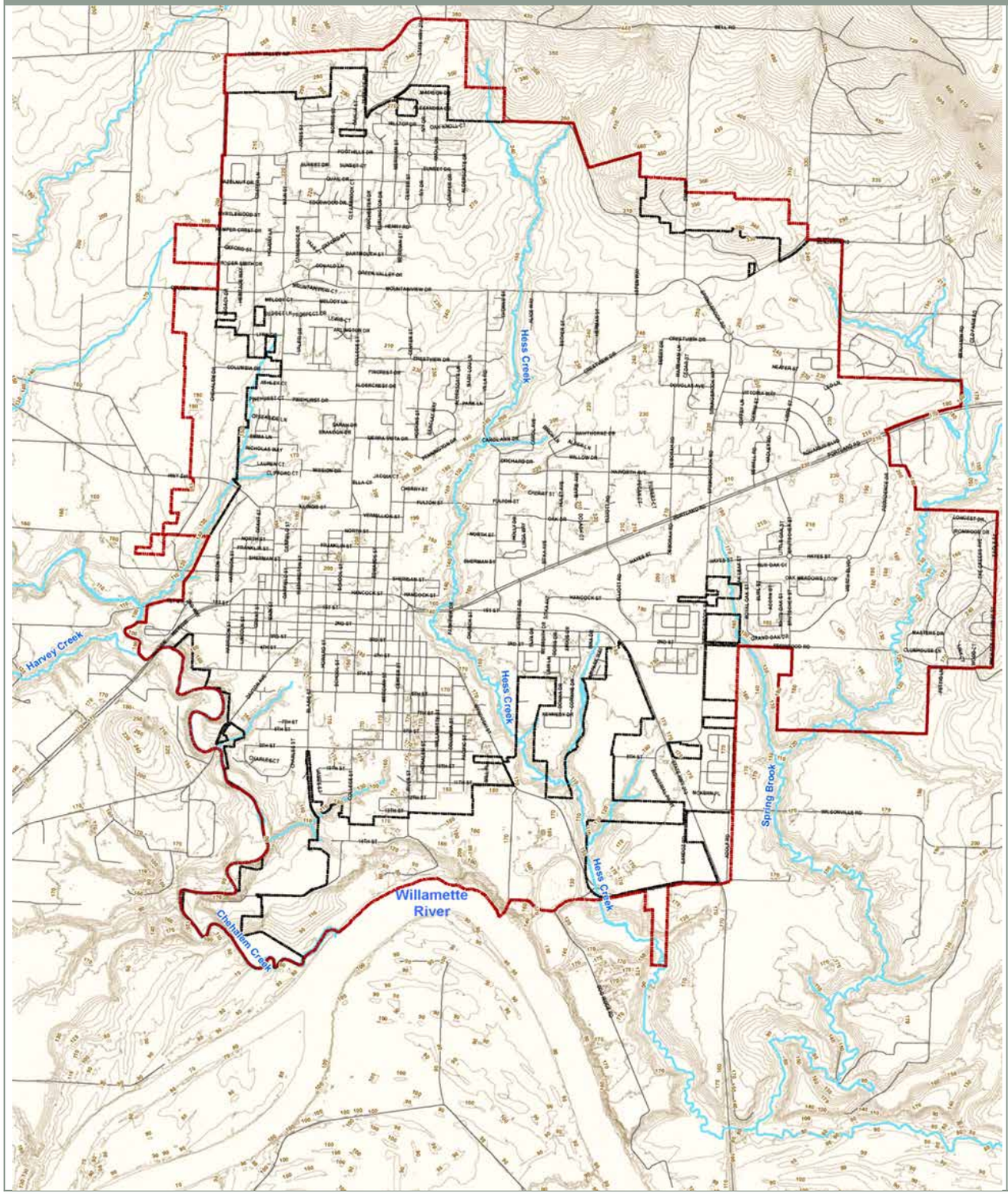
Stormwater Master Plan

FINAL | REPORT



Prepared for:

City of Newberg, Oregon

Prepared by:

Brown and Caldwell

June 5, 2014

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City of Newberg
Stormwater Master Plan

Prepared for
City of Newberg, Oregon
June 5, 2014

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This document was prepared solely for the City of Newberg in accordance with professional standards at the time the services were performed and in accordance with the contract between the City of Newberg and Brown and Caldwell dated April 29, 2013. This document is governed by the specific scope of work authorized by the City of Newberg; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the City of Newberg and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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List of Abbreviations

CIP	capital improvement project
City	City of Newberg
cfs	cubic feet per second
CRRC	Citizen Rate Review Committee
DEQ	Oregon Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GIS	geographic information system
HDPE	high density polyethylene
H/H	hydrologic and hydraulic
IDDE	Illicit Discharge Detection and Elimination
LID	low impact development
Master Plan	stormwater master plan
MS4	Municipal Separate Storm Sewer System
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NGVD29	National Geodetic Vertical Datum of 1929
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
Hwy 99W	Oregon Highway 99W
RCP	reinforced concrete pipe
SWMM	Surface Water Management Model
TMDL	Total Maximum Daily Load
UGB	urban growth boundary
URA	urban reserve area
WQ	water quality

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Executive Summary

In 2013, the City of Newberg (City) initiated development of a multi-objective Stormwater Master Plan (Master Plan) to provide a clear understanding of the existing stormwater system and provide a capital improvement project (CIP) program to address deficiencies in the system. The main objectives of this plan are as follows:

- Update the City's stormwater system's hydrologic and hydraulic models to evaluate system capacity.
- Develop an integrated stormwater system capital improvement program to address storm system capacity needs and water quality.
- Evaluate stream channel conditions with respect to erosion and impacts from future development.
- Continue to comply with water quality regulations.
- Review the City's stormwater management program and make recommendations on activities and staffing where applicable.
- Identify implementation priorities and impacts to the program budget.
- Develop a Master Plan document that is useful and easy to read, reference, and update.

Master Plan Technical Analyses

Development of the Master Plan involved four primary technical analyses to evaluate the stormwater infrastructure and programs.

Stormwater System Capacity Evaluation – Chapter 3 documents the development of a hydrologic and hydraulic model to simulate rainfall and runoff characteristics within Newberg. The model simulates stormwater flows through pipe networks, drainage ditches, and culverts to identify areas that are over capacity. The model considered both current conditions and the impacts of future development on stormwater flows. Stormwater infrastructure capacity concerns are presented in Table 3.7.

Problem Areas Survey – Surveys of City staff, compilation of public complaints, and review of past reports were used to identify additional problem areas within the stormwater infrastructure. The aim was to identify problem areas that would not be identified through hydraulic modeling, such as deteriorating pipes, frequent maintenance concerns, inadequate maintenance access, or underserved areas resulting in flooding. Problem areas are documented in Table 3.8.

Stream Channel Vulnerability Assessment – Field walks were conducted between October 15 and 17, 2013 to evaluate and assess existing and potential future channel conditions in the streams within Newberg. The City's existing stream channels are already well protected through development restrictions in the zoning code. Section 4.3 includes recommendations for small projects to address minor areas of erosion and adjustments to the City's stormwater design standards to reduce potential future channel impacts.

Maintenance and Program Evaluation – The City's stormwater management program was formed around addressing drainage capacity and flooding problems. In the last decade, the program has shifted to include addressing increased water quality regulations, such as the Total Maximum Daily Load (TMDL) program. Section 5 documents the current maintenance practices and programmatic activities within the City's stormwater management program and provides recommendations for maintenance and program enhancements.

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Integrated Management Strategy

The recommendations in Chapter 6 present an integrated strategy of programs, projects, and maintenance activities to address stormwater management concerns. Recommendations include increasing staff by approximately 1.2 full-time equivalents (FTEs) to 6.60 FTEs within the stormwater program to support preventative maintenance activities and full implementation of the City's stormwater ordinance. Section 6 also identifies and recommends the following one-time projects and studies:

- Develop a Water Quality Sensitive O&M Manual at an estimated cost of $25,000.
- Conduct a System Development Charge (SDC) Rate Study at an estimated cost of $15,000.
- Plan for a future Stormwater Master Plan update in 2025 at an estimated cost of $250,000.

Capital Improvement Projects (CIPs) have been developed to address existing and predicted future conditions flooding problems, integrate water quality elements, and replace deteriorating pipe segments. The recommended CIP plan includes 15 specific projects (some divided into smaller phases) and two ongoing programs for annual pipe replacement and water quality retrofits. Section 6 documents the process used in developing the city-wide CIP plan.

Figure ES-1 shows the location of the proposed CIPs. Table ES-1 summarizes the identified CIPs, estimated costs, priority ranking, and an estimated timeline for implementation. Detailed cost estimates and scoring information are provided in Appendix D. As described in Section 7, highest priority has been given to projects that address safety and liability concerns. Short-term projects are targeted to be completed in the first 5 years of this Master Plan implementation, while the timing for mid-term and long-term projects will be dependent on available funding. Detailed fact sheets and planning level cost estimates for each CIP can be found in Appendix D.

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Table ES-1. CIP Prioritization and Implementation Timeline

Basin	CIP number	Project name	Cost, $	Prioritization score	Estimated timeline
Chehalem Creek	C-1	Blaine Street Improvements: Design	180,000	n/a[a]	Short-term
	C-1A	Highway 99W to 2nd Street Parking Lot Pipe Replacement	131,000	10.0	Short-term
	C-1B	S Blaine Street Pipe Replacement	384,000	9.0	Short-term
	C-1C	E 2nd Street to E 5th Street Pipe Decommissioning/Replacement	291,000	10.0	Short-term
	C-1D	E 6th and S Blaine Streets Pipe Replacement	176,000	6.5	Long-term
	C-2	S Center Street Improvements: Design	180,000	n/a[a]	Short-term
	C-2A	E 9th Street to S Center Street Pipe Decommissioning	294,000	10.5	Short-term
	C-2B	S Center, E 8th, and E 7th Streets Pipe Replacement	930,000	7.0	Long-term
	C-3	E Columbia Drive Improvements near Main Street	79,000	8.0	Mid-term
	C-4	Oxford Street Improvements	1,092,000	7.5	Mid-term
	C-5	N College Street Improvements, north of Foothills Drive	260,000	6.5	Long-term
	C-6	S River Street Improvements at E 11th Street	160,000	9.0	Short-term
	C-7	S College Street at Andrew Street Improvements	196,000	7.0	Long-term
	C-8	Dayton Avenue Green Streets	125,000	7.5	Mid-term
Hess Creek	H-1	N Elliot Road Improvements	239,000	5.5	Long-term[b]
	H-2	N Edwards Street Improvements from Vermillion to Sheridan	1,217,000	6.0	Long-term
	H-3	E 3rd Street Improvements: Design	142,000	n/a[a]	Long-term
	H-3A	S Church and E 1st Street Improvements	404,000	6.0	Long-term
	H-3B	E 3rd Street between S Everest Road and S Church Street	341,000	5.5	Long-term
	H-4	Villa Road Culvert Improvements	104,000	8.0	Mid-term[b]
Spring Brook	S-1	N Springbrook Road Improvements from Middlebrook to Haworth	777,000	6.5	Long-term[c]
	S-2	Libra Street Improvements at Vittoria Way	246,000	7.0	Long-term
City-wide	A-1	Stream Bank Protection Projects	190,000	8.0	Mid-term
		Total	8,137,000		

[a] *Design work for phased projects should be prioritized based on the highest scoring construction phase.*

[b] *Project to be constructed with roadway improvement project. Schedule dependent on transportation program priorities.*

[c] *Project to be designed and constructed with water and wastewater system improvements. Schedule based on joint priorities.*

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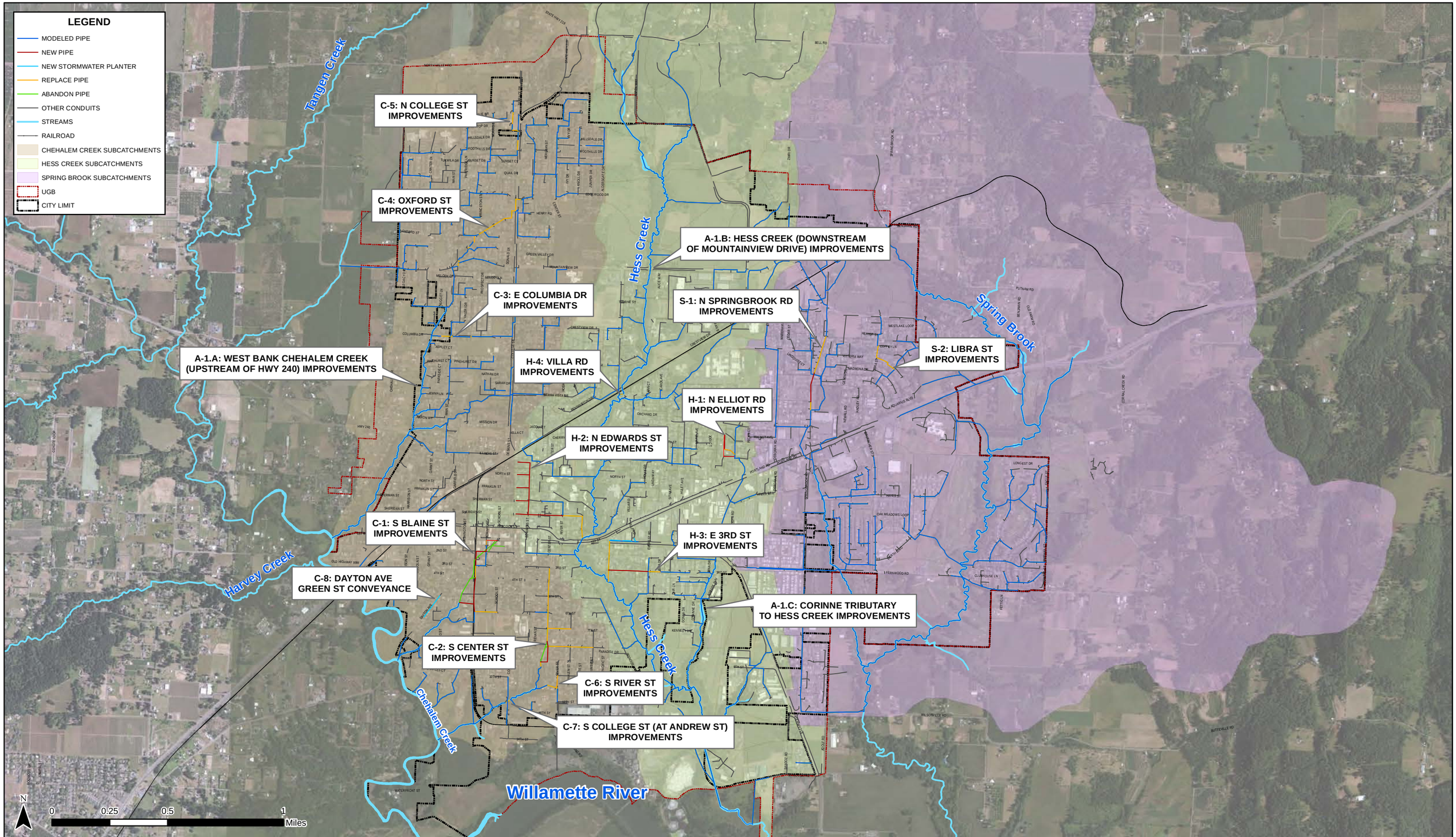

STORMWATER MASTER PLAN UPDATE

FIGURE ES-1. CAPITAL IMPROVEMENT PROJECTS

NEWBERG, OREGON

City of Newberg

Brown AND Caldwell

JUNE 2014

Section 1

Introduction

This Stormwater Master Plan (Master Plan) documents the methods and results of stormwater system capacity and stormwater program evaluations for the Newberg study area. The study area for this Master Plan includes land within Newberg's urban growth boundary (UGB) and Yamhill County land upstream of the UGB that drains to tributaries of Chehalem Creek Tributary, Hess Creek, and Spring Brook. This section provides a summary of the need for the plan, the plan objectives, a description of the approach for preparing the plan, and a summary of how the plan is organized.

1.1 Need for the Plan

According to Portland State University's Population Research Center, Newberg's population was 22,580 on July 1, 2013. The Newberg Comprehensive Plan projects population to grow to 28,250 in 2020 and 32,213 in 2025. As projected growth continues to fill in the UGB, and the City plans for future expansion into the urban reserve areas, City staff must plan for such development in a way to maintain the character of the community. Stormwater master planning offers one mechanism to anticipate and address infrastructure and programmatic needs in conjunction with development and expansion.

The City will use this Master Plan as a tool to proactively address stormwater management with prioritized stormwater capital improvement projects (CIPs) that work in conjunction with the City's ongoing stormwater program that includes development standards addressing stormwater. This project provides an opportunity to expand upon the City's current planning approach to improve public safety, water quality, and aesthetic benefits while addressing storm drain capacity in several flood-prone areas.

Programmatic recommendations set forth in this plan will also address long-term management requirements under the City's Total Maximum Daily Load (TMDL) program with the Oregon Department of Environmental Quality (DEQ).

1.2 Plan Objectives

This multi-objective Master Plan addresses stormwater quantity control and current stormwater system capacity limitations. In conjunction with the development of the capital improvement program, a summary of recommendations to address water quality and long-term stream stabilization is provided. In summary, the main objectives of this plan are as follows:

- update the City's stormwater system hydrologic and hydraulic models to evaluate system capacity
- develop an integrated stormwater system capital improvement program to address storm system capacity needs and water quality
- evaluate stream channel conditions with respect to erosion and impacts from future development
- continue compliance with water quality regulations
- review the City's stormwater management program and make recommendations on activities and staffing where applicable
- identify implementation priorities and impacts to the program budget
- develop a Master Plan document that is useful and easy to read, reference, and update

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1.3 Approach

The approach for developing this Master Plan is summarized in Figure 1-1. This approach was developed to meet the City's stormwater management objectives and increase the understanding of the existing stormwater infrastructure. The data collection, evaluation, and improvement strategies were conducted as follows:

1. The City's storm drain geographic information system (GIS) data were reviewed and supplemental data were collected through field investigations. Existing water quantity and quality control facilities were also reviewed.
2. Collected data were used to develop the stormwater hydrologic and hydraulic (H/H) model and associated model attributes such as subcatchment drainage areas, land uses, soils, and topography.
3. City staff were interviewed to identify known drainage problem areas.
4. Alternatives were developed for improvements to the stormwater infrastructure.
5. Improvements were evaluated with City staff to determine the best alternatives for incorporation into both the future management program and the City's capital improvement program.
6. Project costs were developed, along with a proposed implementation timeline, consistent with anticipated program funding.
7. The approach was documented in this Master Plan to provide information in a clear and easy–to-use format.

