	IN 2928	GM 1109	13.702	17.481	23.484	188.189	188.356	190.446
BASIN_67	IN 2934	GM 1140	94.679	119.328	153.866	140.787	141.594	145.807
BASIN_52	IN 2953	GM 1204	15.291	18.258	19.847	123.114	126.125	127.169
BASIN_494	IN 2984	GM 1248	16.563	17.622	17.728	153.196	153.186	152.831
BASIN_374	IN 2985	GM 1249	20.306	22.389	23.555	153.278	154.498	155.121
BASIN_473	IN 2988	GM 1252	1.059	0.918	0.883	155.948	155.978	156.017
BASIN_375	IN 2989	GM 1253	22.884	29.241	38.140	156.512	156.716	157.001
BASIN_475	IN 2990	GM 1568	79.705	90.582	104.355	142.736	142.969	143.353
BASIN_182	IN 2994	GM 1258	10.630	12.890	16.139	157.723	158.294	159.377
BASIN_361	IN 2996	GM 1261	42.766	44.885	46.439	146.007	146.555	147.411
BASIN_194	IN 3011	GM 3926	67.592	67.098	70.806	103.799	104.491	105.240
BASIN_192	IN 3022	GM 1339	10.665	12.572	15.397	109.180	109.436	110.518
BASIN_298	IN 3047	GM 1455	7.734	9.394	11.901	88.642	89.498	90.154
BASIN_54	IN 3106	GM 1535	14.620	17.445	21.507	123.999	124.203	124.459
BASIN_363	IN 3121	GM 1567	27.722	33.125	42.695	135.564	135.879	136.962
BASIN_65	IN 3122	GM 1563	8.299	9.994	12.537	135.912	136.263	137.523
BASIN_64	IN 3127	GM 1575	14.867	17.869	22.248	137.972	138.622	141.155
BASIN_62	IN 3129	GM 1579	18.752	22.672	27.475	140.059	142.828	145.069
BASIN_360	IN 3137	GM 1587	22.001	21.542	21.365	147.753	147.979	148.504

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_181	IN 3139	GM 1588	21.471	21.224	21.083	147.444	147.769	148.524
BASIN_477	IN 3143	GM 1590	21.471	25.179	25.992	146.493	146.890	147.185
BASIN_55	IN 3155	GM 2812	28.040	30.477	31.501	120.515	121.808	122.008
BASIN_509	IN 3205	GM 3927	26.203	26.380	33.867	114.829	115.551	116.060
BASIN_535	IN 3244	GM 3947	1.201	1.377	1.730	112.208	113.353	114.022
BASIN_28	IN 3281	GM 1856	69.464	76.845	81.259	119.301	119.455	119.606
BASIN_222	IN 3320	GM 1943	29.735	36.904	40.117	179.701	185.200	187.064
BASIN_79	IN 3330	GM 1957	34.714	45.909	59.894	162.260	162.628	162.989
BASIN_132	IN 3346	GM 1982	43.826	52.866	53.431	184.672	189.442	189.977
BASIN_75	IN 3349	GM 1989	26.380	33.937	44.744	202.523	202.766	206.693
BASIN_424	IN 3352	GM 1999	114.031	118.410	126.038	147.979	148.114	148.274
BASIN_84	IN 3364	GM 2025	14.126	17.340	21.719	152.648	153.819	154.721
BASIN_85	IN 3374	GM 2038	22.319	26.663	32.878	139.977	140.755	141.818
BASIN_128	IN 3384	GM 2057	10.700	12.996	16.209	153.802	154.163	155.404
BASIN_129	IN 3385	GM 2684	54.632	59.894	66.886	153.261	153.970	155.318
BASIN_257	IN 3420	GM 2165	15.397	13.843	20.447	108.278	109.308	109.934
BASIN_150	IN 3424	GM 2167	4.873	5.615	6.922	108.284	109.321	109.944
BASIN_495	IN 3456	GM 3959	32.172	32.666	33.125	132.211	132.244	132.339
BASIN_418	IN 3481	GM 2299	5.085	6.604	7.805	125.367	127.608	129.446
BASIN_99	IN 3493	GM 3956	19.317	19.317	19.388	129.833	129.888	129.954
BASIN_434	IN 3493	GM 3956	19.317	19.317	19.388	129.833	129.888	129.954
BASIN_100	IN 3498	GM 2331	29.276	33.514	35.597	135.253	135.617	135.748
BASIN_70	IN 3524	GM 2399	10.700	17.410	21.507	149.777	152.477	155.751
BASIN_146	IN 3538	GM 2423	12.713	15.715	18.540	163.780	165.341	165.381
BASIN_119	IN 3541	GM 2427	21.789	26.486	32.913	165.154	167.900	167.969
BASIN_168	IN 3557	GM 2463	11.089	13.208	16.386	128.993	129.213	130.148
BASIN_278	IN 3574	GM 2513	49.335	51.948	54.420	131.050	132.287	134.163
BASIN_153	IN 3578	GM 2511	6.039	7.028	8.793	130.896	132.162	134.055
BASIN_48	IN 3586	GM 2525	14.196	14.726	14.691	124.311	124.026	123.963
BASIN_336	IN 3600	GM 2546	22.495	28.499	26.521	124.865	126.877	127.592
BASIN_46	IN 3623	GM 2610	88.816	112.018	141.188	139.948	142.815	144.688
BASIN_180	IN 3644	GM 2666	9.500	11.407	14.444	117.867	118.930	119.656
BASIN_61	IN 3647	GM 2674	30.017	37.751	43.790	122.188	123.750	123.799
BASIN_358	IN 3655	GM 2694	24.579	27.298	28.464	123.973	124.259	124.308
BASIN_396	IN 3658	GM 2701	9.323	12.325	13.631	123.097	123.852	124.157
BASIN_173	IN 3659	GM 2703	53.078	53.431	53.502	122.306	122.490	122.579

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_174	IN 3660	GM 2704	61.659	63.284	63.602	121.375	121.749	121.775
BASIN_332	IN 3670	GM 2718	45.167	50.500	56.433	120.673	120.869	121.083
BASIN_176	IN 3675	GM 2729	6.604	8.193	9.888	106.821	109.439	109.938
BASIN_508	IN 3677	GM 2740	71.936	63.390	74.337	113.228	114.386	115.197
BASIN_480	IN 3703	GM 3808	9.429	11.089	13.737	116.407	116.545	116.690
BASIN_148	IN 3729	GM 2845	4.909	5.827	7.063	117.848	117.946	118.438
BASIN_41	IN 3734	GM 2851	13.808	15.821	19.141	115.833	117.283	118.369
BASIN_42	IN 3753	GM 3954	19.847	19.847	19.812	125.335	125.564	125.801
BASIN_102	IN 3778	GM 2924	11.089	5.686	4.626	129.852	129.633	129.347
BASIN_109	IN 3785	GM 4002	7.593	8.440	10.594	109.232	109.738	110.568
BASIN_266	IN 3790	GM 3933	14.126	16.280	18.116	118.068	118.540	118.743
BASIN_43	IN 3800	GM 2982	20.235	22.919	22.955	130.531	132.785	133.035
BASIN_264	IN 3807	GM 2996	15.856	17.869	18.152	126.375	128.793	128.665
BASIN_155	IN 3814	GM 2823	35.421	39.164	40.753	116.864	118.593	120.164
BASIN_282	IN 3820	GM 3014	83.272	98.740	110.994	125.600	126.421	128.665
BASIN_436	IN 3820	GM 3014	83.272	98.740	110.994	125.600	126.421	128.665
BASIN_324	IN 3855	GM 3058	16.245	26.627	31.042	105.377	106.946	107.710
BASIN_88	IN 3857	GM 3060	25.356	30.194	33.266	104.987	105.686	106.181
BASIN_320	IN 3858	GM 3061	12.148	22.813	38.034	111.280	111.808	114.482
BASIN_321	IN 3859	GM 3062	12.325	22.778	38.281	110.423	110.991	113.442
BASIN_330	IN 3865	GM 3076	40.117	49.370	52.937	123.701	124.544	125.384
BASIN_210	IN 3871	GM 3091	14.973	14.267	13.490	124.770	123.530	126.588
BASIN_357	IN 3873	GM 3093	33.337	33.902	34.644	121.509	121.575	121.699
BASIN_328	IN 3880	GM 3105	3.178	3.779	4.591	116.371	116.998	117.677
BASIN_447	IN 3881	GM 3107	2.684	3.178	4.450	116.224	116.906	117.664
BASIN_165	IN 3894	GM 3136	51.348	60.106	71.724	112.493	112.799	113.376
BASIN_163	IN 3930	GM 3202	9.464	11.018	10.806	107.546	109.882	110.203
BASIN_90	IN 3931	GM 3216	72.925	73.525	76.739	110.814	111.542	111.818
BASIN_460	IN 3936	GM 3232	13.843	17.057	19.458	108.570	111.680	112.467
BASIN_351	IN 3945	GM 3919	10.983	12.925	15.786	112.064	112.188	112.356
BASIN_89	IN 3966	GM 3299	53.643	56.539	58.163	114.895	115.148	115.476
BASIN_91	IN 3967	GM 3307	132.289	148.887	172.865	107.949	108.127	108.415
BASIN_459	IN 3973	GM 3410	11.053	13.031	15.998	101.736	104.209	105.883
BASIN_549	IN 3986	GM 4027	15.397	17.905	21.860	100.942	103.140	104.357
BASIN_344	IN 4027	GM 3471	110.782	122.507	129.322	99.259	99.961	100.210
BASIN_343	IN 4031	GM 3474	57.104	63.249	67.486	98.757	99.350	99.528