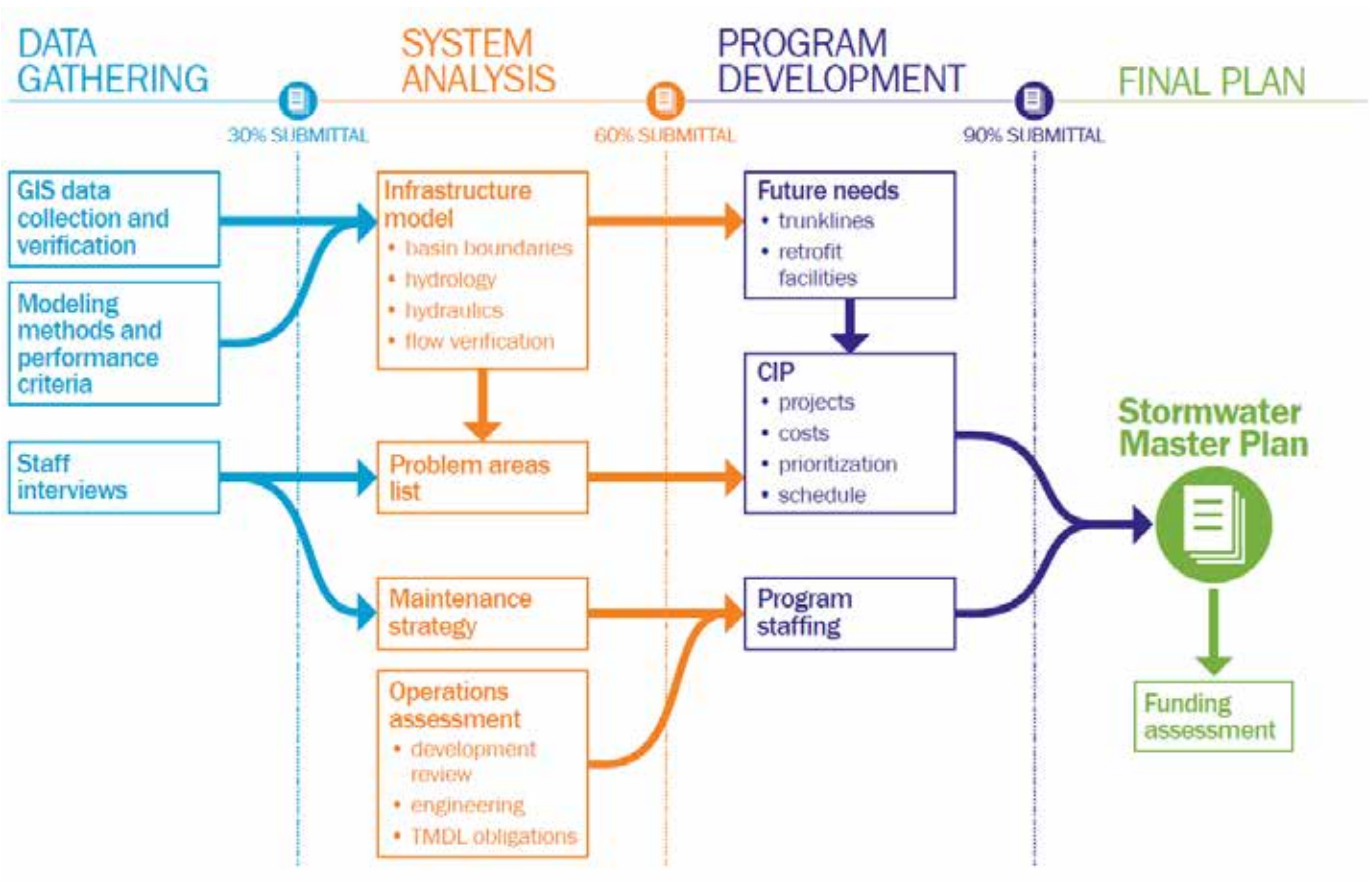

Figure 1-1. Stormwater master plan approach

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1.4 Plan Organization

This Master Plan is organized as follows:

- Section 2 includes a description of study area characteristics and associated mapping.
- Section 3 describes the methods used to conduct a storm system capacity evaluation including hydrologic and hydraulic modeling.
- Section 4 is a summary of the stream and natural area vulnerability assessment.
- Section 5 provides a review of the existing maintenance and programmatic management activities and identifies future program needs.
- Section 6 describes the methods and results of integrating the programmatic and capital measures to address the City's storm system capacity and water quality needs.
- Section 7 describes the recommended capital improvement project prioritization and implementation schedule to address storm system capacity and water quality.
- Appendices A through D provide supporting and technical information used in the development of the Master Plan document.

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Section 2

Study Area Characteristics

This section includes an overview of study area characteristics including location; topography; soils; land use; climate and rainfall; drainage system; and current stormwater quality conditions.

2.1 Location

The City of Newberg is located 25 miles southwest of Portland, Oregon, along the Oregon Highway 99W (Hwy 99W) corridor. Newberg is in northeast Yamhill County and is bordered by the Chehalem Mountains to the north and the Willamette River to the south.

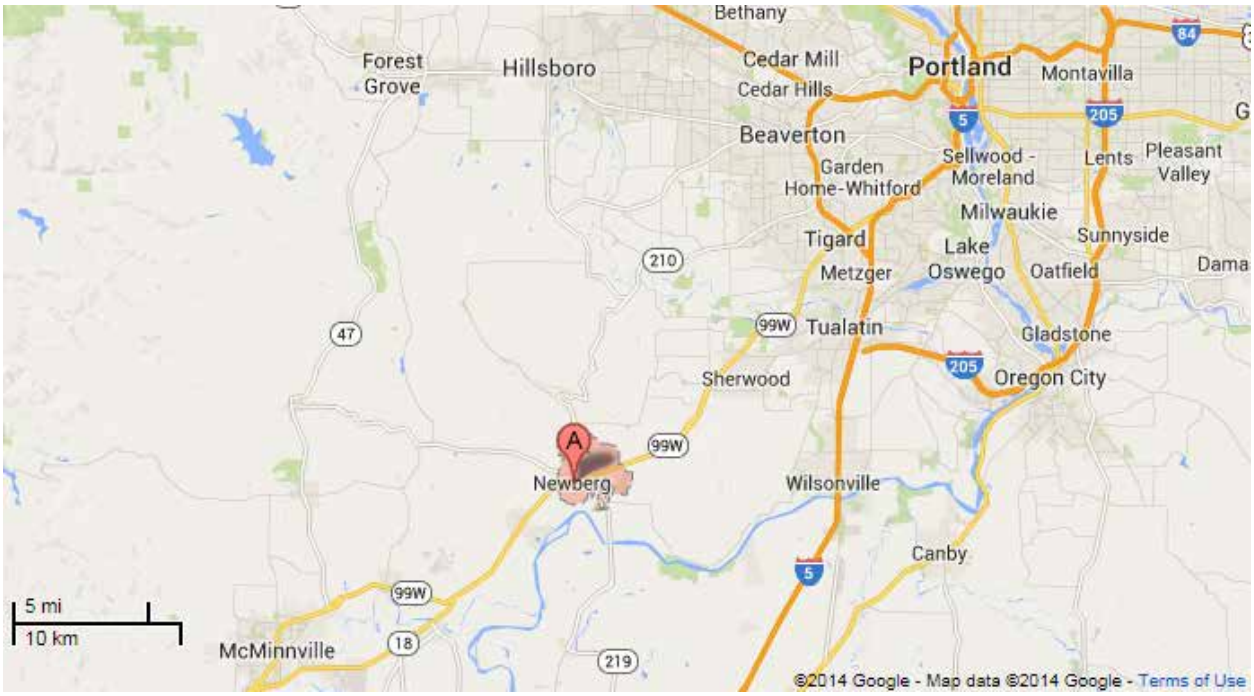

Figure 2-1. Vicinity map

The city is approximately 5.8 square miles and is drained by Chehalem Creek, Hess Creek, and Spring Brook. Chehalem Creek and Spring Brook drain to the Willamette River near River Mile 51.0 and River Mile 47.2, respectively. Hess Creek enters Spring Brook downstream of the city limits.

2.2 Topography

Topographic information was compiled using 2012 aerial imagery and LiDAR data on the North American Vertical Datum of 1988 (NAVD88). Anecdotal information from City staff and six field visits by Brown and Caldwell staff were used to supplement these data.

Newberg is located within the Willamette River Valley and gently slopes from the north down to the Willamette River to the south. The highest point within the city is located at elevation 456.3 and the

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lowest is near the Willamette River at elevation 62.2. The Hess Creek and Spring Brook watersheds extend into the mountains and flow through Newberg. Outside of the city, the watersheds extend up to elevations of 1,249.4 and 1,225.8, respectively. The creeks within the city flow from north to south and provide a natural drainage system throughout the city. The average slope within the city boundary ranges from 0.5 percent to 27.4 percent and averages approximately 5.6 percent. The average slope of Hess Creek passing through the center of the city from north to the south is approximately 1 percent. Figure 2-2 illustrates the city topography.

2.3 Soils

Soil classification is an important characteristic to consider when evaluating runoff flow rates and volumes. Soil types within the study area were identified using data from the Natural Resource Conservation Service Soil (NRCS) Survey. Soil information is based upon data obtained from the NRCS Web Soil Survey (2013) which publishes information from the 1974 publication from the U.S. Department of Agriculture Soil Conservation Service titled *Soil Survey of Yamhill Area, Oregon*.

Table 2-1 shows soil types, soil characteristics and distribution within the UGB according to the NRCS soil survey.

Table 2-1. Soil Characteristics

NRCS map unit name	NRCS map symbol	Hydrologic soil group	Percent coverage in UGB
Aloha silt loam	Ah	C	42.8
Amity silt loam	Am	D	8.3
Carlton silt loam, 0 to 7 Percent slopes	CaB	C	0.1
Carlton silt loam, 7 to 12 Percent slopes	CaC	C	0.1
Carlton silt loam, 12 to 20 percent slopes	CaD	C	0.1
Cloquato silt loam	Cm	B	0.0
Cove silty clay loam, thick surface	Cs	D	0.7
Dayton silt loam	Da	D	0.4
Dayton silt loam, thick surface	Dc	D	0.8
Hazelair silty clay loam, 2 to 7 percent slopes	HcB	D	0.5
Hazelair silty clay loam, 7 to 20 percent slopes	HcD	D	0.7
Jory clay loam, 2 to 7 percent slopes	JrB	B	0.7
Jory clay loam, 12 to 20 percent slopes	JrD	B	0.2
Jory clay loam, 20 to 30 percent slopes	JrE	B	0.0
Jory clay loam, 30 to 60 percent slopes	JRF	B	0.1
Laurelwood silt loam, 3 to 12 percent slopes	LuC	B	0.1
Laurelwood silt loam, 12 to 20 percent slopes	LuD	B	0.2
Nekia clay loam, 2 to 7 percent slopes	NcB	B	0.2
Nekia clay loam, 7 to 20 percent slopes	NcD	B	0.5
Panther silty clay loam, 4 to 20 percent slopes	PaD	D	0.0
Shale rock land	SH	D	0.0
Stony land	SL	A	0.3
Terrace escarpments	Te	C	6.0
Water	WATER	Water	0.0

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Table 2-1. Soil Characteristics

NRCS map unit name	NRCS map symbol	Hydrologic soil group	Percent coverage in UGB
Wapato silty clay loam	Wc	D	3.0
Willakenzie silty clay loam, 2 to 12 percent slopes	WeC	C	0.3
Willakenzie silty clay loam, 12 to 20 percent slopes	WeD	C	0.1
Willakenzie silty clay loam, 20 to 30 percent slopes	WeE	C	0.0
Willamette silt loam, 0 to 3 percent slopes	WIA	B	0.8
Willakenzie silty clay loam, moderately shallow, 7 to 20 percent slopes	WkD	C	0.1
Woodburn silt loam, 0 to 7 percent slopes	WuB	C	28.0
Woodburn silt loam, 7 to 12 percent slopes	WuC	C	2.6
Woodburn silt loam, 12 to 20 percent slopes	WuD	C	2.4

The soils listed in Table 2-1 are illustrated within the study area in Figure 2-3.

2.4 Land Use

Newberg's 2010 population was reported by the U.S. Census Bureau to be 22,068. The City's Comprehensive Plan projects significant population growth over the next several decades, with the 2020 population projection at 28,250 and the 2030 population projection at 35,408. The city is largely developed within the current UGB, but does have some significant remaining vacant areas in the northeast portion of the city. Currently land use includes a mix of residential land use and industrial and commercial corridor along Hwy 99W.

The City's GIS department has measured and mapped existing impervious areas within the city limits. These include residential houses (roofs), and building footprints and pavement areas for commercial, industrial, and civic areas. The mapped pavement areas include parking lots, sidewalks, and paved paths. Public right of way was mapped based on tax lot information and is assumed to average 75 percent impervious.

Figure 2-4 shows the existing impervious areas mapped by the City's GIS department.

The Comprehensive Plan land use map was used to estimate and assign impervious area percentages applicable to future development conditions for hydrologic modeling. The Comprehensive Plan includes several special planning districts, including the Springbrook District and the Riverfront District. These areas are designated to provide a flexible development approach, allowing for a mixture of residential, hospitality/public, commercial, and industrial uses. Newberg's Urban Reserve Areas were discussed with the City and divided into three categories: Industrial, High-Density Residential, and Low-Density Residential. The City's comprehensive plan was used to assign future impervious percentages, as shown in Table 2-2. All vacant lands were assumed to be developed in the future condition land use scenario for modeling purposes.

Figure 2-5 shows the future conditions land use coverage within Newberg and the UGB.

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Table 2-2. Future Conditions Land Use Categories	
Future conditions land use (LU) classification	Impervious percentage, %
Commercial	85
Commercial (Riverfront)	85
Commercial (Specific Plan)	85
Springbrook District: Village	85
Springbrook District: Neighborhood Commercial	85
Springbrook District: Hospitality	85
Mixed Use	80
Mixed Use (Specific Plan)	80
Industrial	75
Industrial (Riverfront)	75
Industrial (Specific Plan)	75
Urban Reserve Area: Industrial	75
Springbrook District: Employment	75
High-Density Residential	70
High-Density Residential (Specific Plan)	70
Urban Reserve Area: High-Density Residential	70
Medium-Density Residential	60
Medium-Density Residential (Riverfront)	60
Medium-Density Residential (Specific Plan)	60
Springbrook District Mid-Rise Residential	60
Low-Density Residential	50
Low-Density Residential (6 du/ac)	50
Low-Density Residential (Riverfront)	50
Low-Density Residential (1A)	50
Low-Density Residential (Specific Plan)	50
Urban Reserve Area: Low-Density Residential	50
Springbrook District: Low-Density Residential	50
Urban Reserve Area: Multi-Use	40
Quasi-Public	40
Parks	10
Parks (Riverfront)	10

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2.5 Climate and Rainfall

The north Willamette valley experiences relatively warm, dry summers and mild wet winters. The Coast Range provides some shielding from Pacific Ocean storms. The following climate data is based on the Western Regional Climate Center historic record from 1928 to 2005 for McMinnville, Oregon (station 355384). The normal daily high temperatures range from approximately 83 degrees in August to 46 degrees in January. Normal daily low temperatures range from approximately 50 degrees in July to 33 degrees in January.

The average annual precipitation is approximately 41.8 inches with 6.7 inches of snowfall. Most of the precipitation in this area falls between the months of October and April; however, short, intense summertime storms contribute to the annual rainfall as well.

Reference: http://www.wrcc.dri.edu/summary/climsmor.html

2.6 Drainage System

The city's drainage system is defined by the three creeks running from north to south through the city. From west to east, the creeks include Chehalem Creek, Hess Creek, and Spring Brook. All of the creeks flow into the Willamette River, which is one of the Columbia River's primary tributaries.

The City maintains approximately 55 miles of conveyance system, either in closed storm pipes or open channels.

For the purposes of the modeling effort for this plan, subcatchments were delineated to capture drainage to City-owned 12-inch-diameter and larger storm drain piping and major open channel conveyances within the UGB. Inlet leads, pipes smaller than 12 inches in diameter, and pipes not owned by the City were not included in this effort.

Drainage areas for Hess Creek and Spring Brook were also delineated to capture the extent of their respective watersheds which extend beyond the UGB. The Hess Creek watershed extends north of the existing UGB to Mountain Top Road and is bound to the west by Chehalem Creek and to the east by Spring Brook. The drainage area for Spring Brook extends north of the existing UGB to Mountain Top Road and east of the UGB to NE Old Parrett Mountain Road and NE Kramien Road.

Figure 2-6 illustrates delineated subcatchments and the modeled pipe system on a citywide scale. More detailed mapping associated with system modeling is presented in Section 3.