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_135	IN 4148	GM 308	122.577	154.572	160.364	122.451	126.056	127.208
BASIN_446	IN 4155	GM 3134	37.681	43.331	50.924	114.209	114.383	114.642
BASIN_450	IN 4159	GM 3604	6.674	18.258	26.804	91.768	92.959	93.593
BASIN_226	IN 4166	GM 221	22.601	22.107	21.153	127.234	128.291	127.500
BASIN_233	IN 4167	GM 3966	5.015	6.039	7.593	120.413	120.600	120.827
BASIN_249	IN 4170	GM 465	41.071	46.368	53.007	114.275	114.423	114.616
BASIN_315	IN 4171	GM 784	48.205	57.492	70.382	94.770	95.335	95.653
BASIN_335	IN 4177	GM 2544	15.115	18.116	20.906	126.532	126.798	127.231
BASIN_267	IN 4182	GM 2968	23.555	24.191	27.651	123.048	122.385	122.028
BASIN_164	IN 4184	GM 3187	127.627	131.512	132.465	106.772	108.314	109.019
BASIN_349	IN 4184	GM 3187	127.627	131.512	132.465	106.772	108.314	109.019
BASIN_190	IN 4186	GM 3991	34.573	41.848	52.054	102.684	103.688	104.478
BASIN_312	IN 4189	GM 3924	0.424	0.106	0.106	110.991	111.112	111.296
BASIN_393	IN 4191	GM 3842	37.292	45.803	57.634	114.127	115.233	117.497
BASIN_142	IN 4196	GM 3865	49.087	59.187	66.568	131.982	132.188	132.438
BASIN_521	IN 4200	GM 3868	212.877	218.880	216.196	123.219	123.494	123.586
BASIN_238	IN 4219	CU 207	66.392	72.748	78.858	125.016	125.505	125.889
BASIN_283	IN 4221	GM 3877	214.819	239.010	277.891	115.551	117.162	118.222
BASIN_326	IN 4224	CU 132	2.543	2.825	3.037	119.131	119.088	119.157
BASIN_110	IN 4226	GM 3878	13.384	12.890	18.046	123.038	122.149	123.809
BASIN_327	IN 4229	GM 3882	41.883	42.413	42.766	119.888	120.069	120.256
BASIN_448	IN 4229	GM 3882	41.883	42.413	42.766	119.888	120.069	120.256
BASIN_172	IN 4230	CU 134	136.456	154.608	166.156	100.318	101.079	101.516
BASIN_370	IN 4236	CU 57	29.664	28.570	28.499	119.911	120.512	121.007
BASIN_482	IN 4236	CU 57	29.664	28.570	28.499	119.911	120.512	121.007
BASIN_481	IN 4237	CU 180	63.920	74.726	83.131	119.751	120.308	120.801
BASIN_239	IN 4238	OD 358	33.125	39.376	47.851	125.269	125.344	125.440
BASIN_59	IN 5043	GM 3898	29.099	34.396	42.660	103.189	103.747	104.521
BASIN_72	IN 7044	GM 3912	103.719	108.381	105.944	139.751	140.400	140.200
BASIN_12	IN 10243	GM 3965	13.031	15.574	17.375	114.472	115.066	116.250
BASIN_2	IN 12644	GM 64	85.108	88.958	95.985	123.891	124.190	124.475
BASIN_145	IN 12648	OD 184	1.165	4.450	13.243	157.493	157.904	158.392
BASIN_139	IN 12649	GM 337	129.852	163.224	173.642	119.058	121.132	121.913
BASIN_116	IN 12653	GM 3968	96.727	105.979	111.347	117.461	118.409	119.226
BASIN_108	IN 12655	CU 192	37.999	39.800	40.082	127.060	127.133	127.234
BASIN_117	IN 12676	GM 76	140.588	148.392	156.479	114.698	115.358	115.850

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_147	IN 12687	CU 198	15.115	18.116	22.531	116.073	116.253	116.572
BASIN_248	IN 12690	GM 3984	129.146	137.515	144.825	116.568	117.490	118.228
BASIN_143	IN 12692	OD 373	213.654	241.800	245.260	123.327	123.671	123.770
BASIN_115	IN 12707	CU 201	86.556	98.139	103.719	136.342	136.801	137.057
BASIN_87	IN 12709	GM 2254	34.714	34.785	34.538	128.136	128.501	128.717
BASIN_123	IN 12710	GM 4006	#N/A	#N/A	#N/A	137.579	137.956	138.438
BASIN_389	IN 12726	OD 374	148.428	159.622	175.690	130.722	130.784	130.853
BASIN_530	IN 12728	OD 353	2.578	3.072	3.814	120.187	120.220	120.266
BASIN_251	MH 22	GM 91	24.897	25.144	26.874	121.375	121.670	125.164
BASIN_125	MH 27	GM 124	56.609	62.754	64.131	135.791	136.001	135.928
BASIN_397	MH 28	GM 126	11.760	11.972	11.830	139.134	139.524	139.137
BASIN_214	MH 31	GM 141	15.892	17.092	16.774	138.770	139.058	139.406
BASIN_519	MH 40	GM 164	34.856	42.695	52.019	127.349	128.967	130.102
BASIN_141	MH 42	GM 166	0.530	0.706	0.636	127.467	129.035	130.669
BASIN_126	MH 53	GM 210	33.196	35.738	37.681	137.785	138.150	138.635
BASIN_5	MH 58	GM 216	63.637	57.810	54.526	124.875	125.295	125.495
BASIN_212	MH 61	GM 224	60.353	70.100	79.988	126.841	127.949	128.481
BASIN_544	MH 66	GM 247	8.511	9.994	12.996	133.474	134.839	136.024
BASIN_127	MH 71	GM 271	37.751	47.781	46.368	132.913	134.232	135.236
BASIN_386	MH 81	GM 294	7.310	8.970	11.230	125.571	126.542	127.234
BASIN_230	MH 83	GM 312	125.579	157.821	170.005	121.896	125.131	126.411
BASIN_231	MH 83	GM 312	125.579	157.821	170.005	121.896	125.131	126.411
BASIN_523	MH 86	GM 323	127.733	160.152	169.652	121.506	124.560	125.856
BASIN_29	MH 91	GM 3971	130.911	164.319	179.575	118.871	120.912	121.962
BASIN_412	MH 95	GM 3978	136.244	170.923	186.815	117.388	118.501	119.196
BASIN_413	MH 95	GM 3978	136.244	170.923	186.815	117.388	118.501	119.196
BASIN_525	MH 113	GM 469	53.007	59.752	68.263	112.192	112.451	112.822
BASIN_423	MH 117	GM 557	15.786	18.858	25.179	104.954	107.300	112.014
BASIN_122	MH 125	GM 575	128.439	166.332	179.787	147.743	151.490	154.045
BASIN_286	MH 130	GM 606	29.876	35.315	44.214	99.268	100.633	102.198
BASIN_442	MH 136	GM 638	5.403	6.392	7.910	102.579	102.651	102.759
BASIN_296	MH 137	GM 660	15.786	18.328	23.166	99.869	100.354	101.017
BASIN_13	MH 138	GM 655	25.956	25.674	24.579	99.777	99.747	100.994
BASIN_14	MH 139	GM 654	30.088	29.135	29.029	96.949	97.451	97.854
BASIN_288	MH 142	GM 679	49.017	57.457	67.769	99.012	99.642	100.364
BASIN_440	MH 142	GM 679	49.017	57.457	67.769	99.012	99.642	100.364

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_157	MH 143	GM 676	64.661	73.631	81.047	97.717	98.166	98.333
BASIN_548	MH 145	GM 690	8.122	12.855	13.561	98.907	99.993	100.092
BASIN_9	MH 147	GM 697	21.153	25.038	30.583	101.335	103.488	106.053
BASIN_158	MH 147	GM 697	21.153	25.038	30.583	101.335	103.488	106.053
BASIN_10	MH 149	GM 707	6.604	7.875	9.182	100.981	101.083	101.932
BASIN_287	MH 151	GM 712	15.856	19.317	23.308	100.266	100.630	101.716
BASIN_314	MH 153	GM 3699	44.355	52.372	66.109	96.913	98.031	98.737
BASIN_297	MH 166	GM 771	37.681	44.850	54.914	94.790	95.364	95.696
BASIN_24	MH 167	GM 779	47.357	56.468	69.111	94.787	95.358	95.689
BASIN_197	MH 172	GM 816	111.241	156.479	171.311	135.171	138.517	140.266
BASIN_196	MH 176	GM 824	125.438	151.924	162.306	136.916	140.512	142.247
BASIN_200	MH 181	GM 837	14.656	17.728	19.564	146.877	148.389	149.275
BASIN_201	MH 184	GM 842	29.841	26.804	27.651	143.255	144.006	145.102
BASIN_202	MH 185	GM 845	40.894	38.670	40.541	141.683	142.254	144.829
BASIN_144	MH 190	GM 853	66.038	68.899	76.880	133.438	134.980	135.115
BASIN_215	MH 197	GM 893	131.017	164.884	173.430	134.393	136.604	137.900
BASIN_208	MH 202	CU 186	252.323	338.244	376.313	132.835	134.032	134.944
BASIN_32	MH 205	GM 925	18.187	18.470	18.222	136.365	135.853	138.028
BASIN_385	MH 206	GM 934	42.554	43.331	43.049	131.319	131.680	131.988
BASIN_206	MH 211	GM 3967	67.734	72.360	77.339	129.216	129.505	129.770
BASIN_204	MH 212	GM 956	15.503	18.505	23.060	131.896	132.454	133.428
BASIN_416	MH 213	GM 963	13.455	16.457	20.483	131.936	133.196	133.323
BASIN_211	MH 214	GM 962	9.464	11.230	13.879	131.962	133.904	133.944
BASIN_36	MH 215	GM 974	33.231	32.772	34.820	128.241	128.698	130.863
BASIN_383	MH 215	GM 974	33.231	32.772	34.820	128.241	128.698	130.863
BASIN_207	MH 216	GM 986	36.127	35.668	36.515	127.251	127.982	128.291
BASIN_205	MH 226	GM 1022	25.073	28.958	30.830	126.093	129.793	130.584
BASIN_217	MH 237	GM 1095	37.222	34.926	36.480	157.812	158.048	159.226
BASIN_438	MH 248	GM 1139	13.102	13.843	13.914	139.203	139.406	139.603
BASIN_276	MH 253	GM 1155	117.245	144.931	153.089	134.068	137.608	140.226
BASIN_277	MH 255	GM 1153	12.501	14.903	20.129	134.354	138.012	140.991
BASIN_272	MH 264	GM 1179	112.265	121.800	158.422	131.972	132.615	133.130
BASIN_63	MH 267	GM 1241	189.463	216.338	252.182	125.833	126.299	126.631
BASIN_476	MH 271	GM 1270	38.316	39.835	41.106	144.600	145.003	145.341
BASIN_364	MH 274	GM 1281	22.213	22.319	22.389	139.419	139.475	139.531
BASIN_479	MH 275	GM 1273	48.770	51.383	53.996	143.107	143.504	143.875

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_187	MH 276	GM 1286	35.809	35.950	35.774	131.191	131.388	131.391
BASIN_511	MH 278	GM 1290	10.736	15.256	24.650	123.606	125.853	128.360
BASIN_483	MH 283	GM 1297	36.621	37.080	37.928	126.283	126.335	126.440
BASIN_373	MH 284	GM 1293	32.807	48.946	49.476	120.226	124.708	125.827
BASIN_191	MH 291	GM 1319	42.660	44.602	46.086	109.229	109.646	109.738
BASIN_464	MH 292	GM 1324	56.963	55.303	56.857	107.421	107.835	108.153
BASIN_367	MH 294	GM 1315	23.520	28.817	30.971	109.892	110.581	110.955
BASIN_515	MH 297	GM 1347	13.737	16.315	21.048	106.919	107.129	107.585
BASIN_466	MH 300	GM 1359	24.014	28.358	35.915	106.444	106.608	106.896
BASIN_487	MH 302	GM 1368	17.693	8.899	8.440	116.119	117.067	116.214
BASIN_394	MH 305	GM 3835	36.374	43.260	52.195	111.690	111.939	112.405
BASIN_162	MH 310	GM 1436	88.958	103.543	118.304	88.730	90.390	91.381
BASIN_21	MH 311	GM 1407	78.399	91.606	106.015	89.167	90.994	92.123
BASIN_452	MH 311	GM 1407	78.399	91.606	106.015	89.167	90.994	92.123
BASIN_339	MH 315	GM 1420	33.831	40.223	50.359	89.741	91.483	93.005
BASIN_453	MH 315	GM 1420	33.831	40.223	50.359	89.741	91.483	93.005
BASIN_20	MH 318	GM 1428	7.557	8.228	10.135	90.036	91.739	93.386
BASIN_161	MH 321	GM 1462	8.793	10.559	12.925	94.829	95.974	96.995
BASIN_340	MH 323	GM 1468	23.237	29.912	29.947	100.020	101.699	102.001
BASIN_497	MH 326	GM 1475	29.770	35.774	35.986	90.374	92.657	93.694
BASIN_498	MH 326	GM 1475	29.770	35.774	35.986	90.374	92.657	93.694
BASIN_22	MH 328	GM 1493	14.832	17.622	19.953	91.719	94.400	94.816
BASIN_454	MH 329	GM 1489	19.882	23.767	24.897	91.129	93.570	94.285
BASIN_540	MH 334	GM 1512	19.176	22.389	22.778	101.440	103.576	103.953
BASIN_23	MH 335	GM 1522	16.810	20.165	19.141	102.907	106.201	106.890
BASIN_371	MH 336	GM 1527	51.489	67.557	73.737	118.015	120.098	122.244
BASIN_493	MH 339	GM 2808	166.261	197.939	204.754	120.636	121.923	122.372
BASIN_365	MH 341	GM 1572	141.223	158.845	180.493	129.760	130.135	130.732
BASIN_179	MH 346	GM 1617	22.637	28.216	27.086	122.549	123.934	124.193
BASIN_369	MH 350	GM 1672	60.423	62.118	68.510	100.696	102.221	102.313
BASIN_185	MH 364	GM 1721	21.153	17.410	24.120	114.846	115.574	115.741
BASIN_188	MH 367	GM 1731	60.000	73.596	83.978	115.423	116.847	118.428
BASIN_151	MH 373	GM 1791	82.884	106.191	125.014	112.205	113.340	114.012
BASIN_382	MH 380	GM 4014	56.892	57.069	61.907	120.003	122.736	123.435
BASIN_236	MH 383	GM 1838	5.262	6.321	10.736	119.196	119.350	120.039
BASIN_419	MH 386	GM 1876	65.473	68.793	76.456	116.178	118.917	118.937