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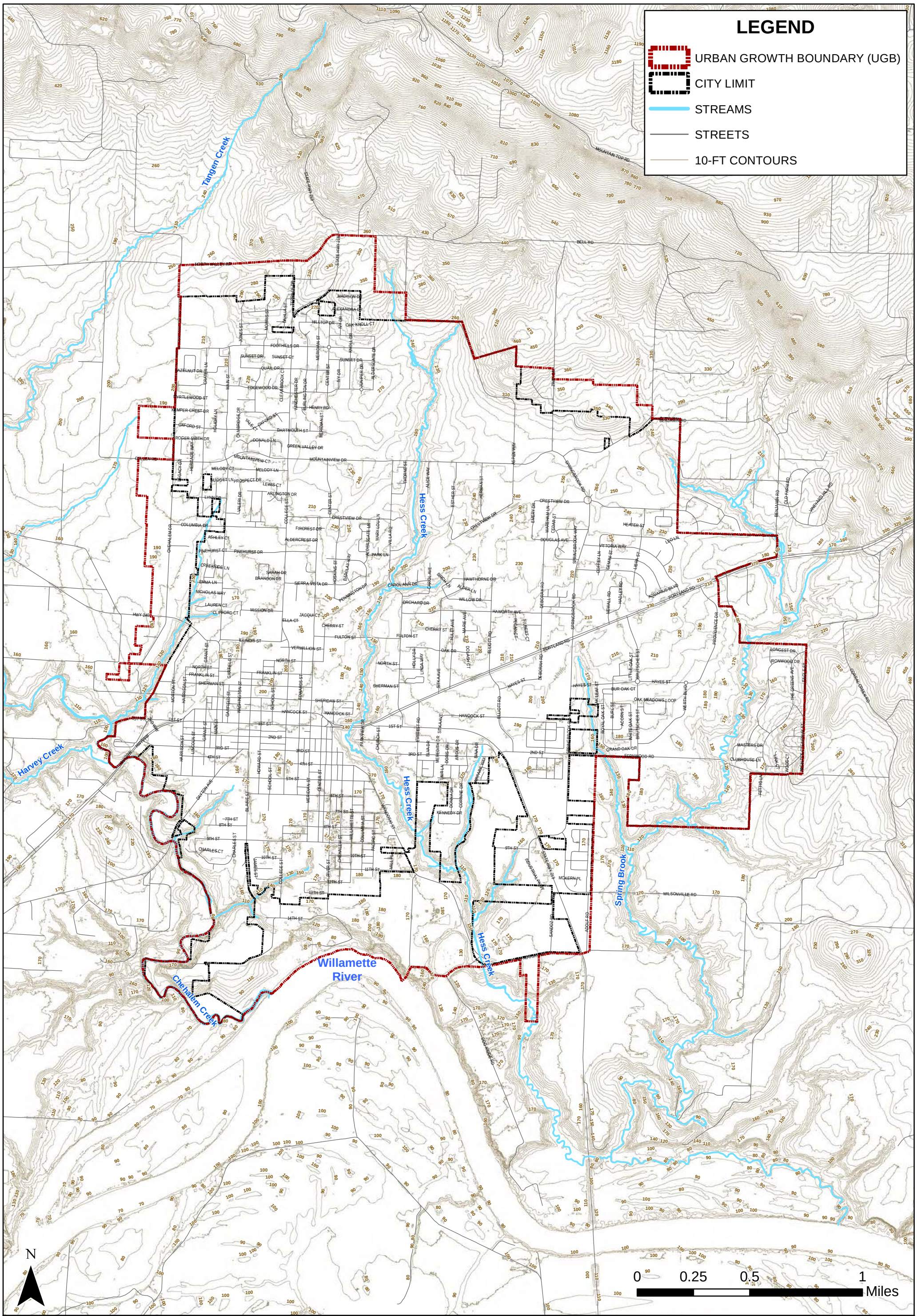

STORMWATER MASTER PLAN UPDATE

FIGURE 2-2. TOPOGRAPHIC MAP

NEWBERG, OREGON

City of Newberg

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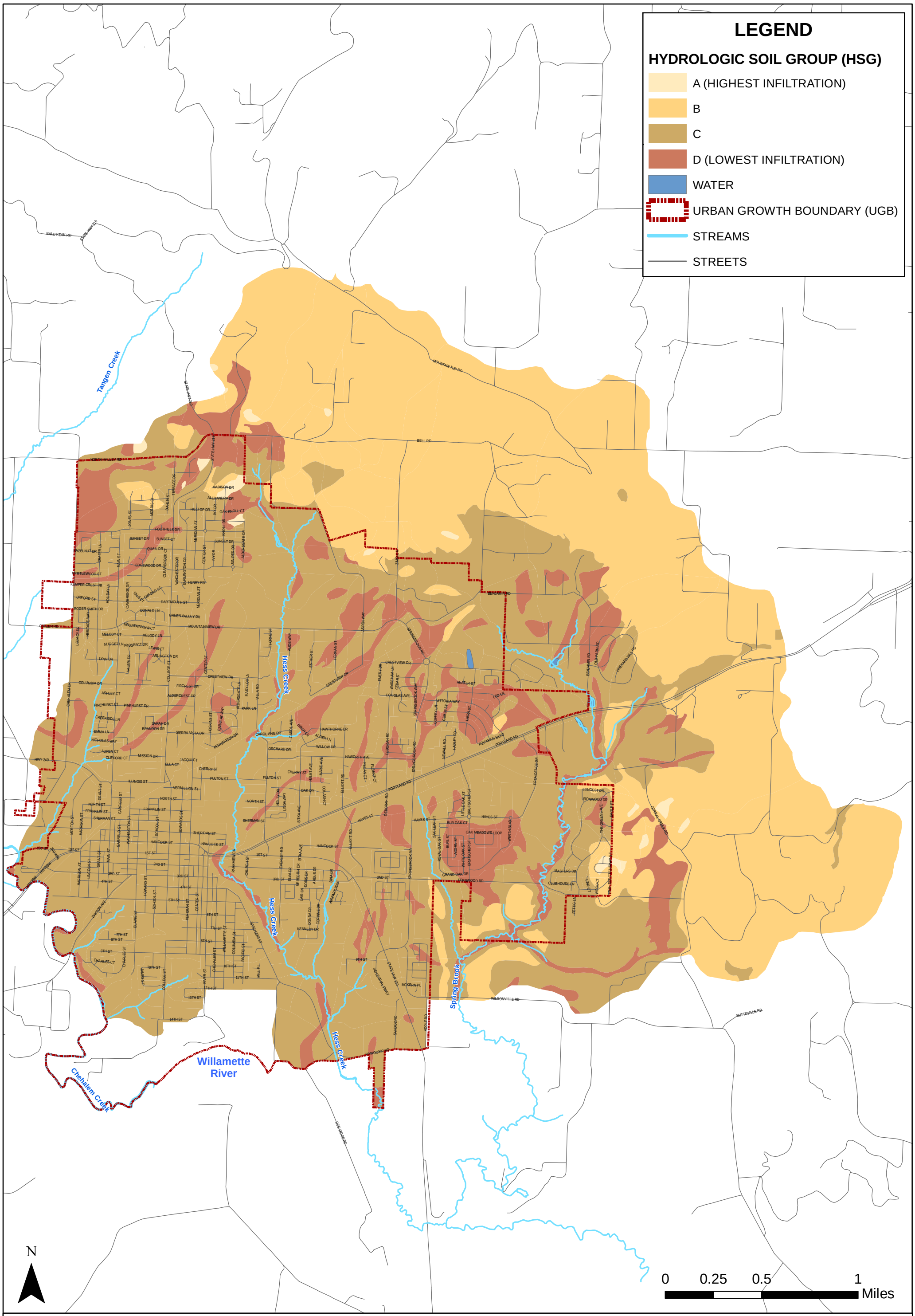

City of Newberg

STORMWATER MASTER PLAN UPDATE

FIGURE 2-3. SOILS MAP

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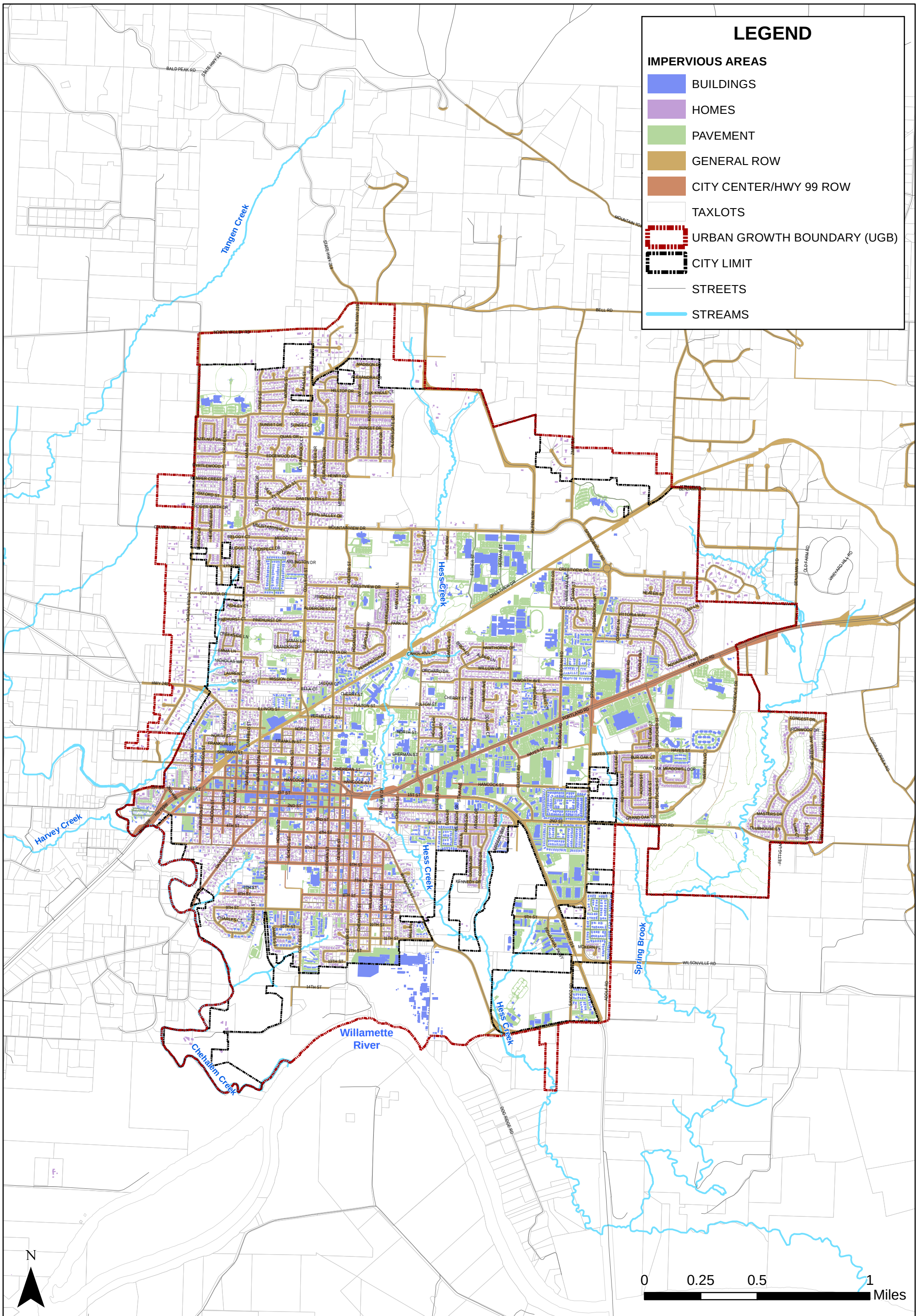

STORMWATER MASTER PLAN UPDATE

FIGURE 2-4. EXISTING IMPERVIOUS AREAS

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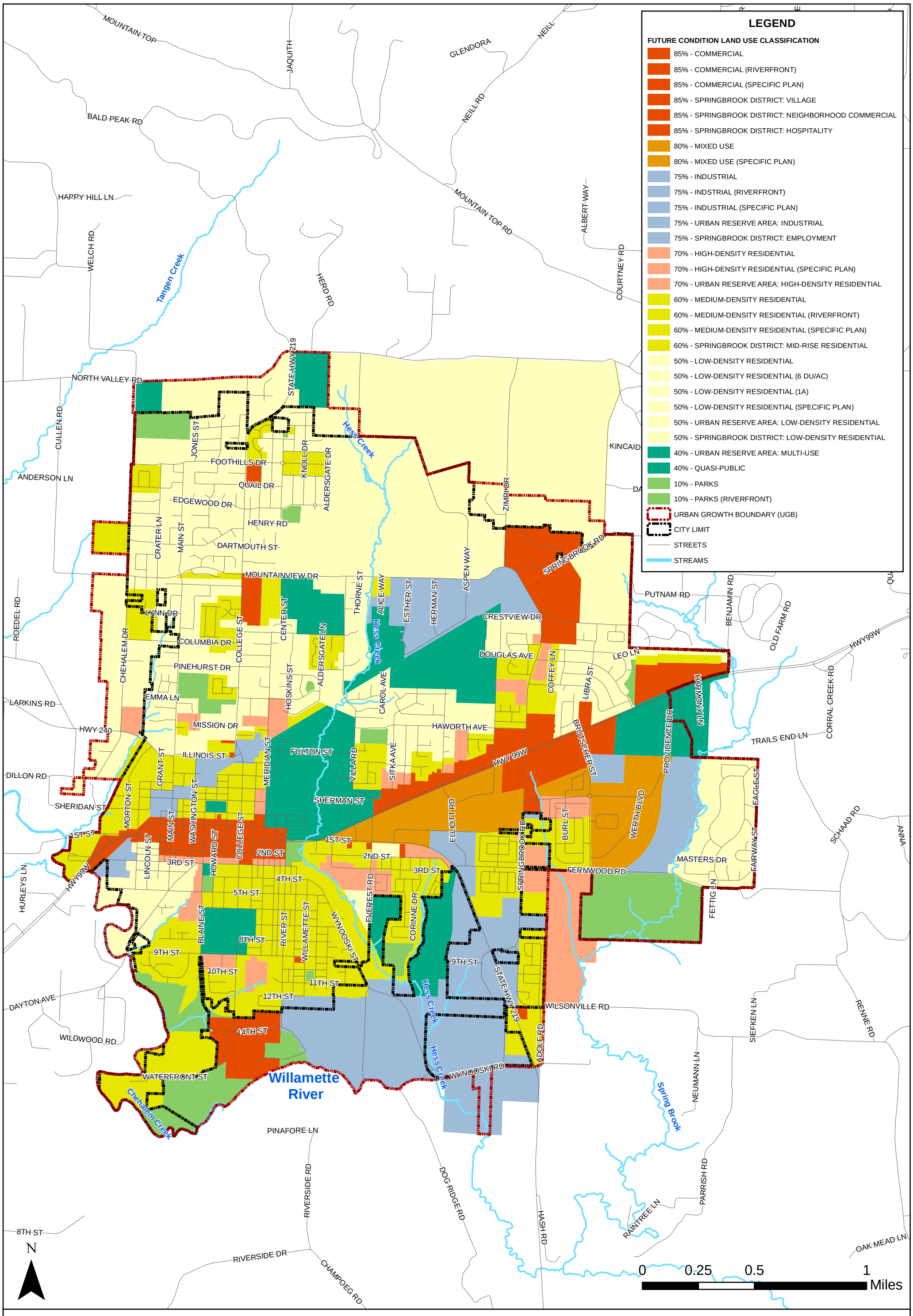

STORMWATER MASTER PLAN UPDATE

FIGURE 2-5. FUTURE CONDITIONS LAND USE

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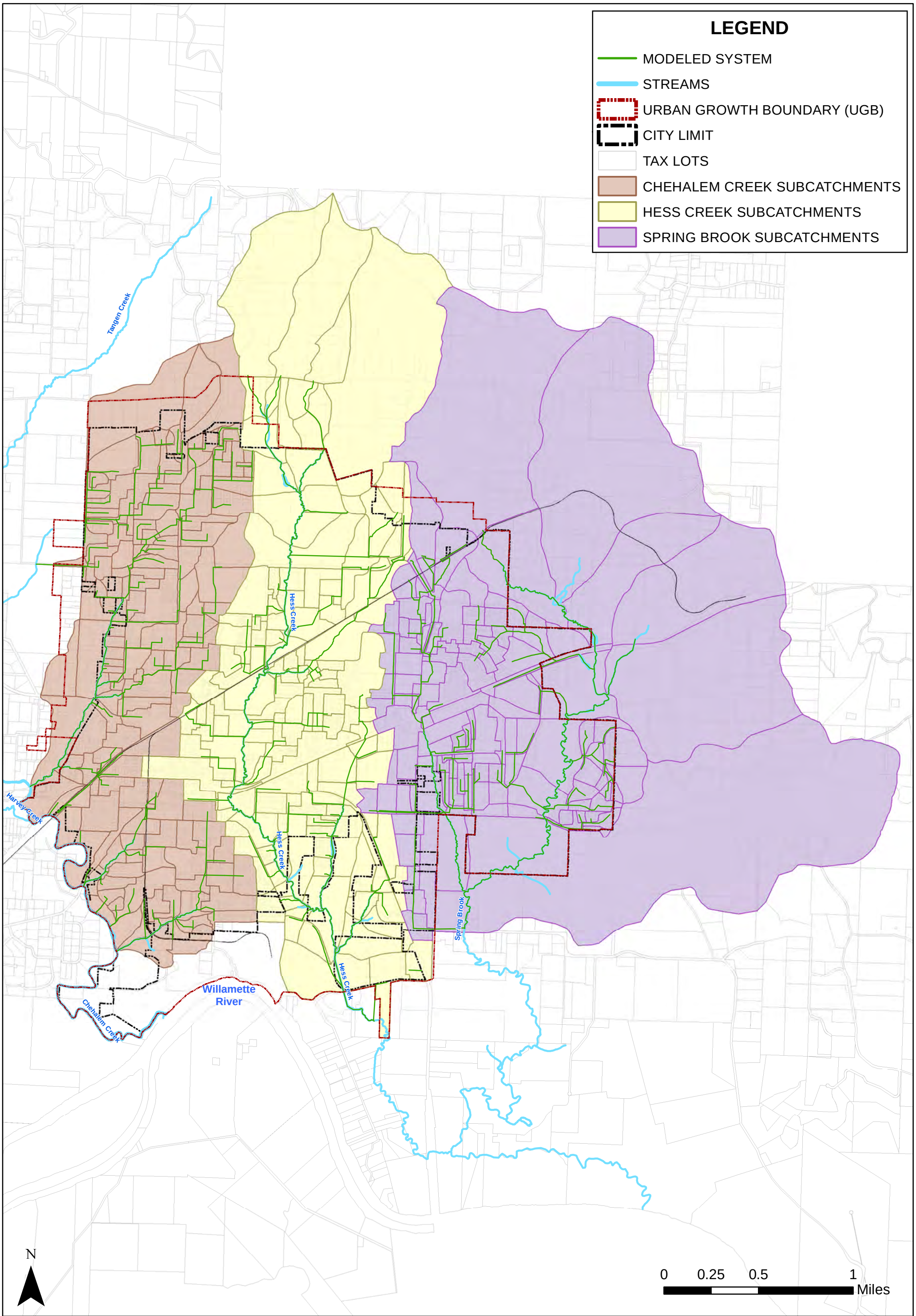

City of Newberg

STORMWATER MASTER PLAN UPDATE

FIGURE 2-6. DRAINAGE SYSTEM AND STUDY AREA

NEWBERG, OREGON

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Section 3

Stormwater System Capacity Evaluation

To identify flooding problems and opportunities for CIPs, two primary methods of system evaluation were utilized. First, the City's public stormwater drainage system was evaluated using a hydrologic and hydraulic model to simulate the rainfall to runoff characteristics and route estimated flows through the City's conduits and channels. The stormwater drainage system was evaluated under both existing land use and future development scenarios. This section provides a description of the modeling methods used for the system capacity evaluation and provides a summary of results.

The second method of system evaluation was to identify drainage capacity and other infrastructure problems through discussions with City staff and a review of existing reports that document potential problems. The compilation of additional problem areas is documented in Section 3.5.

3.1 Model Development

Computational Hydraulics International's PC SWMM 2012, v. 5.0.022, was the software used to model the City's storm system. PC SWMM 2012 provides a graphical interface for the U.S. Environmental Protection Agency (EPA) SWMM5 engine. The PC SWMM interface is integrated with Esri ArcGIS. Files transferred to the City will be in EPA SWMM5 format, which may be used by the City for internal modeling and future updates after the completion of this Stormwater Master Plan (Master Plan).

The model of the City's storm drain system includes City-owned storm drainage pipes 12 inches and larger in diameter and major open-channel conveyances. Inlet leads, pipes smaller than 12 inches in diameter, and pipes not owned by the City were generally not included in this effort. System mapping completed for the model development is shown in Appendix A, which contains a key map at a 1" = 2,000' scale and seven full size system maps at a 1" = 500' scale.

The storm system model also includes limited channel modeling for the east branch of Chehalem Creek, Hess Creek and two branches of Spring Brook as shown on Figure 2-5. A Yamhill County Flood Study was developed in 1980 and includes models of Chehalem Creek and Hess Creek. However, as urbanization has significantly changed the creek systems since the development of these earlier models, current channel information was estimated from more recent LIDAR topographic information and verified through limited field work. Culvert and bridge data were incorporated from the City's geographic information system (GIS) and as-built maps.

Model development requires input of meteorological data, subcatchment hydrology, and surface water system hydraulic input parameters. Precipitation data, as design storms, were used to evaluate system capacity. Input parameters associated with subcatchment hydrology and surface water system hydraulics were developed through use of the City's GIS data. Gaps in City GIS data were filled using data from City field verifications and the 2001 Stormwater Master Plan.

3.1.1 Horizontal and Vertical Datum

All reported elevations and coordinates in this study are measured in feet and use the NAVD88 and the North American Datum of 1983 (NAD83) state plane coordinate system, respectively.

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A section of the City's storm-drain system GIS data were on the National Geodetic Vertical Datum of 1929 (NGVD29) prior to this project and were converted to NAVD88. The conversion from NAVD88 to NGVD29 is to subtract 3.415 feet.

3.1.2 Design Storms

Traditional design storms are synthetic rainfall events used to evaluate the capacity of storm drainage systems and design capital improvements for the desired level of capacity and flood protection.

Design storms evaluated for this study included the 2-year, 10-year, 25-year, and 100-year 24-hour duration design storms.

The rainfall depths for these design storms were based on isopluvial maps published in the NOAA Atlas 2, Volume X. The rainfall distribution for these design storms is based on the Soil and Conservation Service (SCS) 24-hour, Type IA distribution, which is applicable to western Oregon, Washington, and northwestern California. Table 3-1 lists the precipitation depths for each design storm used in the model.

Table 3-1. Design Storm Depths

Design storm event	Rainfall depth, inches
2-year, 24-hour	2.5
10-year, 24-hour	3.5
25-year, 24-hour	4.0
50-year, 24-hour	4.2

3.1.3 System Nomenclature

This master planning effort incorporated the same nomenclature as the City's GIS for all the different elements all the stormwater system. Most of the manholes in the system are labeled STMH followed by an identifier number. Most of the pipes within the system are identified with STGM followed by a unique number. For the modeling effort additional identifiers were created for the modeled creek system and to provide additional detail to the pipe system. Open channel reaches on the three main creeks were labeled with CC, HC, or SB followed by a number. These labels represent Chehalem Creek, Hess Creek and Spring Brook, respectively. Numbering was started at the lower reaches and numbers increased in the upstream direction. Tributaries were named CCT1 (Chehalem Creek Tributary 1) followed by a number. Additional nodes were included in the model as breaking points between reaches, at slope changes, and where manholes were discovered that were not part of the GIS inventory. These additional nodes were labeled with a J followed by a number.

Subcatchments or drainage basins were developed and each subcatchment was named according to the name of the drainage element that the subcatchment drained into. For example, the runoff from subcatchment SC_STMG128 would enter the system STMG128. The key map in Appendix A illustrates the location of the modeled elements within the study area. Detailed maps which include the location of the modeled elements, named subcatchments, and inlet nodes are also located in Appendix A.

3.1.4 Hydrologic Data

This section includes a summary of subcatchment delineations and model input parameters used to define the hydrologic characteristics of the subcatchments. Table 3-2 identifies and describes model attributes associated with subcatchments.

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Table 3-2. Subcatchment Model Attributes	
Attribute	Value
Name/Outlet	Identified by the storm drain element that has been identified according to the subcatchment inlet node
Area	Area of the subcatchment in acres
Width	Characteristic width of the overland flow path for sheet flow in feet
Slope	Average percent slope of the subcatchment
Imperv	Average percent of land area that is directly connected impervious area
Nimperv	Manning's *n* for overland flow over the impervious portion of the subcatchment (default value = 0.015)
Nperv	Manning's *n* for overland flow over the pervious portion of the subcatchment (default value = 0.030)
Dstore-Imperv	Depth of depression storage on the impervious portion of the subcatchment (default value = 0.05)
Dstore-Perv	Depth of depression storage on the pervious portion of the subcatchment (default value = 0.2)
ZeroImperv	Percent of the impervious area with no depression storage (default value = 25)
Routing	Runoff from pervious and impervious areas routes to a node within the storm drain system (value=OUTLET)
PctRouted	Percent runoff routed between subcatchments (default = 100)
Groundwater	Groundwater routing is not included (value=NO)
CurveNo	SCS pervious curve number calculated as an area-weighted average, based on the hydrologic soil group within each subcatchment

The curve number method was used to model runoff characteristics. PC SWMM utilizes a pervious curve number to calculate the infiltration for each sub-catchment. This method is documented in the U.S. EPA *Technical Release 55*.

The pervious curve number is based on the underlying soil type, as shown in Table 3-3.

Table 3-3. Pervious Curve Numbers				
Land Use	Hydrologic Soil Group (HSG)			
	A	B	C	D
Impervious	98	98	98	98
Open space/grass	39	61	74	80

For the existing conditions model, the percentage of impervious surface was estimated using the City's impervious surface and tax lot layers in GIS and spot-checking with aerial imagery. For the future conditions model, the percent impervious was assigned based on the assumed impervious percentages for each land use type from the Comprehensive Plan (See Table 2-2).

Appendix B, Table B-1, provides model parameters and peak flows for each subcatchment and modeled design storm. Table B-2, provides model parameters and runoff volumes for each subcatchment and modeled design storm.

3.1.5 Hydraulic Data

This section describes the model input parameters used to characterize the hydraulic characteristics of the system.

System hydraulics were based on GIS data provided by the City. Where needed, GIS data were supplemented with data from the 2001 Master Plan; as-built information and maps provided by the City; aerial imagery; and LIDAR topographic information. The City collected field survey data to validate invert

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and rim elevations and system geometry as part of this Master Plan process. Hydraulic components developed from these data and imported into the model included conduits and junctions. A description of hydraulic components is provided in the following sections.

3.1.5.1 Nodes

Model nodes include storm drain utility manholes, catch basins, and other relevant connection points or locations where a conduit change occurs. Model nodes have the attributes as listed in Table 3-4.

Table 3-4. Model Node Attributes

Attribute	Value
ID	Unique identifier
Invert elevation	Invert elevation of the node in feet.
Depth	Depth (feet) = Rim elevation – invert elevation.
Ponded area	Area available for ponding of water atop of the node after flooding occurs in square feet. Allows ponded water to be stored and subsequently returned to the drainage system when capacity exists.

Appendix B, Table B-2, provides model parameters and peak flows for each modeled node.

3.1.5.2 Conduits

Model conduits include pipes, culverts, and open channels. Model conduits have the model attributes as shown in Table 3-5.

Table 3-5. Model Conduit Attributes

Attribute	Value
ID	GIS Unique ID (when available)
Length	Length between upstream and downstream junctions in feet
Roughness	Manning's Roughness Coefficient: • Concrete Pipe: 0.013 • Corrugated Metal Pipe: 0.024 • Ductile Iron (DI): 0.013 • HDPE: 0.0125 • PVC: 0.0125 • Unknown: 0.013 • Open channel: 0.04 – 0.10
Cross-Section	Circular, trapezoidal, or irregular
Inlet Elevation	Elevation of conduit inlet in feet
Outlet Elevation	Elevation of conduit outlet in feet
Geom1	• Circular: diameter in feet • Trapezoidal: max depth in feet
Geom2	Trapezoidal: bottom width in feet
Geom3	Trapezoidal: left slope (horizontal/vertical)
Geom4	Trapezoidal: right slope (horizontal/vertical)
Barrels	One for single pipe, two or more for parallel pipes

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Table B-2 in Appendix B provides model parameters, 10-year recurrence interval peak flows, and the calculated hydraulic capacity for each modeled conduit.

3.1.5.3 Storage

No storage facilities were modeled because there were no in-line facilities located within the modeled system.

3.1.5.4 Outfalls

The study area includes 16 piped outfalls. Model outfalls have the attributes shown in Table 3-6.

Table 3-6. Outfall Model Attributes

Attribute	Value
Name	Unique identifier
Invert elevation	Invert elevation of the outfall in feet
Rim elevation	Ground surface elevation at the outfall in feet
Type	Type of outfall boundary condition; options used include: • FREE: Outfall stage is determined by minimum of critical flow depth and normal flow depth in the connecting conduit. • FIXED: Outfall stage is set to a fixed value equal to the top of the outfall pipe; this condition was selected for system evaluation and CIP sizing in systems draining to Chehalem Creek, Hess Creek, and Spring Brook.

3.2 Evaluation Criteria

Section 4 of the City's Standard Design Manual includes design requirements for storm drainage systems in Newberg. At the time of the SWMM model development, the City was using the *2010 Standard Design Manual*, so that manual was referenced for establishing the design standards for evaluating the capacity of the stormwater infrastructure. The existing and future storm drainage pipe network was evaluated for capacity based on the following conditions:

- Minor drainage system elements (streets, curbs, gutters, inlets, catch basins, and collector drains): capacity for the 10-year design storm
- Major laterals (laterals and collectors with less than 250 acres tributary area): capacity for the 10-year design storm
- Major trunk lines (trunk lines with greater than 250 acres of tributary area and drainage systems under arterial streets: capacity for the 50-year design storm
- Culverts on creek systems: capacity for the 50-year design storm

For the purpose of evaluating the capacity of the existing and future storm drainage infrastructure, flooding was defined as any surcharge over the rim elevation of a manhole or above the bank elevation of open channels. Minor flooding is defined as flooding that occurs for less than 2-hours during the peak 24-hour design storm. Major flooding is defined as flooding that occurs for more than 2-hours during the peak 24-hour design storm.

During the development of this Master Plan, the City was in the process of updating the Stormwater Design Standards. The proposed standards included a change to using the 25-year, 24-hour design storm for sizing stormwater pipes conveying water from drainage areas less than 250 acres in size. In order to plan for this change in the City's design standards, the proposed capital improvement projects (CIPs) for drainage areas less than 250 acres have been sized for the 25-year design storm. See Section 6 for additional information on proposed CIPs.

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3.3 Model Validation

Preliminary modeling results were reviewed with City staff during a project meeting in November 2013 and compared to known flooding problems reported by the City's maintenance crews. Anecdotal accounts of flooding were generally consistent with the locations where flooding occurs in the modeled system. In some cases, City staff report flooding problems due to sediment build-up or other field conditions (e.g. a grading problem that prevents adequate collection of runoff into the stormwater system) that are not reflected in the hydraulic model. These problems were documented for CIP development, but did not require a change in the hydraulic model.

Discussions with City staff lead to several minor adjustments to the modeled drainage system. Most notably, maintenance staff identified locations between Oxford Street and Meadowview Drive, where maintenance crews had addressed flooding problems through field adjustments to the drainage system that had not yet been documented in the City's GIS database. After adjusting the modeled system to reflect field conditions, the model validation was complete.

3.4 Model Results

PC SWMM (version 5.2.1318) was used to simulate the 2-year, 10-year, 25-year, and 50-year design storms for the current and future development conditions.

Results of the hydrologic/hydraulic (H/H) model simulations are tabulated in Appendix B (Table B-1 for hydrologic peak flow results and Table B-2 for hydraulic results). For reporting purposes, the hydrologic results reflect all simulated design storms, and the hydraulic results tables reflect just the 10-year flows, which were used to identify capacity deficiencies in most areas of the City. Hydraulic results for larger storm events are available in the electronic project files.

The hydrologic results table (Table B-1) is sorted by basin and subcatchment, and includes the subcatchment name, modeled inlet node ID, subcatchment area, curve number, impervious area, and associated design flow. The hydraulic results table (Table B-2) is sorted by system basin and conduit, and includes the conduit name, upstream and downstream node ID, length, size, invert and rim elevations, and existing and future 10-year peak flows and water surface elevations.

3.4.1 Initial Identification of Flooding Problems

Based on the hydraulic model results summarized in Table B-2, conduits experiencing backwater conditions that resulted in flooding of the upstream manhole were identified. Figures 3-1 and 3-2 illustrate predicted flooding for existing and future land use conditions.

The model results were reviewed with City staff in November, 2013. City staff provided comment and discussion about each identified modeled flooding area. Table 3-7 summarizes the identified flooding problem areas.