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_269	MH 393	GM 2095	34.926	41.813	51.206	115.653	120.433	121.591
BASIN_426	MH 398	GM 1951	45.415	51.630	52.689	172.241	173.757	174.639
BASIN_425	MH 401	GM 1949	42.166	41.318	43.296	168.022	168.212	168.320
BASIN_118	MH 403	GM 1962	21.507	25.815	27.334	158.589	162.841	164.281
BASIN_500	MH 410	GM 1985	50.712	61.659	65.897	176.660	177.881	178.376
BASIN_131	MH 411	GM 1987	10.277	13.137	17.304	199.390	199.501	199.656
BASIN_219	MH 413	GM 2006	38.281	38.705	38.528	172.959	173.642	174.137
BASIN_218	MH 419	GM 2059	43.260	48.946	48.275	155.085	156.591	156.903
BASIN_422	MH 422	GM 2074	9.606	10.241	11.336	116.070	119.357	120.755
BASIN_107	MH 424	GM 2082	15.856	17.092	16.598	115.279	119.045	119.259
BASIN_255	MH 427	GM 2094	55.868	66.921	72.501	114.262	118.540	118.852
BASIN_256	MH 431	GM 2124	11.936	14.161	17.657	112.215	113.369	114.035
BASIN_270	MH 433	GM 2128	5.297	6.251	7.840	112.221	113.379	114.045
BASIN_531	MH 435	GM 3938	0.000	0.000	0.000	104.255	105.167	106.647
BASIN_254	MH 447	GM 2211	21.224	25.568	32.984	111.444	112.536	115.016
BASIN_253	MH 450	GM 2218	33.443	40.718	52.336	110.253	110.794	112.152
BASIN_316	MH 454	GM 2223	48.099	58.305	78.399	108.862	109.144	109.760
BASIN_19	MH 456	GM 2230	20.235	23.979	28.605	109.662	110.348	111.332
BASIN_258	MH 464	GM 2251	47.357	46.757	47.180	124.934	126.014	127.129
BASIN_86	MH 467	GM 2259	30.724	31.960	32.878	134.196	134.921	134.570
BASIN_496	MH 468	GM 2269	27.651	29.276	32.066	135.610	135.797	136.060
BASIN_242	MH 472	GM 2297	12.819	15.503	18.717	125.112	127.267	128.199
BASIN_381	MH 475	GM 2302	16.492	20.129	31.183	138.504	139.409	141.083
BASIN_101	MH 477	GM 3958	36.974	17.622	39.870	135.082	135.338	135.673
BASIN_243	MH 482	GM 2358	120.776	121.129	120.988	151.621	151.932	152.014
BASIN_74	MH 491	GM 3906	45.097	47.710	51.418	141.490	143.409	145.056
BASIN_244	MH 491	GM 3906	45.097	47.710	51.418	141.490	143.409	145.056
BASIN_524	MH 492	GM 2383	74.902	91.606	95.985	143.921	147.372	147.733
BASIN_246	MH 493	GM 2396	71.336	86.097	84.155	144.905	148.819	149.163
BASIN_71	MH 494	GM 2388	50.217	65.262	66.533	153.688	160.909	159.409
BASIN_429	MH 496	GM 2393	58.269	70.100	71.300	147.054	151.709	152.228
BASIN_430	MH 499	GM 2405	11.654	10.383	9.676	151.424	149.101	149.226
BASIN_431	MH 500	GM 2413	21.648	21.577	21.542	148.852	149.035	149.403
BASIN_432	MH 504	GM 2419	110.817	120.035	112.618	154.751	154.997	155.108
BASIN_428	MH 507	GM 2421	85.214	84.614	83.872	162.297	162.533	162.372
BASIN_76	MH 511	GM 2432	47.534	59.364	61.412	174.337	175.413	176.854

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_77	MH 512	GM 2434	56.998	70.523	77.092	169.921	173.950	175.331
BASIN_427	MH 516	GM 2446	35.915	44.779	45.450	181.965	184.524	185.066
BASIN_285	MH 521	GM 2483	25.356	30.830	38.599	129.528	129.682	129.895
BASIN_167	MH 522	GM 2472	72.889	87.580	108.134	127.526	127.818	128.238
BASIN_280	MH 525	GM 3692	31.218	29.735	26.804	138.799	138.917	139.206
BASIN_281	MH 526	GM 2520	37.434	39.729	40.965	132.425	133.399	135.203
BASIN_171	MH 531	GM 2549	22.672	24.685	27.016	124.245	124.406	124.593
BASIN_338	MH 533	GM 2556	75.750	90.759	112.407	126.286	126.634	127.178
BASIN_467	MH 538	GM 3905	21.824	27.404	33.690	129.531	129.744	132.277
BASIN_209	MH 545	GM 2590	28.146	34.291	36.904	131.411	132.602	132.959
BASIN_337	MH 550	GM 2611	93.301	118.269	138.363	139.820	142.605	143.402
BASIN_175	MH 558	GM 2639	61.200	53.996	61.907	114.521	116.119	116.325
BASIN_50	MH 560	GM 2661	32.136	27.545	29.947	117.677	118.120	118.232
BASIN_356	MH 562	GM 2650	15.327	13.066	12.148	118.127	120.778	120.827
BASIN_178	MH 567	GM 2676	15.362	17.304	18.046	125.003	128.875	128.720
BASIN_542	MH 575	GM 2713	50.500	50.641	50.712	117.484	117.575	117.723
BASIN_355	MH 576	GM 2715	62.507	66.215	70.276	116.325	116.375	116.506
BASIN_472	MH 581	GM 2747	15.574	14.973	15.538	118.497	118.609	121.047
BASIN_274	MH 585	GM 2936	122.542	123.036	122.966	139.255	139.469	139.685
BASIN_492	MH 586	GM 2810	188.157	229.863	236.396	119.970	121.030	121.496
BASIN_372	MH 594	GM 2787	62.083	82.001	109.511	113.776	115.144	116.903
BASIN_259	MH 598	GM 2857	7.840	9.323	11.336	116.089	117.552	118.773
BASIN_529	MH 601	GM 2853	81.648	90.653	95.738	116.079	117.536	118.743
BASIN_527	MH 604	GM 2862	67.204	70.982	73.172	119.341	120.925	122.297
BASIN_528	MH 605	GM 2866	1.377	1.872	1.978	119.455	121.260	122.333
BASIN_69	MH 609	GM 2907	119.681	148.251	158.598	131.519	133.694	135.833
BASIN_433	MH 612	GM 2931	132.889	146.026	145.214	138.812	140.249	140.722
BASIN_275	MH 616	GM 3949	123.248	126.215	124.520	131.119	131.325	131.486
BASIN_271	MH 617	GM 2943	118.516	133.489	162.553	131.293	131.772	132.093
BASIN_435	MH 629	GM 3023	158.139	188.933	202.494	130.062	131.447	133.268
BASIN_262	MH 631	GM 2819	189.781	217.538	259.316	118.156	120.778	122.667
BASIN_170	MH 635	GM 3092	32.101	30.653	30.724	122.805	122.300	122.356
BASIN_333	MH 638	GM 3099	36.551	36.727	36.763	120.597	120.774	120.860
BASIN_449	MH 642	GM 3112	10.453	11.830	16.103	116.099	116.699	117.638
BASIN_341	MH 649	GM 3158	174.101	187.662	197.480	98.661	99.764	100.230
BASIN_342	MH 661	GM 3494	14.196	16.951	20.977	99.593	100.427	100.994