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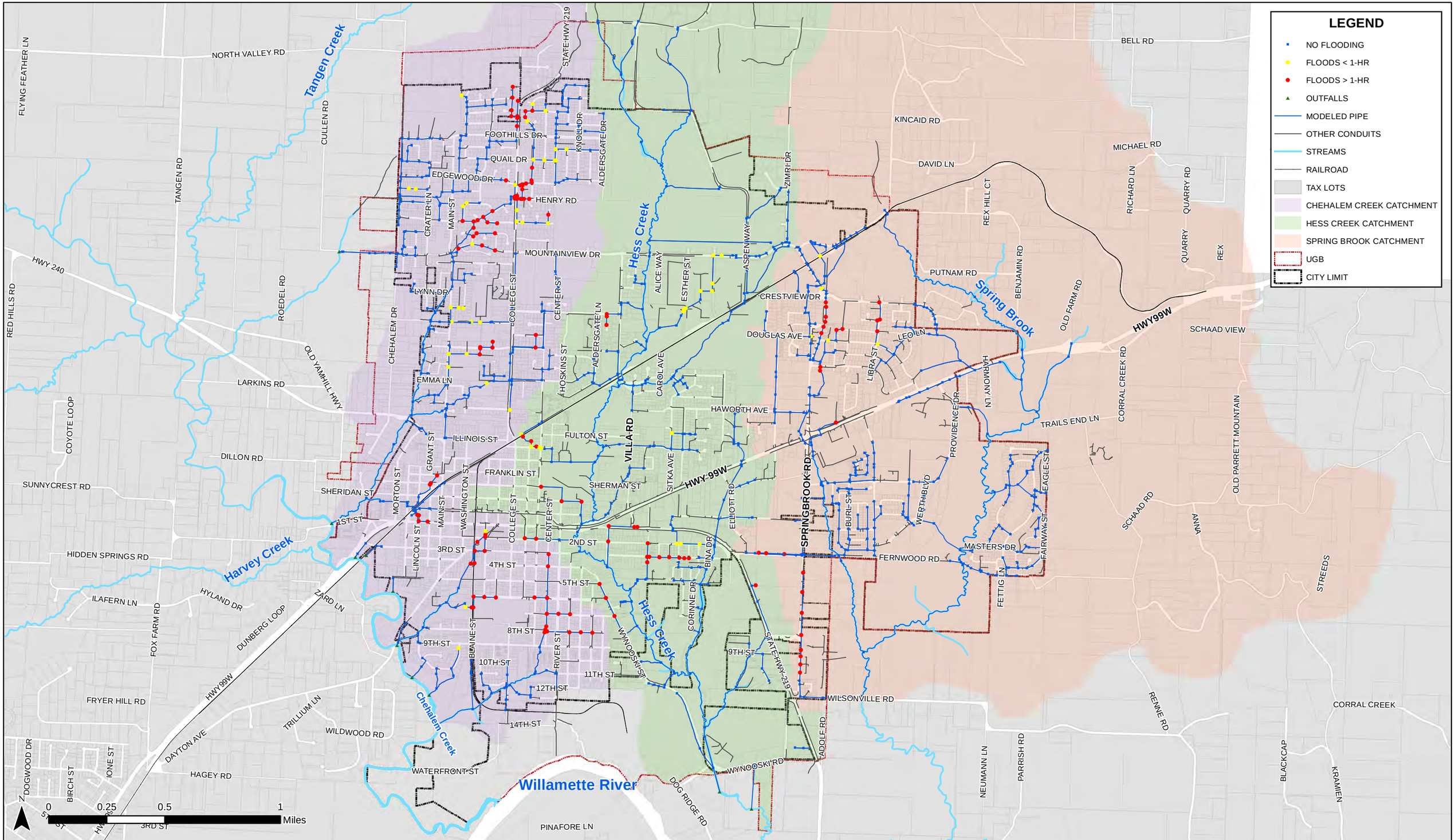

STORMWATER MASTER PLAN UPDATE

FIGURE 3-1. PREDICTED FLOODING: EXISTING LAND USE, 10-YR DESIGN STORM

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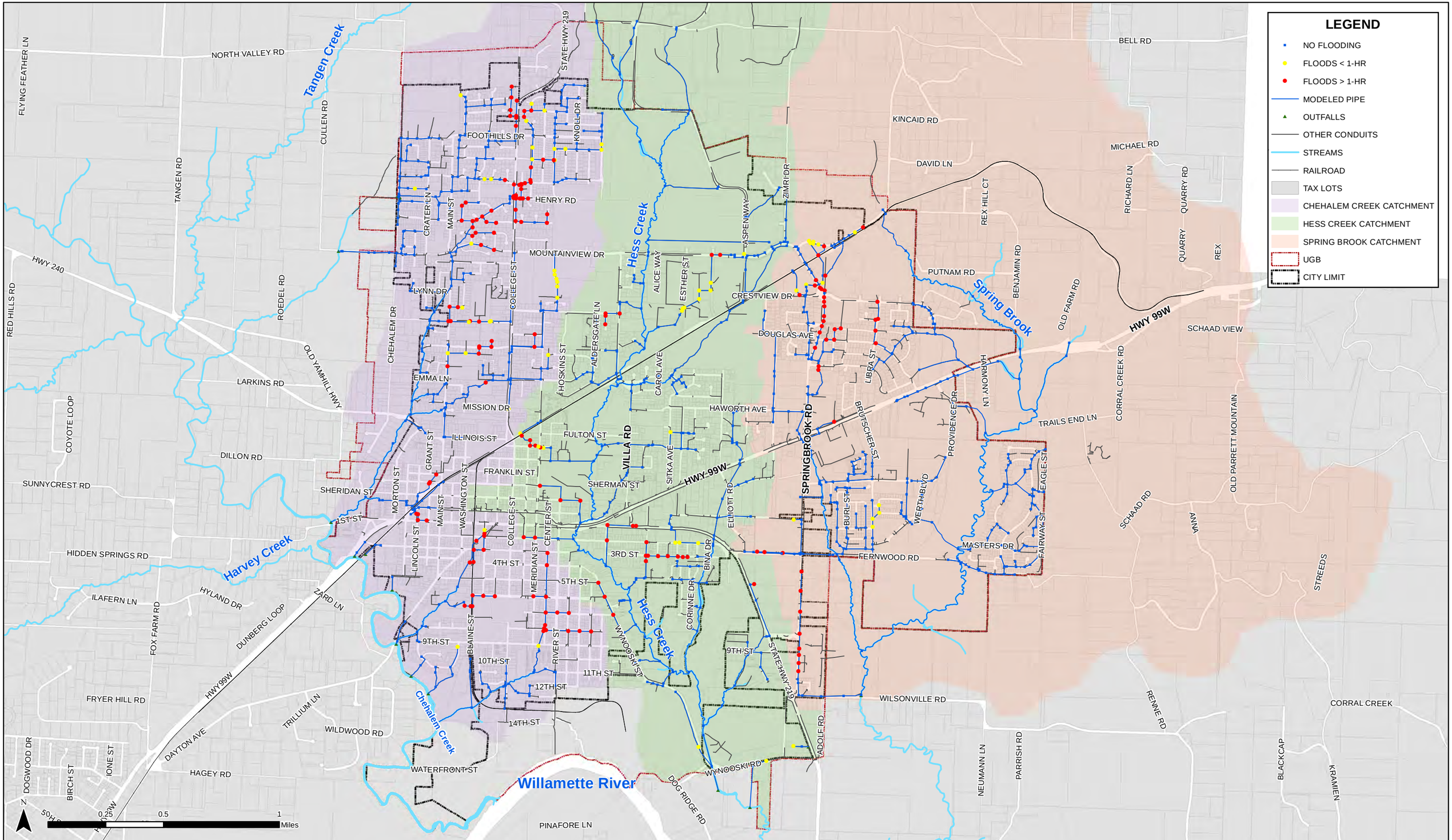

STORMWATER MASTER PLAN UPDATE

FIGURE 3-2. PREDICTED FLOODING: FUTURE LAND USE, 10-YR DESIGN STORM

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Table 3-7. Flooding Problem Areas

Location	Event(s) deficiency occurs	Problem description	Potential solution	Length of conveyance improvements, linear feet	Contributing drainage area, acres
Chehalem Creek					
South Blaine Street, between East 6th Street and East 7th Street	Existing and future 10-yr	Currently a reach of 12"-18" stormwater pipe runs through private property and under several houses. Flooding along E 6th St and S Blaine St occurs during the current and future conditions 10-year storm event.	Decommission the stormwater pipes which are in private property and add a 24" stormwater pipe along S Blaine St and a 12" pipe along E 1st St. Connect the stormwater system from E 6th St to S Blaine St to provide conveyance and storage. Upsize existing stormwater pipes to 24" and 18" to convey existing and future flows.	2,887	62.0
South Center Street, between East 3rd Street and East 9th Street	Existing and future 10-yr	Currently a reach of 21" stormwater pipe runs through private property and under several houses. Flooding along E 8th St, E 7th St, and S Center St occurs during the current and future conditions 10-year storm event.	Decommission the stormwater pipes which are on private property and add a 30" stormwater pipe along S Center St. Upsize existing stormwater pipes to 30", 24" and 18" to convey existing and future flows.	3,860	100.1
East Columbia Drive, west of North College Street	Existing and future 10-yr	Flow is currently limited by three undersized 18" pipes which restrict flow from larger-diameter upstream pipes. Hydraulic modeling shows overflow from manholes during the 10-year existing/future flow event. Downstream pipe segments are 24" diameter and have capacity for current and future 10-year flow event.	Upsize existing stormwater pipes to 24" to convey existing and future flows.	92	56.7
Oxford Street, between Winchester Drive and East Mountainview Drive	Existing and future 10-yr	Flow is currently restricted by fourteen undersized pipes. Flooding from manholes is shown to occur during the 10-year existing/future flow event. Pipe diameters increase and decrease in numerous places throughout this alignment. The City has installed some upsized pipes to address acute problems. This project provides a broader solution to provide long term capacity.	Upsize existing stormwater pipes to 36" to provide capacity for future flows.	1,860	167.4
North College Street and Dahlia Street, between Natalie Drive and Foothills Drive	Existing and future 10-yr	Flow is currently restricted by four undersized pipes during the current and future conditions 10-year storm event.	Upsize existing stormwater pipes to 24" to convey existing and future flows.	691	102.8
Hess Creek					
North Edwards Street, from Vermillion Street to East Sheridan Street	Existing and future 10-yr	The City has reported drainage problems along Vermillion St between N College St and the railroad. Currently a flat and undersized pipe discharges stormwater along the railroad tracks. This neighborhood has some bubblers at intersections, but does not have a defined connection to the public stormwater system.	Add a drainage system to convey flows from Vermillion St to the existing drainage system at E Sheridan St.	4,340	38.0
East 3rd Street and South Church Street	Existing and future 10-yr	Modeling shows flooding problems along E 3rd St and S Church St during the current and future conditions 10-year storm event.	Add a 24" stormwater pipe to connect the stormwater system from E 3rd St to S Church St to provide conveyance and storage. Upsize existing stormwater pipes to 30", 24" and 18", as estimated by modeling. Install stormwater planters (low impact development [LID]/green stormwater infrastructure design) along E 1st St to provide additional storage capacity and water quality improvements.	2,427	40.7
Villa Road, north of Carol Ann Drive	Frequent Flooding and Maintenance issues	The culvert on Hess Creek at Villa road is a mix of corrugated metal pipe (CMP) and concrete box culverts. This is an area of maintenance attention during large storm events to prevent flood waters from impeding traffic on Villa Road.	The existing culvert will be upsized from a 30" to a 60" culvert to convey current and future flows.	75	1,174.4
Spring Brook					
North Springbrook Road, north of Highway (Hwy) 99W	Existing and future 10-yr	Modeling shows flooding problems along N Springbrook Rd during the current and future conditions 10-year storm event. The upstream stormwater system along N Springbrook Rd was upgraded during installation of traffic improvements, but flows are constricted from a 30" pipe down to an 8"-12" section of pipe near Middlebrook Dr.	Upsize the stormwater pipes along N Springbrook Rd to 30" diameter and connect the system to the existing system to the south. The proposed pipe system is sized for both current and future flows.	1,735	55.9
Libra Street and Victoria Way	Existing and Future 10-yr	Modeling shows flooding problems along Libra St during the current and future conditions 10-year storm event. This system needs frequent maintenance to address silt accumulation.	Upsize existing stormwater pipes along Libra St to 18" to convey current and future flows.	804	14.4

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3.5 Reported Problem Areas

In addition to reviewing simulated problem areas identified through hydraulic modeling, other locations of drainage concerns were identified through the following methods:

- Engineering Problem Map – During the master plan kick-off period, maintenance and engineering staff developed a map of known problem areas throughout the City. Known problem areas include some of the capacity problems predicted through modeling and also problems that are the result of challenging maintenance conditions (i.e. areas with frequent need of leaf or sediment removal). The engineering problem map also includes locations where the piped stormwater system is located beneath private buildings. Relocating these pipes to public right-of-way is a high priority for the City.
- Maintenance Staff Questionnaires – All maintenance field staff completed problem area questionnaires to document drainage capacity and maintenance challenges they have observed during the course of their field duties.
- Citizen Report – City staff maintain records of drainage problems reported by citizen. The majority of the complaints are resolved through responsive maintenance visits to alleviate a blockage in the drainage network. Occasionally, a reported problem is indicative of a larger problem that needs to be addressed through infrastructure changes. During the master planning period one citizen report was included in the overall problem area list.
- 2001 Master Plan – the City's previous Stormwater Master Plan was completed in 2001, identifying 50 locations for potential stormwater capacity improvements. Since 2001, many of the project areas have been addressed through capital projects or resolved through other means, such as adjusted maintenance procedures or through reconstruction of the drainage system along Hwy 99W. Other projects are no longer required, as development patterns (and therefore flow rates) have shifted from what was assumed in the previous modeling. A detailed review of the 2001 Master Plan identified three remaining project areas that should be considered for inclusion in this Master Plan.

Table 3-8 includes a compilation of reported problem areas, sorted and numbered by drainage basin. In several cases, the same problem was reported by multiple sources. These overlaps are noted. The reported problem area locations are shown in Figure 3-3.

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Table 3-8. Reported Problem Areas

Identifier	Location	Problem description	Frequency/duration	Source of information	Drainage basin	Model in this area	Notes
DP-C-1	Near 5th and Blaine Streets	Hollingsworth drain is CMP/concrete; has roots; is 30' deep, under houses, and failing. When it fails/plugs, all of downtown storm system fails.		City - engineering map	Chehalem	Model does not show flooding, but pipe is very deep (model says 25-20 feet).	Commonly reported on crew surveys.
DP-C-1	Hollingsworth Storm Line	12" storm line under 5th Street needs realignment.		maintenance questionnaire	Chehalem		
DP-C-1	Blaine/Hollingsworth	Failed pipe - 18" tin whistle.		maintenance questionnaire	Chehalem		Realign pipe.
DP-C-2	College Street north of railroad tracks	Inadequate storm system in LID; Roadside drainage ditches overtop and flood neighboring properties.		City - engineering map City - photos during flood event	Chehalem	Model shows minor (<2 hour) flooding in 10-year event.	City has capital improvement project in process for College Street.
DP-C-3	Creek downstream of Kemper Crest Drive	Downstream creek discharge blocked; causes Kemper Crest to back up.		City - engineering map	Chehalem	Model shows 10-year flooding around existing pond.	Also reported on crew surveys.
DP-C-3	Columbia and Kemper Crest	Street and intersection water backs up from ditch in county.	heavy rainfall	maintenance questionnaire	Chehalem		
DP-C-3	Columbia and Kemper Crest	Road and ditches flood	every rainfall	maintenance questionnaire	Chehalem		Needs debris removal on downstream farm property.
DP-C-4	Between 8th and 9th Streets near Center Street	Flat sloped pipe runs under house on private property; needs to be rerouted.		City - engineering map	Chehalem	Model shows 10-year flooding upstream of problem pipe.	
DP-C-5	Natural system crossing College Street, south of Andrew Street	Steep ravine; multiple pipe materials; potential to collapse and fail.		City - engineering map	Chehalem		Field visit needed?
DP-C-5	College Street south of Andrew Street	Existing pipe system under College Street is composed of multiple pipe materials, causing ongoing maintenance problems and concerns over long-term stability.	n/a	2001 Master Plan	Chehalem		City staff confirmed this problem needs attention.
DP-C-6	1st and Harrison Streets	Flooding in front of Subway.	every rainfall	maintenance questionnaire	Chehalem		No storm drain in this area?
DP-C-7	2nd and Main Streets	Street floods at Naps Thriftway parking lot driveway on 2nd Street.	heavy rainfall	maintenance questionnaire	Chehalem		No mapped drainage system in this area.
DP-C-8	Clifford Court	No information given.	every rainfall	maintenance questionnaire	Chehalem		
DP-C-9	9th and River Streets, southeast Corner	Roadway floods 10-12' radius around catch basin.	heavy rainfall	maintenance questionnaire	Chehalem		Suggestion to move catch basin and raise the corner bubbler, near, but not connected to, DP-C-4.
DP-C-9	S River Street and 11th Court	Two clay sewer tile pipe segments are deteriorating and require replacement. Replacement should be sized to convey future flows.	n/a	2001 Master Plan	Chehalem		City staff confirmed this problem needs attention.
DP-C-10	Between 1st and 2nd Streets at Howard Street	Storm drain pipe is under commercial building.	n/a	City - engineering map	Chehalem		
DP-C-11	Dayton Avenue near Johanna Court	Roadway drainage flows into driveways and causes minor damage of driveways and sidewalk. Report confirmed by maintenance staff.	1-2 times/year	citizen e-mail report	Chehalem		No drainage system in this area. Possible green street solution in existing planter strips.
DP-H-1	Elliot Road just north of Hwy 99W	This area does not have a drainage system, resulting in frequent ponding during storm events.	heavy rainfall	City - engineering map	Hess	Not modeled.	Drainage systems existing to east and west of Elliot; need easements to reach either.
DP-H-2	Vermillion Street between College Street and railroad tracks	Undersized and flat pipe discharges to tracks with no fall. (Note: GIS data do not show a pipe in this area.)		City - engineering map	Hess	Model shows 10-year flooding in adjacent system.	Most commonly reported problem; also reported on crew surveys. Maintenance suggestion to repave at College and Vermillion Streets
DP-H-2	College and Vermillion Streets	Intersection ponding	every rainfall	maintenance questionnaire	Hess		Recommends repaving.
DP-H-2	College and Vermillion Streets	Gravel street area floods.	heavy rainfall	maintenance questionnaire	Hess		
DP-H-3	Hess Creek at Hoover Park	Flooding during January 2012 storm event.		City - photos during storm event	Hess		Is Hoover Park part of the floodplain?
DP-H-3	Hoover Park	Trash, beaver dams, and people place debris in creek to slow the flow.	every rainfall	maintenance questionnaire	Hess		Needs frequent maintenance and public education regarding Hoover Park's natural floodplain.
DP-H-4	Hess Creek at Villa Road, near railroad tracks	Flooding during January 2012 storm event. Water constrained by culvert overtops roadway. Ongoing maintenance attention is needed to remove debris accumulated at culvert.		City - photos during storm event	Hess		
DP-H-4	Villa Road Culverts	Capacity improvement needed to upsize two existing culverts.		2001 Master Plan	Hess		Since 2001 Master Plan development, one of the two Villa Road culverts was replaced with a 60" culvert. Existing 30" culvert still needs replacement.