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_329	MH 664	GM 3302	60.847	62.578	64.379	111.873	112.277	112.484
BASIN_177	MH 668	GM 3320	15.680	18.328	22.566	107.231	109.859	110.528
BASIN_354	MH 673	GM 3337	18.964	23.873	29.029	117.234	117.392	117.740
BASIN_49	MH 677	GM 3330	7.275	8.758	10.912	117.713	118.087	118.717
BASIN_457	MH 679	GM 3999	19.776	23.025	28.287	100.636	101.398	102.221
BASIN_455	MH 683	GM 3417	177.209	192.853	205.108	96.309	97.195	97.461
BASIN_345	MH 687	GM 3486	46.156	52.831	58.340	98.448	98.917	99.094
BASIN_346	MH 691	GM 3459	18.010	21.330	23.908	98.845	99.911	100.712
BASIN_347	MH 692	GM 3461	4.732	5.650	6.992	98.852	100.108	100.722
BASIN_556	MH 697	GM 3532	32.489	41.883	48.416	104.738	107.372	107.552
BASIN_555	MH 699	GM 3554	29.382	36.657	41.883	105.223	109.291	109.751
BASIN_195	MH 709	GM 794	7.734	9.146	11.795	135.682	137.927	139.058
BASIN_554	MH 714	GM 3675	12.925	15.362	18.293	110.968	112.139	113.812
BASIN_169	MH 718	GM 2555	90.617	108.663	123.672	128.205	128.392	128.553
BASIN_348	MH 723	GM 3215	82.036	82.389	84.755	107.575	108.806	108.980
BASIN_229	MH 725	GM 298	246.249	318.362	367.273	126.775	128.025	128.881
BASIN_186	MH 730	MH 730 Dummy Link	88.145	108.946	185.261	112.917	113.724	114.062
BASIN_189	MH 730	MH 730 Dummy Link	88.145	108.946	185.261	112.917	113.724	114.062
BASIN_235	MH 733	GM 378	10.736	12.678	16.315	120.453	120.778	121.995
BASIN_403	MH 738	GM 584	104.602	146.521	164.814	138.973	141.903	144.127
BASIN_198	MH 739	GM 897	129.923	163.048	171.629	134.423	136.650	137.953
BASIN_490	MH 739	GM 897	129.923	163.048	171.629	134.423	136.650	137.953
BASIN_68	MH 745	GM 1143	106.968	133.207	168.910	136.627	139.426	143.219
BASIN_331	MH 753	GM 2559	104.249	126.850	157.927	123.255	123.885	124.885
BASIN_51	MH 756	GM 2562	13.455	17.057	21.966	132.513	132.690	133.806
BASIN_516	MH 756	GM 2562	13.455	17.057	21.966	132.513	132.690	133.806
BASIN_462	MH 757	GM 2712	50.182	50.500	50.641	119.501	119.619	119.724
BASIN_304	MH 765	GM 3080	126.427	153.089	186.744	122.264	122.674	123.189
BASIN_410	MH 776	GM 3869	211.076	214.784	210.864	122.438	122.674	122.812
BASIN_228	MH 777	GM 3871	276.231	291.240	296.255	121.749	121.985	122.149
BASIN_522	MH 777	GM 3871	276.231	291.240	296.255	121.749	121.985	122.149
BASIN_352	MH 1182	GM 3233	21.507	23.096	26.733	107.421	111.234	110.827
BASIN_538	MH 1584	GM 3891	32.525	34.432	34.291	129.790	130.223	130.564
BASIN_510	MH 2783	GM 1713	9.535	11.301	29.346	112.306	112.641	113.720
BASIN_478	MH 3183	GM 1268	0.565	0.459	0.388	145.118	146.624	148.819

			Baseline Conditions					
Sub-Basin	Sub-Basin Connection Node	Downstream Pipe	10-Year Peak Q (cfs)	25-Year Peak Q (cfs)	100-Year Peak Q (cfs)	10-Year Max HGL (feet)	25-Year Max HGL (feet)	100-Year Max HGL (feet)
BASIN_513	MH 4389	MH 4389 Dummy Link	14.656	17.234	21.259	116.191	117.228	117.566
BASIN_380	MH 9583	GM 2271	1.872	2.825	4.097	138.222	138.560	139.026
BASIN_284	MH 9983	GM 3988	9.712	12.254	16.527	103.094	103.704	104.193
BASIN_92	MH 9986	GM 3477	75.785	55.515	61.200	97.854	98.196	98.215
BASIN_376	MH 12382	GM 1592	7.699	9.146	11.830	124.911	127.090	128.730
BASIN_451	MH 12782	GM 4001	98.351	114.349	130.806	88.678	90.049	90.351
BASIN_437	MH 13184	GM 2999	34.467	36.974	36.692	120.299	122.369	123.068
BASIN_260	MH 13186	GM 2852	76.244	82.071	85.108	116.152	117.608	118.852
BASIN_263	MH 13583	GM 3001	30.371	31.713	29.276	124.331	126.673	127.051
BASIN_18	MH 13592	GM 2203	11.195	13.561	16.774	112.280	113.002	115.787
BASIN_3	MH 13593	GM 99	166.120	179.928	192.430	113.415	113.845	114.255
BASIN_399	MH 13595	GM 154	24.862	25.391	24.508	134.688	135.069	135.164
BASIN_545	MH 13599	GM 249	19.953	19.917	19.917	133.156	134.488	135.436
BASIN_47	MH 13600	GM 2607	104.425	120.423	123.001	136.857	138.323	138.563
BASIN_512	MH 13601	GM 2807	12.855	15.856	19.564	113.862	114.698	114.970
BASIN_73	MH 13611	GM 3909	241.093	276.620	290.251	130.719	131.033	131.260
BASIN_295	MH 13615	GM 3913	106.968	96.586	97.186	91.946	92.375	92.612
BASIN_138	MH 13620	GM 3980	136.527	171.276	187.450	116.217	116.732	117.083
BASIN_506	MH 13626	GM 2163	21.118	19.494	27.722	108.271	109.291	109.921
BASIN_57	MH 13631	GM 3990	84.720	90.264	102.624	100.630	101.388	102.211
BASIN_250	MH 13632	GM 4023	55.162	62.260	72.077	111.772	111.949	112.231
BASIN_237	MH 13650	OD 376	66.286	73.490	84.014	123.150	123.241	123.360
BASIN_517	MH 13658	OD 186	109.193	128.122	139.740	132.756	132.972	133.091
BASIN_539	MH 13659	OD 185	34.926	37.787	39.305	126.293	126.407	126.490
BASIN_353	MH 13661	OD 356	123.778	129.358	124.096	115.827	115.860	115.922
BASIN_350	MH 13665	OD 217	119.293	123.425	133.737	107.720	107.858	108.051
BASIN_294	MH 13670	OD 390	51.736	69.040	69.287	91.637	92.090	92.303
BASIN_224	MH 13671	OD 248	183.601	214.748	255.043	120.157	120.243	120.341
BASIN_225	MH 13671	OD 248	183.601	214.748	255.043	120.157	120.243	120.341

Appendix D Chapter 7 – Planning-level Opinions of Probable Project Cost

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Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

SDIP 1 Improvements along Biggs Way and Natalie Drive

ENR Construction Cost Index:	
Jun-19	12,354.46

Date: 7/3/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$182,000	$182,000
Temporary Traffic Control (8%)		1	LS	$224,000	$224,000
Potholing		1	LS	$10,000	$10,000
Shoring and Trench Safety		1	LS	$20,000	$20,000
Dewatering		1	LS	$160,000	$160,000
Demolish 30" Pipe	30	660	LF	$15	$9,900
Install 60" Pipe (invert 10' or less)	60	1,300	LF	$1,050	$1,365,000
Install 72" Pipe (invert 10' or less)	72	660	LF	$1,100	$726,000
Demolish Manholes		4	EA	$2,000	$8,000
72" Manholes for 48" Pipes (invert 10' or less)		1	EA	$20,000	$20,000
84" Manholes for 60" Pipes (invert 10' or less)		6	EA	$25,000	$150,000
96" Manholes for 72" Pipes (invert 10' or less)		4	EA	$30,000	$120,000
Catch Basin Improvements and Tie-In to Existing Storm Drain		1	LS	$25,000	$25,000
Pavement Overlay		830	TN	$220	$182,600
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$3,210,000
Construction Subtotal (Rounded)					$3,210,000
Contingency (25%) (Rounded)					$810,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$4,020,000**

Design, Survey and Geotechnical, Environmental Review, Permits (25% of Construction)	$1,005,000
Inspection/CM/ESDC (12% of Construction)	$483,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$5,510,000**

Notes:
(1) Does not include property acquisition and permit costs.

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

	ENR Construction Cost Index:		Date:
SDIP 5 Gumview Drive, Berry Lane, and Starr View Drive Improvements	Jun-19	12,354.46	7/3/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$113,000	$113,000
Temporary Traffic Control (8%)		1	LS	$140,000	$140,000
Potholing		1	LS	$20,000	$20,000
Shoring and Trench Safety		1	LS	$33,000	$33,000
Dewatering		1	LS	$130,000	$130,000
Install 54" Pipe (invert 10' or less)	54	1,610	LF	$800	$1,288,000
84" Manhole for 54" Pipes (invert 10' of less)		8	EA	$25,000	$200,000
Catch Basin Improvements and Tie-In to Existing Storm Drain		1	EA	$20,000	$20,000
Pavement Overlay		200	TN	$220	$44,000
Striping		1	LS	$8,000	$8,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$2,000,000
Construction Subtotal (Rounded)					$2,000,000
Contingency (25%) (Rounded)					$500,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$2,500,000**

Design, Survey and Geotechnical, Environmental Review, Permits (25% of Construction)	$625,000
Inspection/CM/ESDC (12% of Construction)	$300,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$3,430,000**

Notes:
(1) Does not include property acquisition and permit costs

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

SDIP 6 Hiram Lewis Detention Basin Improvements

ENR Construction Cost Index:	
Jun-19	12,354.46

Date: 7/3/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$29,000	$29,000
Notice of Intent		1	LS	$1,200	$1,200
Rain Event Action Plan		1	EA	$500	$500
Clearing and Grubbing		1	LS	$10,000	$10,000
Earthen Berm (Top Width 5', Height 3', Slope 3:1, Length 870 LF)		1,353	CY	$319	$432,054
Berm Landscaping		1	LS	$20,000	$20,000
Erosion Control		1	LS	$10,000	$10,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$503,000
Construction Subtotal (Rounded)					$510,000
Contingency (25%) (Rounded)					$128,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$640,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$160,000
Inspection/CM/ESDC (12% of Construction)	$77,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$880,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

SDIP 8 Old Redwood Highway at Dawn Way Drainage Improvements

ENR Construction Cost Index:	
Feb-19	12,131.37

Date: 2/11/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$34,000	$34,000
Temporary Traffic Control (8%)		1	LS	$41,000	$41,000
Clearing and Grubbing		1	LF	$15,000	$15,000
Erosion Control		1	LF	$25,000	$25,000
Potholing		1	LS	$15,000	$15,000
Shoring and Trench Safety		1	LS	$50,000	$50,000
Dewatering		1	LS	$20,000	$20,000
Install Headwall in Roadside Ditch		1	LS	$25,000	$25,000
Install 4' x 6' Box Culvert under Residential Driveway		20	LF	$1,200	$24,000
Repair Residential Driveway		1	LS	$5,000	$5,000
Improve Roadside Ditch Downstream of Driveway		1	LS	$45,000	$45,000
Install 66" Pipe (invert 10' or less)	66	140	LF	$1,000	$140,000
Junction Structure for 66" Pipe in Roadside Ditch		1	EA	$25,000	$25,000
Junction Structure for 66" Pipe Connection to 14'x4' Arch Culvert		1	EA	$50,000	$50,000
Install Weir in each of the Dual 60" Pipes		2	EA	$5,000	$10,000
Install Pedestrian Safety Improvements (Allowance)		1	LS	$45,000	$45,000
Pavement Overlay		70	TN	$220	$15,400
Striping		1	LS	$2,200	$2,200
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$590,000
Construction Subtotal (Rounded)					$590,000
Contingency (25%) (Rounded)					$150,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$740,000**

Design, Survey and Geotechnical, Environmental Review, Permits (25% of Construction)	$185,000
Inspection/CM/ESDC (12% of Construction)	$89,000
Easement/Land Acquisition [1]	0
Project Total (Rounded) [2]	**$1,020,000**
Project Total (Adjusted for inflation, 3%) [3]	**$1,046,000**

Notes:
(1) Does not include property acquisition and permit costs
(2) Does not include utility undergrounding or installation of sidewalk on the east side of Old Redwood Highway
(3) This project is assumed to occur in FY 19-20 and FY 20-21.

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

SDIP 9 Old Redwood Highway and Pleasant Avenue Improvements

ENR Construction Cost Index:	
Jun-19	12,354.46

Date: 7/3/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$55,000	$55,000
Temporary Traffic Control (8%)		1	LS	$73,000	$73,000
Potholing		1	LS	$16,000	$16,000
Clearing and Grubbing		1	LS	$10,000	$10,000
Shoring and Trench Safety		1	LS	$27,000	$27,000
Install 30" Pipe (invert 10' or less)	30	1,330	LF	$500	$665,000
60" Manhole for 30" Pipes (invert 10' of less)		8	EA	$15,000	$120,000
Catch Basin Improvements and Tie-In to Existing Storm Drain		1	LS	$10,000	$10,000
Pavement Overlay		290	TN	$220	$63,800
Striping		1	LS	$8,000	$8,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$1,050,000
Construction Subtotal (Rounded)					$1,050,000
Contingency (25%) (Rounded)					$270,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$1,320,000**

Design, Survey and Geotechnical, Environmental Review, Permits (25% of Construction)	$330,000
Inspection/CM/ESDC (12% of Construction)	$159,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$1,810,000**

Notes:
(1) Does not include property acquisition and permit costs

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

SDIP 11 Shiloh Road at Caletti Ave Drainage Improvements

ENR Construction Cost Index:	
Feb-19	12,131.37

Date: 2/11/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$8,000	$8,000
Temporary Traffic Control		1	LS	$20,000	$20,000
Clearing and Grubbing		1	LS	$7,500	$7,500
Erosion Control		1	LS	$10,000	$10,000
Earthen Berm (Top Width 5', Height 3', Slope 3:1, Length 430 LF)		670	CY	$75	$50,250
Berm Landscaping		1	LS	$10,000	$10,000
Structural Concrete - Valley Gutter (130 LF)		130	LF	$75	$9,750
Catch Basin Improvements and Tie-In to Existing Storm Drain		1	LS	$20,000	$20,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$140,000
Construction Subtotal (Rounded)					$140,000
Contingency (25%) (Rounded)					$40,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$180,000**

Design, Survey and Geotechnical, Environmental Review, Permits (25% of Construction)	$45,000
Inspection/CM/ESDC (12% of Construction)	$22,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$247,000**
Project Total (Adjusted for inflation, 3%) [2]	**$256,000**

Notes:
(1) Does not include property acquisition and permit costs
(2) This project is assumed to occur in FY 20-21.