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Table 3-8. Reported Problem Areas

Identifier	Location	Problem description	Frequency/duration	Source of information	Drainage basin	Model in this area	Notes
DP-H-5	College and Franklin Streets	Intersection ponding	every rainfall	maintenance questionnaire	Hess		Recommends repaving; no mapped drainage system at this intersection.
DP-H-5	College and Sherman Streets	Bubbler backs up	heavy rainfall	maintenance questionnaire	Hess		No mapped drainage system at this intersection
DP-H-6	Haworth Avenue between Elliot and Pecan Streets (near high school)	Flooding during January 2012 storm event. Flooding on/off of private property; standing water on roadway and onto school grounds.		City - photos during storm event	Spring Brook		Construction near high school has resolved Haworth drainage problems. No recent flooding observed.
DP-S-1	Crestview Drive east of Springbrook Road roundabout	8" DI culvert under gravel road; has nowhere to drain.		City - engineering map	Spring Brook	Small culvert not modeled.	
DP-S-2	Springbrook Road south of Crestview Drive roundabout	30" storm (from Mountainview Drive) drains into 8" storm (on Springbrook Road)		City - engineering map	Spring Brook	Model shows 10-year flooding along Springbrook Road.	
DP-S-3	Springbrook Road north of Crestview Drive roundabout	Area draining from the east goes into undersized pipe under Springbrook Road at this location.		City - engineering map	Spring Brook		
DP-S-4	Springbrook Road near 2nd Street	Flooding during January 2012 storm event.		City - photos during storm event	Spring Brook		Oregon Department of Transportation bypass project to replace Springbrook Road drainage system.
DP-S-5	Spring Brook at Golf Course	Flooding during January 2012 storm event.		City - photos during storm event	Spring Brook		Is the golf course part of the floodplain?
DP-S-6	Inlet at Mountainview Park (mobile home village)	Debris gets trapped against grate.		maintenance questionnaire	Spring Brook		Clean upstream - owned by Parks and Rec

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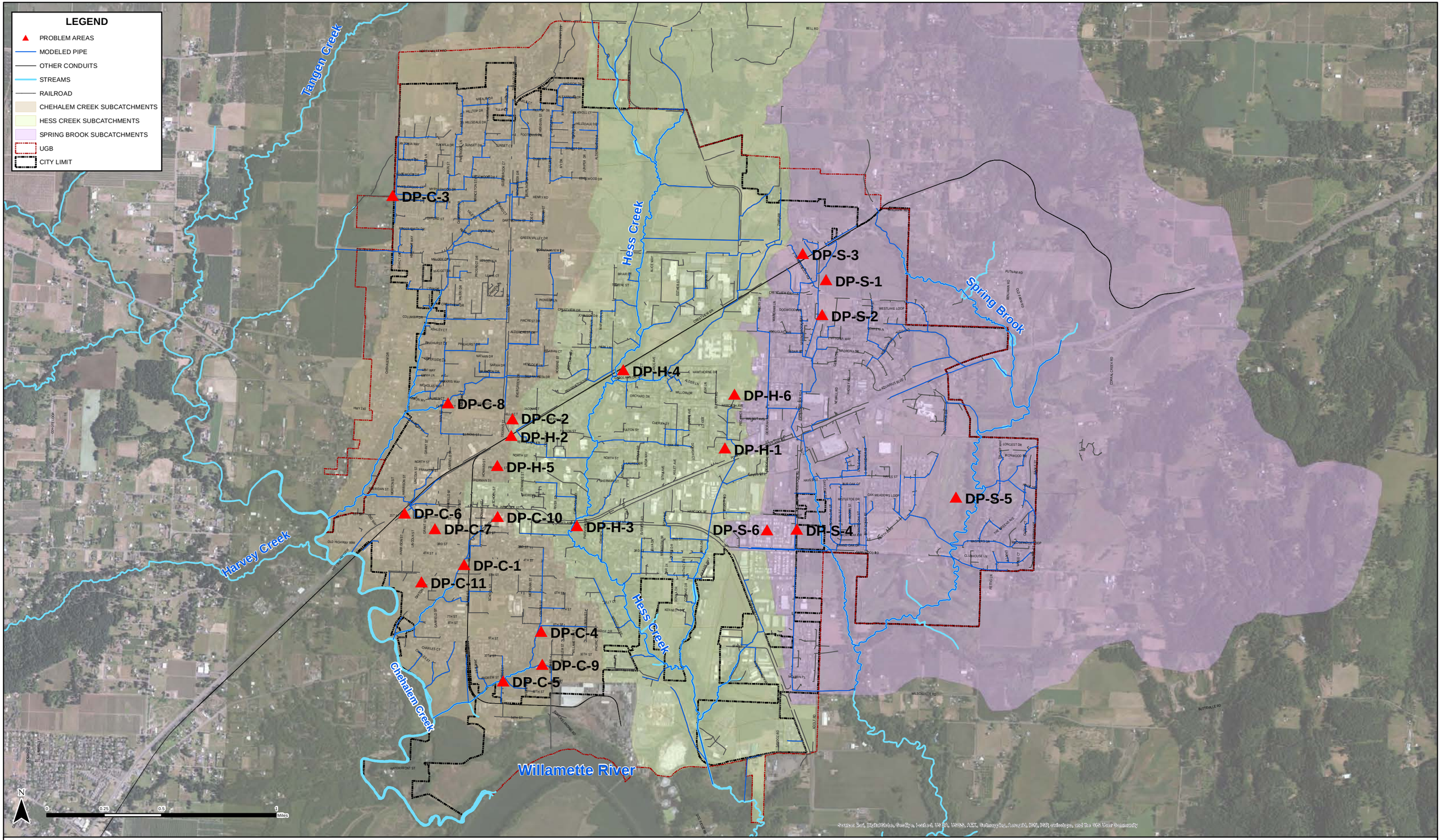

City of Newberg

STORMWATER MASTER PLAN UPDATE

FIGURE 3-3. REPORTED STORMWATER SYSTEM PROBLEM AREAS

NEWBERG, OREGON

Brown AND Caldwell

JUNE 2014

Section 4

Stream Channel Vulnerability Assessment

Section 4 documents the stream channel vulnerability assessment that was conducted to evaluate and assess existing and potential future channel conditions in the streams within Newberg. The field visits for this assessment occurred between October 15 and 17, 2013.

The primary objectives of the stream channel vulnerability assessment included the following:

- Assess existing physical channel conditions relative to the current flow regime and level of development.
- Identify existing problem areas, including areas of bank instability or excessive erosion.
- Assess the potential for future channel issues that could occur as a result of increased flows or watershed changes.

Figure 4-1 shows the location of mapped stream channels, floodplains, and stream corridor zoning within the City of Newberg.

4.1 Methods

The methodology used in this stream vulnerability assessment included:

1. review of existing documentation;
2. qualitative field assessment of selected stream channels within the City limits; and
3. comparison of hydrologic and hydraulic modeling results to observed channel morphology.

4.1.1 Data Review

Several data sources were reviewed prior to conducting the field assessment. The list of sources and description of contents is shown below.

City of Newberg Data – City staff occasionally walk stream channels within the city to assess water quality conditions and document outfall conditions. The City provided photos and data sheets to BC, documenting previously observed conditions. The City also provided photos of past flood events, documenting water elevations resulting from high flows. These data were reviewed relative to current data, and were used to augment the field data collected in October 2013, since not all stream channel reaches were walked within the timeframe allotted for this project.

George Fox University Data – George Fox University (GFU) students have been collecting data and conducting restoration projects in the reach of Hess Creek that runs through the GFU campus. The City provided BC with stream channel cross section data collected by the students. Additionally, Clyde Thomas, facility manager and stream restoration facilitator at GFU provided details on work that is being conducted on Hess Creek on the GFU campus.

City GIS Data – City GIS data were reviewed prior to conducting the stream visit, including the following:

- stormwater infrastructure
- zoning

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- streams and wetlands
- floodplains
- city boundary
- aerial photograph
- LiDAR imagery

Chehalem Watershed Assessment–The Yamhill Basin Council conducted a Chehalem Watershed Assessment in June 2001 through an Oregon Watershed Enhancement Board (OWEB) grant and local matching funds (Yamhill Basin Council. 2001). The Chehalem Watershed includes Chehalem Creek, Hess Creek, and Spring Brook. This document was reviewed specifically for information about the stream channels that are situated in Newberg, including Hess Creek, tributaries of Spring Brook, and a small tributary of Chehalem Creek. Regional geologic information was obtained from this report, as well as information on fish habitat and barriers, wetlands, and other watershed characteristics.

4.1.2 Field Assessment

A field assessment was conducted between October 15 and October 17, 2013, during a relatively dry period, with no measured rainfall in the previous 5 days. Approximately 3 miles of stream channel were walked, including portions of the following reaches, shown on Figure 4-1. The field assessment included the following reaches:

- Hess Creek
  - Upstream of Villa Road in the vicinity of Mountainview Drive (upper reach)
  - George Fox University (middle reach)
  - Hoover Park (middle reach)
  - Corinne Drive Tributary
  - Wynooski Street/Wastewater Treatment Plant (lower reach)
- Chehalem Creek Tributary
  - Upstream of Hwy 240 to Columbia Drive
  - Upstream of Sunnycrest Road
- Spring Brook
  - Benjamin Road and Lake Shore Drive reach (outside City limits)
  - West Tributary between Fred Meyer (Hayes Road) and Fernwood Road (West Tributary reach)

General observations of bank and bed materials, vegetation, erosion, general confinement, and outfalls were made. Photos were taken to document conditions, and occasional measurements of bankfull widths and depths were taken with a stadia rod (in tenths of feet). Latitude and longitude coordinates along with elevations were recorded using a hand-held GPS unit.

The field data and locations of photographs were recorded in a field notebook. Field notes were scanned, and data and photos were transferred to excel spreadsheets. These field notes are provided in Appendix C.

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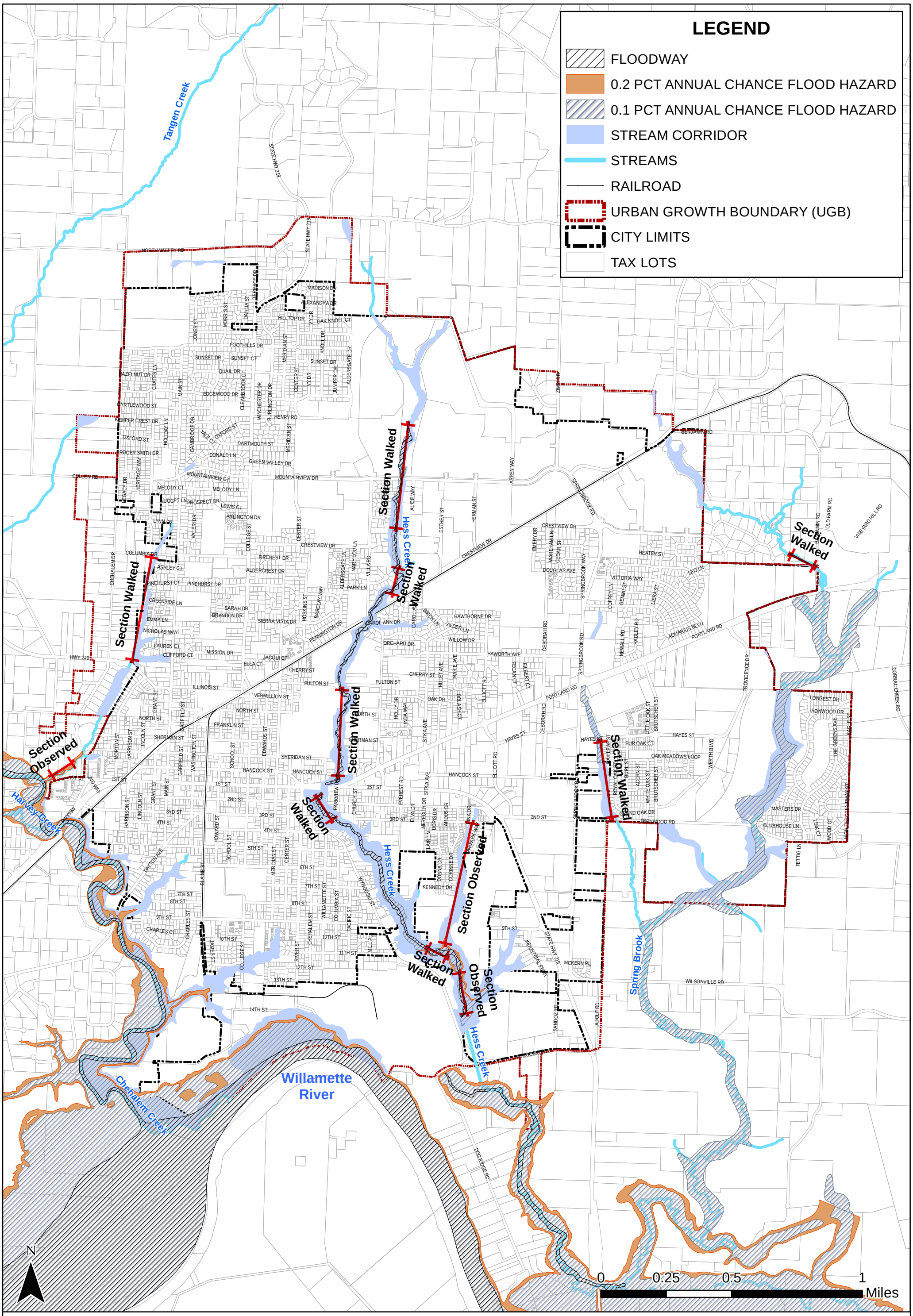

STORMWATER MASTER PLAN UPDATE

FIGURE 4-1. MAPPED STREAM CHANNELS, FLOODPLAINS, AND STREAM CORRIDOR ZONING

NEWBERG, OREGON

City of Newberg

Brown AND Caldwell

JUNE 2014

4.1.3 Flow modeling

A PC-SWMM hydrologic and hydraulic model was constructed to evaluate existing and future stream flows based on predicted land use changes (described in Section 3). Existing conditions modeled flows were compared to observed channel morphology to evaluate patterns and potential morphological changes that might occur with increased flows as predicted in the future condition models.

4.2 Results

Descriptions of the general stream channel characteristics in the reaches observed during our field investigation are provided in Table 4-1 and with more detail in Appendix C. In general, the condition of stream channels within the city limits are variable and likely dependent on a number of factors including riparian conditions (i.e., width of riparian area and vegetation); stream channel gradient and valley confinement; land uses in the general vicinity; and stormwater outfall locations.

4.2.1 Geologic Conditions and Erosivity

The predominant geology of Hess Creek and the other tributaries within the city is Willamette silt (Yamhill Basin Council, 2001), lacustrine (lake) and fluvial (river) deposits consisting of unconsolidated and semi-consolidated silt, clay, sand and gravel. With the exception of the upper reaches of Hess Creek in the vicinity of Mountainview Drive, the bed and bank material of all of the stream channels that were walked consisted of silt and clay. Downstream of Mountainview Drive, conglomerate (mixed sand and small rounded gravel) was observed in the banks. Upstream of Mountainview Drive, bedrock (siltstone) was present in the streambed.

The geologic material for which these stream channels are situated are resistant to slumping and can result in nearly vertical banks. Erosion was observed downstream of culverts or outfalls where flow was concentrated. Outside of these predictable locations where flow is concentrated erosion was also observed in several reaches where blocks of silt have caved into the channel. This type of bank failure is most likely a result of destabilization from undercut banks, animal activity (burrows from mountain beavers or nutria), surface disturbance, or soil saturation. This type of erosion was observed most notably in the Chehalem Creek tributary upstream of Highway 240, the Crestview reach of Hess Creek upstream of the railroad, and the lower reach of Hess Creek near the confluence with the Corinne Drive Tributary.

4.2.1.1 Specific Problem Areas

Below are specific problem areas or poor conditions that were noted during our stream walks. These are locations where restoration, repair or maintenance projects should be considered.

4.2.1.1.1 Chehalem Tributary

- Hill slope failure upstream of Highway 240 on the west bank. Re-vegetation and stabilization would prevent future slumping.
- Beaver dam at Sheridan Road crossing (downstream of Highway 240). The beaver dam observed during our stream walk was removed; however, this location is likely prone to beaver activity and should be monitored to ensure beavers do not get re-established. The road fill above the culvert is at least 30 feet high, and a large storm event that coincides with a culvert blockage could have devastating consequences.

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Table 4-1. Summary of Stream Channel Characteristics

Stream	Segment	Location of modeled flow	Drainage area (acres)	2-year max total inflow (cfs)		Percent change	2-year unit discharge (cfs/acre)		Average bankfull width (ft)	Average bankfull depth (ft)	Average gradient (ft/ft)
				Existing	Future		Existing	Future			
Chehalem Tributary	North of Hwy 240	Creekside Lane and Creekside Court	329.5	42.5	45	5.56	0.13	0.14	8	4	0.016
	South of Hwy 240	West Sheridan Street (downstream side)	753	132.5	136.5	2.93	0.18	0.18	6	4	0.006
Hess Creek	North of Mountainview Drive	Edgewood Drive and Aldersgate Drive	946.5	56.2	62.5	10.08	0.06	0.07	9	3	0.008
	Mountainview Drive to Villa Road/Railroad	Crestview Drive	1,135.20	72.1	80.6	10.55	0.06	0.07	9	3	0.008
	Villa Road/Railroad to Hwy 99W	Fulton Street (downstream side)	1,451.10	100.2	110.7	9.49	0.07	0.08	10	3	0.005
	Hwy 99W to City Limit (near Wynooski Street)	Merlin Lane	1,861.70	174.4	181.8	4.07	0.09	0.10	11	2.5	0.002
Spring Brook	West Tributary, Hwy 99W to City Limit (Fernwood Road)	Hayes Street	358.4	74.4	80.6	7.69	0.21	0.22	7	3	0.012
	North of Hwy 99W near Benjamin Road	Benjamin Road	465.1	21.4	22.5	4.89	0.05	0.05	8	3	0.008

4.2.1.1.2 Hess Creek

- Upstream of Mountainview Drive, a stormwater ditch outfalls above Hess Creek on the hill slope. This discharge has resulted in extensive erosion at the outfall. Additional energy dissipation should be installed in this area, and consideration extending pipe directly to Hess Creek would help alleviate the hill slope erosion.
- In the reach above the railroad (Crestview), the stream has eroded material away from a sanitary sewer manhole that is now located in the stream channel. This manhole should be inspected for integrity and evaluated with respect to potential future impacts to channel migration and erosion.
- GFU has spent a lot of time and energy on the restoration of Hess Creek through the campus. Care should be taken to minimize changes to flow or hydraulics (such as Fulton Street culvert) that could negatively impact the restoration that has occurred.
- Significant erosion is occurring at the outfall location of the detention pond located on the Corinne Drive tributary to Hess Creek.