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

SDIP 12 Hall Park Detention Basin

ENR Construction Cost Index:	
Feb-19	12,131.37

Date: 2/11/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$60,000	$60,000
Temporary Traffic Control (5%)		1	LS	$50,000	$50,000
Notice of Intent		1	LS	$1,200	$1,200
Rain Event Action Plan		1	EA	$500	$500
Clearing and Grubbing		1	LS	$5,000	$5,000
Excavation (including offhaul)		4,700	CY	$55	$258,500
Earthwork, rough grading		4,700	CY	$15	$70,500
Earthwork, fine grading		38,300	SF	$0.35	$13,405
Erosion Control - Inlet and Perimeter Protection		1	LS	$2,500	$2,500
Outlet Structure		1	LS	$25,000	$25,000
RSP		4	CY	$150	$600
Potholing		1	LS	$12,000	$12,000
Shoring and Trench Safety		1	LS	$20,000	$20,000
Dewatering		1	LS	$59,000	$59,000
12" Pipe (invert 10' or less)	12	70	LF	$200	$14,000
30" Pipe (invert 10' or less)	30	900	LF	$500	$450,000
Misc. Utility Relocation		1	LS	$50,000	$50,000
Subtotal (Rounded)					$1,098,000
Construction Subtotal (Rounded)					$1,100,000
Contingency (25%) (Rounded)					$275,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$1,380,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$345,000
Inspection/CM/ESDC (12% of Construction)	$166,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$1,900,000**
Project Total (Adjusted for inflation, 3%) [2]	**$2,007,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.
(2) This project is assumed to occur in FY 20-21 and FY 21-22.

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

SDIP 13 Starr Creek Tributary #5 - South of Arata Lane

ENR Construction Cost Index:	
Feb-19	12,131.37

Date: 2/11/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$44,000	$44,000
Temporary Traffic Control (5%)		1	LS	$37,000	$37,000
Notice of Intent		1	LS	$1,200	$1,200
Rain Event Action Plan		1	EA	$500	$500
Clearing and Grubbing		1	LS	$5,000	$5,000
Excavation (including offhaul)		9,200	CY	$45	$414,000
Earthwork, rough grading		9,200	CY	$15	$138,000
Earthwork, fine grading		88,000	SF	$0.35	$30,800
Erosion Control - Inlet and Perimeter Protection		1	LS	$2,500	$2,500
Outlet Structure		1	LS	$25,000	$25,000
RSP		4	CY	$140	$560
Potholing		1	LS	$2,000	$2,000
Shoring and Trench Safety		1	LS	$5,000	$5,000
Dewatering		1	LS	$2,000	$2,000
36" Pipe (invert 10' or less)	36	20	LF	$700	$14,000
Misc. Utility Relocation		1	LS	$40,000	$40,000
Catch Basin Improvements and Tie-In to Existing Storm Drain		1	LS	$40,000	$40,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$803,000
Construction Subtotal (Rounded)					$810,000
Contingency (25%) (Rounded)					$203,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$1,020,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$255,000
Inspection/CM/ESDC (12% of Construction)	$123,000
Easement/Land Acquisition [1]	0
Project Total (Rounded) [2]	**$1,400,000**
Project Total adjusted for inflation (3%)[3]	**$1,479,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.
(2) Cost does not include any costs associated with off-site environmental mitigation (e.g. tree removal).
(3) This project is assumed to occur in FY 20-21 and FY 21-22.

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

SDIP 14 East Windsor Creek Flood Control Project

ENR Construction Cost Index:	
Feb-19	12,131.37

Date: 2/11/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$104,000	$104,000
Temporary Traffic Control (5%)		1	LS	$87,000	$87,000
Notice of Intent		1	LS	$1,200	$1,200
Rain Event Action Plan		1	EA	$500	$500
Clearing and Grubbing		1	LS	$5,000	$5,000
Excavation (including offhaul)		26,300	CY	$45	$1,183,500
Earthwork, rough grading		26,300	CY	$15	$394,500
Earthwork, fine grading		97,000	SF	$0.35	$33,950
Earthen Berm (Top Width 10', Height 3', Length 50 LF)		60	CY	$50	$3,000
Berm Landscaping		1	LS	$10,000	$10,000
Erosion Control - Inlet and Perimeter Protection		1	LS	$2,500	$2,500
Outlet Structure		1	LS	$25,000	$25,000
RSP		4	CY	$150	$600
Potholing		1	LS	$1,000	$1,000
Shoring and Trench Safety		1	LS	$1,000	$1,000
Dewatering		1	LS	$2,000	$2,000
36" Pipe (invert 10' or less)	36	30	LF	$376	$11,280
Misc. Utility Relocation		1	LS	$50,000	$50,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$1,918,000
Construction Subtotal (Rounded)					$1,920,000
Contingency (25%) (Rounded)					$480,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$2,400,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$600,000
Inspection/CM/ESDC (12% of Construction)	$288,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$3,290,000**
Project Total (Existing need only - 62%)	**$2,030,000**
Project Total (Existing/Adjusted for inflation, 3%) [2]	**$2,208,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.
(2) This project is assumed to occur in FY 21-22 and FY 22-23.

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

F-SDIP 1 Sotoyome Creek Bridge Replacement

ENR Construction Cost Index:	
Jun-19	12,354.46

Date: 7/3/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$124,000	$124,000
Aggregate Base		1,400	CY	$80	$112,000
Asphalt Concrete		700	TN	$300	$210,000
Bridge Cost		1,380	SF	$639	$881,136
Miscellaneous Costs		1	LS	$851,339	$851,339
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$2,180,000
Construction Subtotal (Rounded)					$2,180,000
Contingency (25%) (Rounded)					$550,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$2,730,000**

Design, Survey and Geotechnical, Environmental Review, Permits (25% of Construction)	$683,000
Inspection/CM/ESDC (12% of Construction)	$328,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$3,750,000**

Notes:
(1) Does not include property acquisition and permit costs

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

F-SDIP 3 Detention Basin at Pool Creek and Faught Creek

ENR Construction Cost Index:	
Feb-19	12,131.37

Date: 2/28/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$113,000	$113,000
Notice of Intent		1	LS	$1,200	$1,200
Rain Event Action Plan		1	EA	$500	$500
Clearing and Grubbing		1	LS	$5,000	$5,000
Excavation (including offhaul)		25,200	CY	$35	$882,000
Earthwork, fine grading		180,000	SF	$0.35	$63,000
Earthen Berm (Top Width 20', Height 5', Slope 5:1, Length 2,750 LF)		23,400	CY	$30	$702,000
Erosion Control - Inlet and Perimeter Protection		1	LS	$2,500	$2,500
Outlet Structure		1	LS	$25,000	$25,000
RSP		4	CY	$150	$600
Maintanence Access Road		2,037	CY	$80	$162,963
12" Pipe (invert 10' or less)	12	45	LF	$340	$15,300
30" Pipe (invert 10' or less)	30	45	LF	$570	$25,650
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$2,000,000
Construction Subtotal (Rounded)					$2,000,000
Contingency (25%) (Rounded)					$500,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$2,500,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$625,000
Inspection/CM/ESDC (12% of Construction)	$300,000
Easement/Land Acquisition [1]	0
Project Total (Rounded) [2]	**$3,430,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.
(2) This project is driven 100% by future development.

Assumptions:
Assumes reuse of excavated material for berm construction.

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

F-SDIP 4 Reinforced Concrete Box on Starr Road and Colleen Drive

ENR Construction Cost Index:	
Jun-19	12,354.46

Date: 7/3/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$128,000	$128,000
Temporary Traffic Control (8%)		1	LS	$158,000	$158,000
Clearing and Grubbing		1	LS	$5,000	$5,000
Erosion Control		1	LS	$10,000	$10,000
Potholing		1	LS	$15,000	$15,000
Shoring and Trench Safety		1	LS	$50,000	$50,000
Dewatering		1	LS	$110,000	$110,000
4'x8' Reinforced Concrete Box (RCB)		1,360	LF	$1,100	$1,496,000
72" Manholes (invert 10' or less)		6	EA	$20,000	$120,000
Catch Basin Improvements and Tie-In to Existing Storm Drain and Creek		1	LS	$25,000	$25,000
Pavement Overlay		580	TN	$220	$127,600
Striping		1	LS	$10,000	$10,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$2,260,000
Construction Subtotal (Rounded)					$2,260,000
Contingency (25%) (Rounded)					$570,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$2,830,000**

Design, Survey and Geotechnical, Environmental Review, Permits (25% of Construction)	$708,000
Inspection/CM/ESDC (12% of Construction)	$340,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$3,880,000**

Notes:
(1) Does not include property acquisition and permit costs.

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

F-SDIP 5 Pool Creek at Windsor Road

ENR Construction Cost Index:	
Jun-19	12,354.46

Date: 7/3/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$254,000	$254,000
Aggregate Base		3,400	CY	$80	$272,000
Asphalt Concrete		2,500	TN	$300	$750,000
Bridge Cost		3,680	SF	$639	$2,349,695
Miscellaneous Costs		1	LS	$851,339	$851,339
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$4,480,000
Construction Subtotal (Rounded)					$4,480,000
Contingency (25%) (Rounded)					$1,120,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$5,600,000**

Design, Survey and Geotechnical, Environmental Review, Permits (25% of Construction)	$1,400,000
Inspection/CM/ESDC (12% of Construction)	$672,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$7,680,000**

Notes:
(1) Does not include property acquisition and permit costs

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

F-SDIP 6 Windsor and E Windsor Creek Confluence Improvements

ENR Construction Cost Index:	
Jun-19	12,354.46

Date: 7/8/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$97,000	$97,000
Clearing and Grubbing		1	LF	$20,000	$20,000
Erosion Control		1	LF	$10,000	$10,000
Excavation		4,950	CY	$45	$222,750
Structural Concrete - Flood Wall and Foundation (4,900 LF)		1,470	CY	$700	$1,029,000
Landscaping		1	LS	$15,000	$15,000
Pump Stations		2	EA	$150,000	$300,000
Abandon Bypass		1	LS	$15,000	$15,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$1,710,000
Construction Subtotal (Rounded)					$1,710,000
Contingency (25%) (Rounded)					$430,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$2,140,000**

Design, Survey and Geotechnical, Environmental Review, Permits (25% of Construction)	$535,000
Inspection/CM/ESDC (12% of Construction)	$257,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$2,940,000**

Notes:
(1) Does not include property acquisition and permit costs

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

F-SDIP 7 Franklin Street and Leafhaven Lane Improvements

ENR Construction Cost Index:	
Jun-19	12,354.46

Date: 7/3/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$125,000	$125,000
Temporary Traffic Control (8%)		1	LS	$154,000	$154,000
Clearing and Grubbing		1	LF	$7,500	$7,500
Erosion Control		1	LF	$15,000	$15,000
Potholing		1	LS	$25,000	$25,000
Shoring and Trench Safety		1	LS	$42,000	$42,000
Dewatering		1	LS	$125,000	$125,000
Demolish 30" Pipe	30	380	LF	$20	$7,600
Demolish 36" Pipe	36	150	LF	$20	$3,000
Install 36" Pipe (invert 10' or less)	36	380	LF	$700	$266,000
Install 48" Pipe (invert 10' or less)	48	150	LF	$950	$142,500
Install 60" Pipe (invert 10' or less)	60	1,020	LF	$900	$918,000
Demolish Manholes		3	EA	$2,000	$6,000
60" Manholes for 36" Pipes (invert 10' or less)		3	EA	$15,000	$45,000
72" Manholes for 48" Pipes (invert 10' or less)		2	EA	$20,000	$40,000
84" Manholes for 60" Pipes (invert 10' or less)		5	EA	$25,000	$125,000
Catch Basin & Outfall Improvements and Tie-In to Existing Storm Drain		1	LS	$50,000	$50,000
Pavement Overlay		400	TN	$220	$88,000
Striping		1	LS	$10,000	$10,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$2,200,000
Construction Subtotal (Rounded)					$2,200,000
Contingency (25%) (Rounded)					$550,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$2,750,000**

Design, Survey and Geotechnical, Environmental Review, Permits (25% of Construction)	$688,000
Inspection/CM/ESDC (12% of Construction)	$330,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$3,770,000**

Notes:
(1) Does not include property acquisition and permit costs.

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

F-SDIP 8 Detention at Jensen Lane Development

ENR Construction Cost Index:	
Feb-19	12,131.37

Date: 2/28/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$122,000	$122,000
Temporary Traffic Control (5%)		1	LS	$102,000	$102,000
Notice of Intent		1	LS	$1,200	$1,200
Rain Event Action Plan		1	EA	$500	$500
Clearing and Grubbing		1	LS	$20,000	$20,000
Excavation (incuding offhaul)		20,000	CY	$45	$900,000
Earthwork, rough grading		20,000	CY	$15	$300,000
Earthwork, fine grading		216,000	SF	$0.35	$75,600
Erosion Control - Inlet and Perimeter Protection		1	LS	$10,000	$10,000
Outlet Structure		1	LS	$25,000	$25,000
Diversion Structure		1	LS	$50,000	$50,000
RSP		4	CY	$140	$560
Potholing		1	LS	$12,000	$12,000
Shoring and Trench Safety		1	LS	$20,000	$20,000
Dewatering		1	LS	$60,000	$60,000
30" Pipe (invert 10' or less) (1)	30	1,000	LF	$500	$500,000
Misc. Utility Relocation		1	LS	$50,000	$50,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$2,254,000
Construction Subtotal (Rounded)					$2,260,000
Contingency (25%) (Rounded)					$565,000
Total Estimate of Probable Construction Cost (Rounded) (2)					**$2,830,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$708,000
Inspection/CM/ESDC (12% of Construction)	$340,000
Easement/Land Acquisition (2)	0
Project Total (Rounded) (3)	**$3,880,000**

Notes:
(1) Quantity for this item is assumed and is subject to change during design phase of project.
(2) Does not include property acquisition, permit costs, or City degredation fees.
(3) This project is driven 100% by future development.

Town of Windsor
Storm Drainage Master Plan
Planning Level Opinion of Probable Project Cost

F-SDIP 9 North of Arata Lane Drainage Project

ENR Construction Cost Index:	
Feb-19	12,131.37

Date: 2/11/2019

Description	Diameter (in)	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (6%)		1	LS	$199,000	$199,000
Temporary Traffic Control (5%)		1	LS	$166,000	$166,000
Notice of Intent		1	LS	$1,200	$1,200
Rain Event Action Plan		1	EA	$500	$500
Clearing and Grubbing		1	LS	$20,000	$20,000
Excavation (incuding offhaul)		28,000	CY	$45	$1,260,000
Earthwork, rough grading		28,000	CY	$15	$420,000
Earthwork, fine grading		299,000	SF	$0.35	$104,650
Erosion Control - Inlet and Perimeter Protection		1	LS	$10,000	$10,000
Outlet Structure		1	LS	$25,000	$25,000
Diversion Structure		1	LS	$50,000	$50,000
RSP		4	CY	$140	$560
Potholing		1	LS	$28,000	$28,000
Shoring and Trench Safety		1	LS	$46,000	$46,000
Dewatering		1	LS	$138,000	$138,000
30" Pipe (invert 10' or less)	30	2,300	LF	$500	$1,150,000
Misc. Utility Relocation		1	LS	$50,000	$50,000
TOTAL ESTIMATE OF PROBABLE CONSTRUCTION COST					
Subtotal (Rounded)					$3,681,000
Construction Subtotal (Rounded)					$3,690,000
Contingency (25%) (Rounded)					$923,000
Total Estimate of Probable Construction Cost (Rounded) [1]					**$4,620,000**

Design, Survey, Geotechnical, Environmental Review, Permits (25% of Construction)	$1,155,000
Inspection/CM/ESDC (12% of Construction)	$555,000
Easement/Land Acquisition [1]	0
Project Total (Rounded)	**$6,330,000**
Project Total (Existing need only - 43%)	**$2,730,000**
Project Total (Existing/Adjusted for inflation, 3%) [2]	**$3,058,000**

Notes:
(1) Does not include property acquisition, permit costs, or City degredation fees.
(2) This project is assumed to occur in FY 22-23 and FY 23-24.