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4.2.1.1.3 General Problem Observations

- Erosion is occurring at numerous stormwater outfalls and culvert crossings throughout the city. Outfalls and culvert crossing should be designed with sufficient energy dissipation with a mix of material sizes or geotextile fabric to minimize erosion of the fine grained silt.
- Invasive vegetation species such as reed canary grass, blackberries, and nightshade are prevalent in all the stream reaches (except GFU where restoration work as occurred). There are many opportunities to improve riparian vegetation conditions along Hess Creek (especially in the lower reach) and other Newberg tributaries.

4.2.2 Channel Geomorphology

Channel dimensions were plotted against drainage area and modeled 2-year discharges to evaluate for potential relationships between channel shape and flow conditions.

There is a fairly good correlation of drainage area to bankfull channel width for the stream channels walked in October 2013 (Figure 4-2).

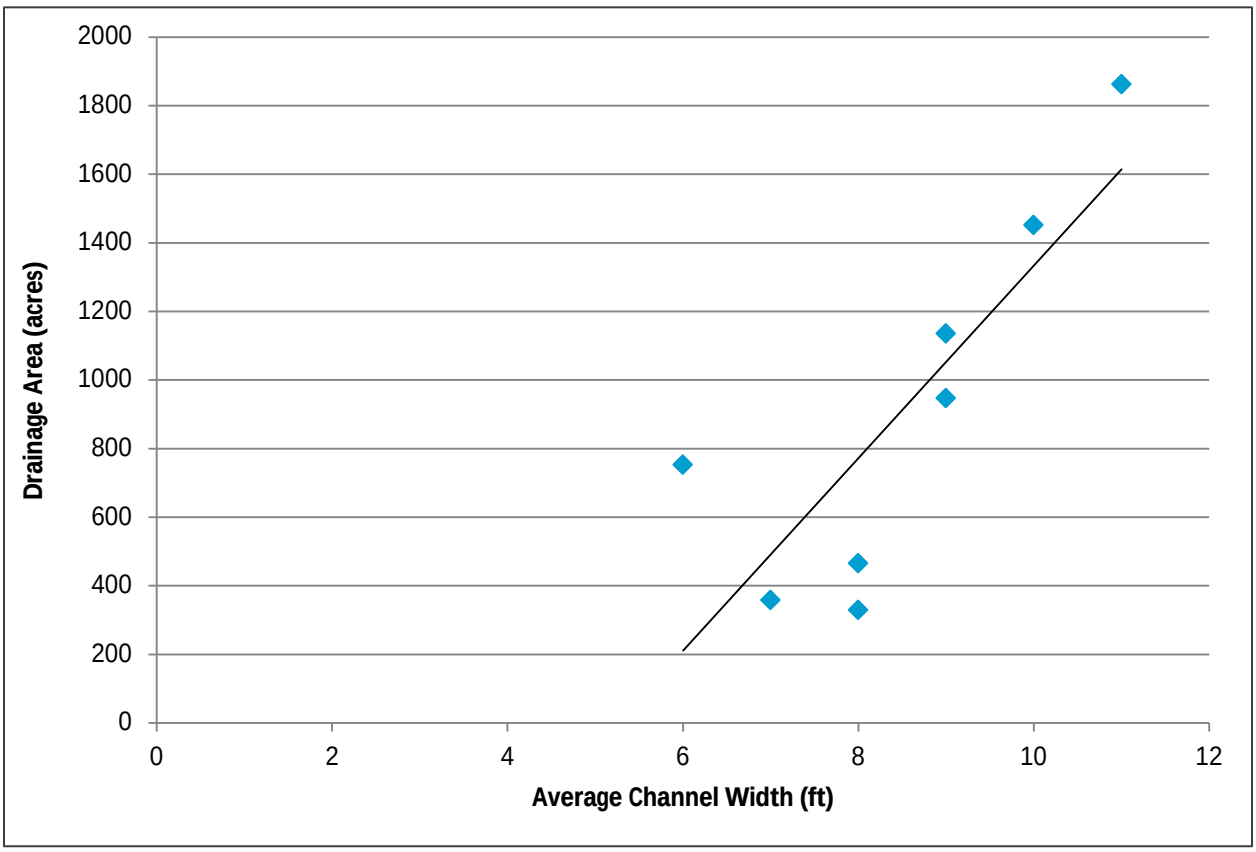

Figure 4-2. Drainage area versus channel width

However, a correlation was not found between discharge and stream channel width (Figure 4-3) or area (Figure 4-4).

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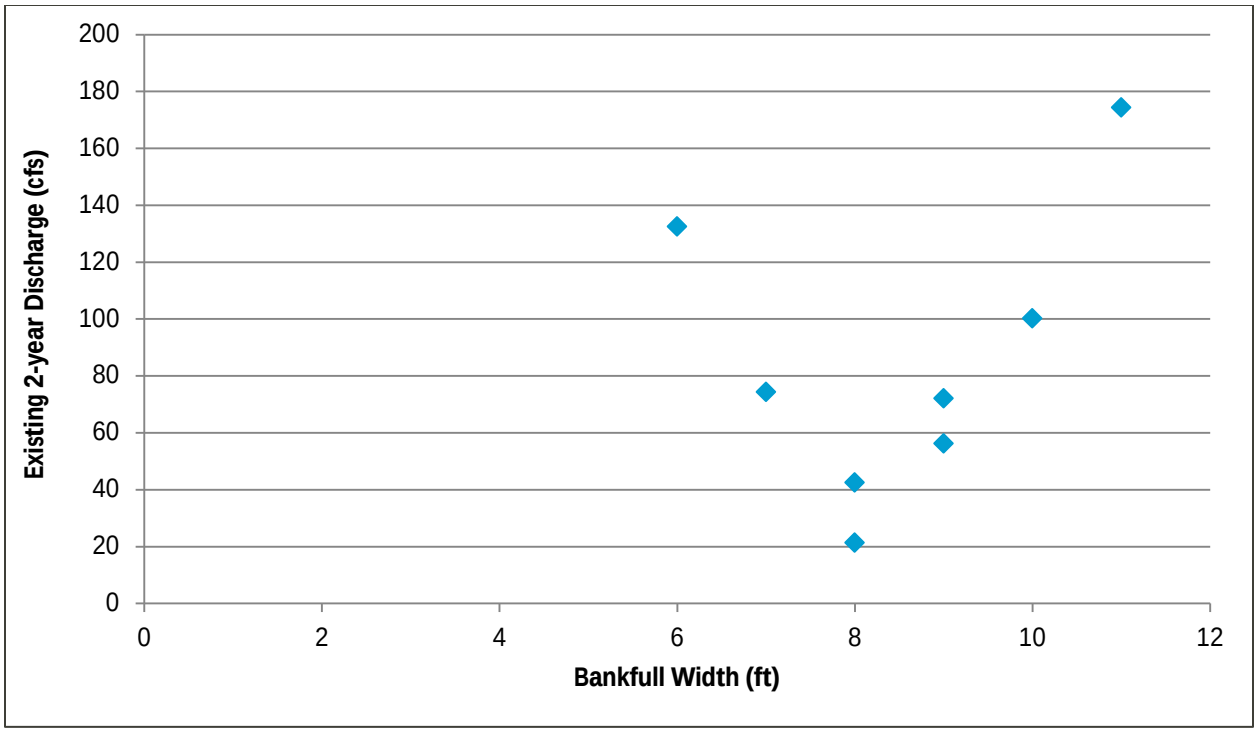

Figure 4-3. Existing 2-year discharge versus bankfull width

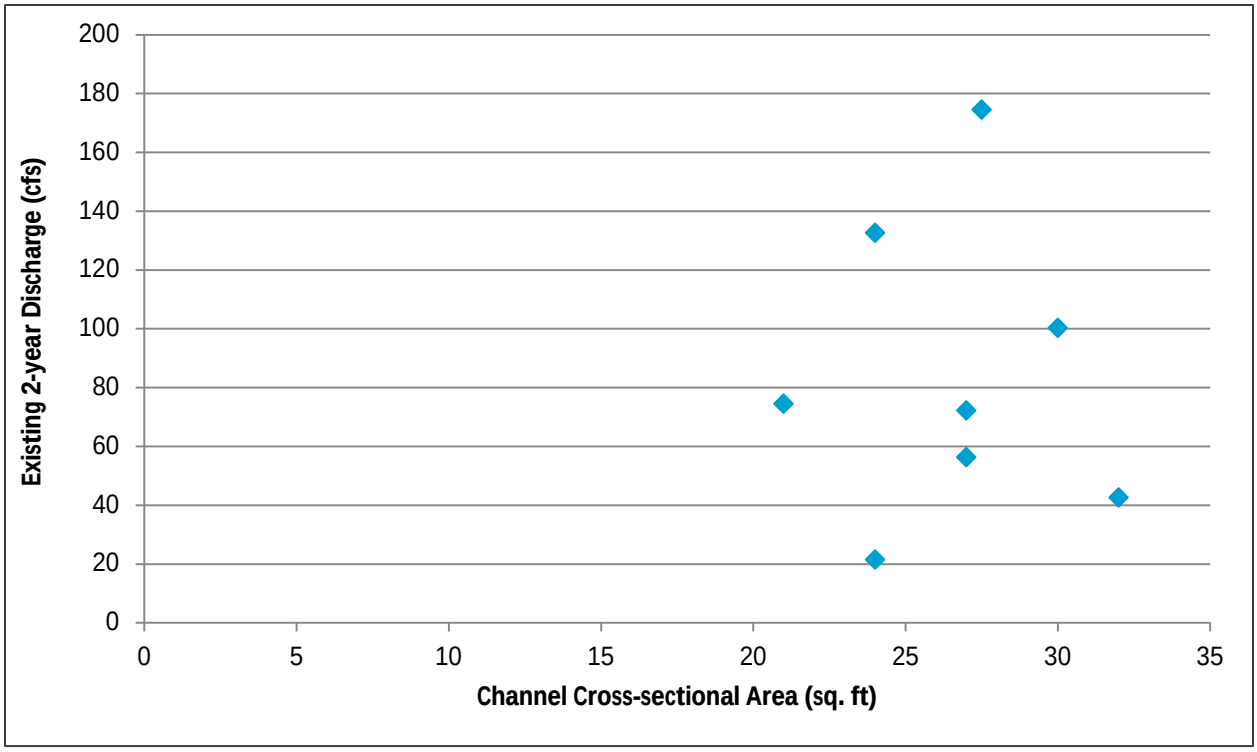

Figure 4-4. Existing 2-year discharge versus channel cross-sectional area

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Figures 4-3 and 4-4 indicate that other factors besides stream channel discharge are likely influencing the geomorphology of stream channels in Newberg. For instance, constrictions in the stream channels such as culvert crossings tend to dampen the impact of peak flows and resulting erosion in downstream reaches. Examples of this include the Fulton Street culvert upstream of GFU, and the Sheridan Street crossing on the Chehalem Tributary on the west side of the city. Additionally, wide floodplains for which stream channels have room to move, and where overbank flooding can occur without risk of damage to infrastructure also dampens the erosive effects of high stream flow discharges.

The stream channel section with the highest unit area discharge (0.21 cfs/acre) is the Spring Brook tributary downstream of Hayes Street. This reach of stream channel was in relatively good condition despite the high velocity discharges it experiences relative to the overall drainage area. This could be because there are retention/detention facilities upstream that were not included in the model, the fairly wide riparian area that consists of large trees and native vegetation, and the connection of the stream channel to its floodplain. Flow control or stormwater detention in other parts of the city could have positive effects for stream channel conditions as well.

The City has designated “stream corridor zoning,” limiting the type and location of development near stream channels based on a study completed in 1995 to comply with statewide planning Goal 5, “Open Spaces, Scenic and Historic Areas, and Natural Resources.” The stream corridor zoning coincides with the natural floodplain area of stream channels within the city limits, providing fairly wide and undeveloped riparian areas in some cases.

4.2.3 Future Conditions

The area of the city that is expected to further develop in the next several years is located north of Mountainview Drive where large agricultural properties will be converted to residential developments. Flow increases are predicted for the upper reaches of Hess Creek based on modeling results. These increases will be less apparent downstream because of hydraulic conditions in the middle reaches (culvert crossings, etc.). The reach that is most vulnerable to increased flows is upstream of the railroad tracks (Crestview), where erosion is already prevalent.

Based on the modeling effort, flow increases are also expected on the west tributary of Spring Brook, particularly as the Austin Property is developed.

Future development of the South Industrial Area is located outside (downstream) of the modeling limits for this Stormwater Master Plan. Design standards to protect streams evaluated in this study should be carried into the South Industrial Area to protect existing stream channels.

No future flooding in the open stream channels is predicted for the 10-year flows based on hydraulic modeling, however, stream channel erosion could occur if measures aren’t taken to control flows, maintain wide riparian areas and open floodplains, or dissipate energy at outfall locations and culvert crossings.

4.3 Recommendations

The City has already taken steps that help alleviate channel erosivity by designating stream corridors for protection in the zoning code. Other measures that should be considered to reduce potential future channel impacts include the following:

- Encourage or require new development to maximize infiltration of stormwater runoff when soil conditions allow. The infiltration of stormwater runoff reduces the impact of increase flows on stream corridors and is critical to the reduction of the channel forming annual flow events.
- Require flow control measures for smaller storms for new development. The 24-hour synthetic storms used for sizing detention can be conservative and therefore the small channel forming flows

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are not addressed in the standards. Although this will not fully address all smaller storm events we recommend adding half the 2-year, 24-hour storm as a flow control storm in addition to the larger storms.

- Ensure culvert crossings, stormwater outfalls, and stream channel crossings (bridges) are designed and installed properly (e.g., aligned with stream flow and include energy dissipation) to minimize erosion downstream.
- Conduct regular field screenings of outfalls and other areas of previously observed erosion to document changes in bank conditions and identify locations for stream bank stability projects. Allocating at least one day per month for stream observation would allow City staff to visit areas of concern several times a year on a rotational basis.
- Vegetation does contribute to stream bank stability, and if invasive species such as reed canary grass are removed, replacement vegetation should be planted immediately.

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Section 5

Maintenance and Programmatic Evaluation

This section documents the City's stormwater program activities as they relate to maintenance of the stormwater infrastructure, water quality protection, engineering, and development review. In general, the activities are divided into two categories: maintenance activities are those conducted by the operations and maintenance staff; programmatic activities are those conducted by administrative and engineering staff. This section also includes an evaluation of the City's existing design standards related to stormwater management and a staffing analysis to identify the staff levels needed to implement the recommended stormwater related activities.

5.1 Stormwater Program History

The City's Public Works Department is responsible for implementing the stormwater management program to meet regulatory requirements. The Public Works Department includes staff that performs roles related to engineering, operations, and maintenance. All staff plays a role in maintaining water quality and managing stormwater runoff.

In 2001, the City adopted Ordinance 2571 that codified the stormwater management program (Newberg Municipal Code (NMC) 13.20 and 13.25). The ordinance included adoption of a stormwater management fee that applies to all properties with impervious surfaces within the City. The stormwater management fee enables the City to fund maintenance and engineering activities, as well as capital projects related to the stormwater infrastructure. The City's Citizens Rate Review Committee (CRRC) meets regularly to adjust the stormwater management fee, along with the fees related to other City utilities. In 2012, the City adopted Ordinance 2754 to update the stormwater management guidelines in NMC 13.25.

Historically, the City's stormwater management program was formed around addressing drainage capacity and flooding problems. In the last decade, the program has shifted to address increasing water quality regulations.

5.2 Regulatory Conditions

The City's current stormwater program has been expanded to address the regulatory requirements of the Total Maximum Daily Load (TMDL) program. Due to its size, Newberg is not currently subject to the National Pollutant Discharge Elimination System (NPDES) permitting requirements for the municipal separate storm sewer system.

5.2.1 Willamette River TMDL

In September 2006, the Willamette River was listed by DEQ and the United States Environmental Protection Agency (USEPA) as a 303(d) stream. Near Newberg, the parameters of concern are bacteria, mercury, and temperature. Additional pollutants, such as dissolved oxygen, turbidity, and toxics are identified as problematic for specific tributaries and portions of the Willamette River, but are not listed as concerns in areas covered by Newberg. In 2008, DEQ and the City agreed to a TMDL Implementation

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Plan to reduce pollutant loads and temperatures in Chehalem Creek, Hess Creek, and Spring Brook, all of which drain to the Willamette River.

The City's TMDL Implementation Plan includes six minimum measures:

- public education
- public involvement
- illicit discharge detection and elimination
- construction site stormwater control
- post-construction stormwater management
- pollution prevention in municipal operations

In March 2013, the City completed a 5-year review of activities from 2008 through 2012 related to the TMDL Implementation Plan and outlined strategies for the next 5-year cycle (2013-2017). The TMDL Implementation Plan remains the City's primary regulatory driver for stormwater management activities.

5.2.2 Future NPDES MS4 Program

In Oregon, DEQ has been delegated the authority from USEPA to implement the MS4 NPDES permitting program, including writing and issuing MS4 permits for municipal stormwater discharges. To date, NPDES MS4 permits have been issued to municipalities with populations greater than 50,000 and smaller communities within larger urbanized areas. Due to its location away from the urbanized areas, the City has not yet been required to obtain a NPDES MS4 Permit. However, if DEQ expands the current permit program to reach a larger number of communities, then Newberg could be subject to a NPDES MS4 permit.

The City's TMDL activities are generally aligned with typical NPDES permit requirements. Fulfilling TMDL obligations puts the City in a good position to comply with a future NPDES permit if DEQ expands the NPDES MS4 permitting program to regulate smaller cities.

5.3 Maintenance Program Review

This section provides an assessment of the resources currently available to maintain the City's stormwater collection system and provides recommendations for improved system operation and efficiency.

5.3.1 Current Activities

The City's stormwater maintenance program is primarily reactive. This assessment is based upon staff interviews and an analysis of the current maintenance program's structure and funding. For example, most inspections, cleaning, and repairs are performed as the result of problems reported by customers, or "hot spots" known to City staff. Typical stormwater maintenance activities are described below. Table 5-1 quantifies the last 5 years of stormwater system maintenance activities, as documented in the City's 2012 TMDL Annual Report.

Structure Inspection – The City currently uses inspections of catch basins, manholes, grates, and inlets primarily as an investigative tool to determine the cause of ponding and drainage problems. The current inspection program is mostly reactive since the inspections are not a part of a preventive maintenance program. In 2010, the City conducted a larger number of catch basin inspections, as part of an effort to locate and map the public infrastructure. However, in recent years, inspections have been limited to those areas where problems are reported.

Structure Cleaning – Catch basins are cleaned to address problems that are reported through customer complaints or that come to the attention of staff by other means. The maintenance staff also conduct preventative maintenance cleaning of several known "hot spots" that routinely have problems with

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sediment build-up. The City has been cleaning approximately 200 catch basins per year, which is equivalent to approximately five percent of the public system.

Storm Line Inspections –As with catch basin/manhole inspections, storm line inspections are used primarily as an investigative tool. In 2013, the City purchased a new CCTV vehicle with improved maneuverability and video capability. The new system will allow staff to observe the condition of storm lines as the camera is moving through the system, reducing the time spent reviewing video. The increased functionality is expected to increase storm line inspections that the maintenance crews can complete on an annual basis.

Storm Line Cleaning – Storm line cleaning is conducted in response to reported and known problem areas. Storm line cleaning has been greatly reduced since 2009 (from 18,800 feet in 2009 to less than 4,000 feet in 2012) due to staff reductions. Newer pipe systems in the city have been designed to be "self cleaning," with flow velocities pushing sediment downstream to adjacent catch basins. Most storm line cleaning is to address larger blockages, like rocks, trash, or debris and the associated built-up of sediment behind the blockage.

Ditch Cleaning – City staff occasionally clean and maintain conveyance ditches along roadsides and the railroad right-of-way in order to maintain flow paths to adjacent areas of the public drainage system. Ditch cleaning is typically on a limited basis, in areas adjacent to culverts.

Minor Repairs – Maintenance crews occasionally identify and repair minor structural problems with the stormwater infrastructure and install new structures to address minor flooding problems or replace aged infrastructure. The City currently budgets $35,000 per year for stormwater repair and $15,000 for pipe and materials. Additional staff and materials budget is needed to replace deteriorating infrastructure.

Stormwater Facility Maintenance – In response to the TMDL Implementation Plan, the City has been strengthening a program to inspect and clean stormwater facilities, including detention ponds. The City current has 10 public stormwater facilities and the number of facility inspections has steadily increased since the TMDL Implementation Plan was approved.

Street Sweeping – Street sweeping occurs on a rotational basis and the City has established a monthly sweeping schedule with an online map to notify residents when their neighborhood is scheduled for sweeping. The schedule plans for each zone to be swept eleven times per year, though weather and emergency maintenance needs occasionally impact the sweeping schedule. In 2012 the City purchased a vacuum sweeper to improve collection and efficiency. The City has been averaging over 4,000 curb miles swept per year with a debris collection rate of 0.24 cubic feet per mile.

Table 5-1. City of Newberg, Stormwater System Maintenance Activities

Activity	2009	2010	2011	2012
Catch basins inspected	-	1,919	72	171
Grates and inlets inspected	251	200	16	130
Catch basins cleaned	78	339	106	264
Storm line inspected, feet	5,691	1.844	4,853	325
Storm line cleaned, feet	18,807	4,581	4,961	3,718
Minor repairs	• 423 feet storm line • 21 structures	• 64 feet storm line • 21 structures	• 362 feet storm line • 4 structures	• 68 feet storm line • 3 structures
Stormwater facility inspection and cleaning	-	10	17	36
Street sweeping, curb miles	5,242	3,192	4,382	3,704

Note: Data from City of Newberg TMDL Implementation Plan, Annual Report 2012 and 5th Year Review (submitted: March 29, 2013).

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5.3.2 Maintenance Program Analysis

The City's current maintenance program is focused on addressing immediate needs and correcting high priority problems. With limited resources, the program has focused on street sweeping, as an opportunity to remove pollutants and sediment before they enter the stormwater conveyance system. The City has also made recent equipment purchases (Vactor sweeper and CCTV vehicle) that improve the efficiency of maintenance activities.

The City's inspection activities have decreased since 2010, due to staff reductions (see Section 5.6). Without a preventive maintenance inspection program to identify storm drain line conditions, defects can not be identified until they become severe enough to cause significant damage or reduction in capacity. A collection system that is operated from a primarily reactive management position will continue to degrade, resulting in an increase in the number of problems as the system ages. Additional challenges from this management approach include inability to plan and schedule work, inefficient use of resources, and a reduction in level of service to the community.

The City is strongly encouraged to move the maintenance program toward a more proactive, preventive maintenance approach, allowing the City to provide an increased level of service to the community at reasonable cost. Specific recommendations related to preventative maintenance are included in Section 5.7.1.

5.4 Programmatic Activity Review

The City's programmatic activities cover engineering, administration, and management activities to implement a successful stormwater management program. This section provides an assessment of the resources currently available to conduct programmatic activities.

5.4.1 Current Activities

Based on discussions with City staff, the City's programmatic efforts are generally focused on TMDL compliance, development review, capital project management, and stormwater fee administration. These activities are generally assigned to different staff members, though development review and capital project management are both assigned to the public works engineers.

TMDL Compliance – Many of the program activities conducted by City staff serve to satisfy requirements of the City's TMDL Implementation Plan. The City reports annually to DEQ on the progress toward meeting measureable goals related to public education, public involvement, illicit discharge detection and elimination, construction site runoff control, post construction stormwater runoff control, pollution prevention in municipal operations, and temperature management. In addition to the maintenance activities described in Section 5.3, the City conducts the following programmatic activities related to TMDL compliance:

- public outreach and education events
- storm drain stenciling
- public involvement in stormwater ordinance, design manual, and stormwater utility rate
- stormwater program website and citizen reporting
- illicit discharge complaint response
- household hazardous waste collection (in conjunction with Yamhill County)
- construction site inspections and erosion control enforcement
- development of stormwater ordinance and stormwater design standards
- stormwater plan review, inspection, and enforcement for new development

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- staff training
- stream corridor overlay and stream bank protection ordinance
- stream trees program

Most of the TMDL compliance activities (outside of maintenance and development review) are conducted by the City's Environmental Specialist, which is funded at 0.5 FTE from the stormwater program though the TMDL tasks are taking increasing time as the required programs are implemented. Additional details regarding these programs are included in the City's TMDL Implementation Plan and TMDL Annual Reports.

Development Review – City staff currently spend the equivalent of approximately 1.0 FTE completing development review activities, which include establishing engineering conditions following pre-application meetings, reviewing development submittals, and conducting inspections during and after construction. Development review activities and inspections cover both construction site erosion and sediment control and the post-construction stormwater facilities. Development review cost is shared by transportation and other departments, as it is most efficient for the engineering reviewer to evaluate all aspects of development submittals at one time.

Capital Project Management – Other than development review and customer response, the City's engineering staff spend the bulk of their time managing the City's CIP program. As staff resources have been reduced, most design work is now being completed through consultant contracts. City staff are performing less design work and focused more on managing consultants and contractors, which allows a fewer number of staff to oversee a larger number of projects.

Stormwater Fee Administration – Programmatic activities also include the administration of the City's stormwater utility fee, which funds the stormwater management program. The stormwater program currently funds 0.45 FTE in general administration.

5.4.2 Future Needs

The following future needs have been identified through evaluation of regulatory obligations, discussions with City staff, and comparison to similar sized stormwater programs in other Oregon cities.

GIS Mapping – In preparing for work on this Stormwater Master Plan (Master Plan), City staff identified data gaps in the City's existing GIS database. In particular, pipe and structure information has been entered into the system using two different vertical datums. A combination of field work and engineering judgment was used to resolve many of the data gaps while preparing the PC SWMM hydraulic model of the stormwater system. However, spot checks in the field continue to reveal areas where the field system and the GIS database are inconsistent. A regular schedule for ongoing field data collection would allow the City to continually improve the accuracy of the GIS database.

TMDL Implementation Activities – The City's current program to address TMDL requirements is well-organized. The City is taking proactive steps to evaluate the effectiveness of program components and make adjustments to the TMDL Implementation Plan through adaptive management. The City's program would benefit from the following enhancements which would improve the level of service for residents and enhance the water quality program related to TMDL compliance.

- Stormwater facility inspection (covered under maintenance discussion) – regular and ongoing inspections are needed to identify maintenance needs.
- Illicit Discharge education for City staff– the City has recently adopted new illicit discharge screening procedures. Public works staff are likely to encounter illicit discharges as they are conducting other activities around the City. One-time training is needed for all public works staff, so they will readily recognize the signs of a potential illicit discharge and understand the reporting procedures.

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- IDDE education for businesses– establishing a program to provide illicit discharge education for business owners is a preventative measure to reduce non-stormwater discharge to the drainage system.
- Private facility maintenance enforcement– The City's recently modified stormwater management municipal code (NMC 13.25.300) requires owners of private stormwater facilities to conduct and record annual facility inspections and perform necessary maintenance. An ongoing program is needed to track whether required activities have been completed and then follow-up with enforcement.
- Electronic database system– An electronic database system would assist the City with the handling of customer complaints, tracking calls, and tracking the City's response. An electronic database could also be used to track illicit discharge concerns logged by City field staff and the follow-up investigations and resolution.
- WQ Sensitive O&M Manual– Maintenance staff and the TMDL Implementation plan have identified the need for the City to develop standard operating procedures for maintenance activities that address water quality protection during regular maintenance. The SOPs should also include guidelines for performing inspections and maintenance of the stormwater system.

Monitoring Program – The City has considered the opportunity to establish an in-stream monitoring program that could track flows as well as water quality data. Flow data would be useful in evaluating changes in runoff rates as the watersheds develop. While not a current obligation, water quality monitoring may eventually be required as part of the City's TMDL Implementation Plan. Due to other immediate program needs and the significant resources that would be required, it is not currently recommended that the City pursue the establishment of an in-stream monitoring program. However, the City may re-evaluate monitoring needs during the future TMDL Implementation Plan 5-year reviews, the next of which will occur in 2017/2018.

Engineering Services – City staff performing development review and capital project management are currently meeting the demand for these services. No changes to the structure of these activities are recommended at this time. If the City sees a substantial increase in new development activity, staff levels should be adjusted accordingly to support the increased need for development review and construction inspection as well as the potential to construct additional capital projects through an increase in system development fees.

5.5 Development Standards Review

Consistent with TMDL implementation Plan requirements, the City adopted municipal code for stormwater management in 2012. NMC 13.25 addresses Erosion Control, Illicit Discharge Detection and Elimination, Stormwater Management (facility design, installation, and maintenance), and Enforcement and Penalties. Following code adoption, the City has been working to update the Standard Design Manual to include a comprehensive chapter to address stormwater requirements. Standard Design Manual, Section 4: Storm Drainage includes standards and submittal requirements for conveyance, water quantity, and water quality. Erosion and sediment control guidelines are outlined in a separate manual, adopted from Clean Water Services.

During the development of this Master Plan, two versions of the City's Standard Design Manual (2013 Draft and 2014 Draft) were reviewed with respect to TMDL obligations and recommendations from the stream channel vulnerability assessment. The review also considered regional and national trends in stormwater management.

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5.5.1 Design Standards Recommendations

Based on a review of regulatory programs, regional trends, and local stream conditions, the City may consider incorporating the following principles into the stormwater design standards:

- Consistent with regional trends, require water quality treatment for both new and replaced impervious areas when redevelopment occurs.
- Consistent with regional trends, establish a water quality design storm that is consistent with capturing 80% of the average annual runoff volume. In Newberg, the design volume would equate to approximately a 1-inch, 24-hour storm event.
- Based on the stream channel assessment, establish flow control requirements that include matching flows from post development to pre-development for a range of flows that includes one-half of the 2-year storm event.

The design standards review also included recommendations on formatting and editorial comments that were presented to the City in a separate memorandum. It is expected that the updated Standard Design Manual will be adopted in 2014.

5.6 Staffing Analysis

This section provides an assessment of the resources necessary to perform maintenance and programmatic activities to support the City's stormwater management program and address TMDL Implementation Plan obligations.

5.6.1 Current Maintenance and Program Staffing

The number of personnel available to the stormwater program has varied over the years. Table 5-2 lists the number of full time equivalent (FTE) positions within the stormwater program budget over the last several years. This table includes maintenance staffing, as well as engineering and administrative staff positions funded by the stormwater program.

Table 5-2. Historic FTE Levels

Group	Fiscal year			
	2010/11	2011/12	2012/13	2013/14
Stormwater administration	-	-	-	0.45
Stormwater engineering	0.91	0.89	2.25	1.65
Stormwater maintenance	4.40	3.65	3.75	3.28
Total	5.31	4.54	6.00	5.38

While a total of 5.38 FTEs has been funded for the 2013-2014 Stormwater Program, not all of these resources will be directly expended toward stormwater programs and maintenance. Maintenance staff are not designated into infrastructure-specific groups and instead respond to complaints across the City based on need. The engineering department operates the same way, with staff working in all aspects of public works.

The stormwater program began funding maintenance positions in the 2002/3 fiscal year. Maintenance staffing was at 2.83 FTE from 2004/5 through 2008/9 and 4.40 FTE in 2009/10 and 2010/11. However, maintenance staffing levels have decreased in recent years due to budget constraints, as shown in Table 5-3. At the same time, the extent of the public stormwater infrastructure has increased greatly over the last five years, increasing from 32.5 miles of conveyance pipe in 2008 to 58.4 miles in

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2013. The larger pipe network will require increased staff time for preventative inspections and follow-up maintenance.

5.6.2 Evaluation of Staffing Levels

Based on the above findings, it is recommended that additional resources be designated toward implementing Newberg's stormwater program. The recommended resource levels for the City's stormwater management programs and maintenance activities are based on a zero-based approach as described below.

The zero-based budgeting approach identifies the activities to be performed and then calculates the resources required to perform them. This approach follows the basic steps outlined below:

- Identify tasks for preventive and corrective maintenance.
- Identify tasks for programmatic activities and regulatory obligations.
- Establish program goals for major activities.
- Estimate production rates for specific activities based on city experience and industry standards.
- Calculate staff hours required to meet program goals.
- Compare calculated requirements with existing resources.

Table 5-3 summarizes the results of the zero-based approach for estimating staffing levels for stormwater management programs and maintenance. The maintenance frequencies and program activities are consistent with the recommendations included in Sections 5.3.2 and 5.4.2.

The effort required to address corrective maintenance activities is based on the City's current experience. It is anticipated that higher (than current) levels of corrective maintenance will be needed to address the backlog of work that has been generated as the City's pipe system continues to age without a preventative maintenance program in place. Once the preventive maintenance program is implemented and backlogged cleaning and repair work has been performed, the levels of certain corrective maintenance activities would likely decline. Likewise, the number of customer complaints may also be reduced.

The staffing requirements in Table 5-3 show a need to staff the stormwater program at 3.60 FTE for maintenance, 2.55 FTE for engineering, and 0.45 FTE for administration. This equates to 6.60 FTE, which is an increase of approximately 1.2 FTE over 2013/14 staff levels. The staffing increases are generally related to:

- Adding a preventative maintenance program (0.67 FTE)
- Increasing field time for engineering staff to map the stormwater system and implement the stormwater management code - responding to illicit discharge concerns, enforcing private facility maintenance requirements, and conducting ongoing stream channel observations (0.5 FTE).

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Table 5-3. Stormwater Management Maintenance and Program Staffing Requirements

Storm drainage system quantities	3,900 structures (catch basins, manholes, and inlets) 312,150 feet of storm lines 10 public stormwater facilities							
	Infrastructure units				Staffing plan			
	Percent per year	Frequency per year	Actual per year	Units	Production rate (units/day)	Crew size	Annual hours	Total FTEs[a]
Stormwater Maintenance Activities							6334	3.60
Inspections, structures	20	1	780	each	50	2	250	0.14
Inspections, storm lines, 12 inches and greater	20	1	48,500	feet	1000	2	776	0.44
Inspections, facilities	100	2	20	each	2	2	160	0.09
Cleaning, structures	10	1	380	each	8	2	760	0.43
Cleaning, storm lines	2	1	4,850	feet	200	2	388	0.22
Cleaning, facilities	100	1	10	each	1	2	160	0.09
Ditch Maintenance	-	-	1,000	Feet	200	2	80	0.05
Minor repairs, structures	-	-	10	each	1	3	240	0.14
Minor repairs, storm lines	-	-	10	locations	1	3	240	0.14
System replacement, structures[b]	-	-	6	each	0.5	3	288	0.16
System replacement, storm lines[b]	-	-	1000	feet	100	3	240	0.14
Miscellaneous investigations	-	-	40	each	2	1	160	0.09
Street sweeping	-		-	-	n/a	1	1760	1.00
Asset management and recordkeeping	-		-	-	8 hours/week	1	416	0.24
Maintenance management and planning	-	rotational	-	-	8 hours/week	1	416	0.24

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Table 5-3. Stormwater Management Maintenance and Program Staffing Requirements

Storm drainage system quantities	3,900 structures (catch basins, manholes, and inlets) 312,150 feet of storm lines 10 public stormwater facilities							
	Infrastructure units				Staffing plan			
	Percent per year	Frequency per year	Actual per year	Units	Production rate (units/day)	Crew size	Annual hours	Total FTEs[a]
Stormwater program activities							4484	2.55
TMDL implementation plan	-	ongoing	-	-	-	n/a	1760	1.00
Development review and inspection	-	ongoing	-	-	-	n/a	880	0.50
CIP program management	-	ongoing	-	-	-	n/a	880	0.50
Customer response	-	as needed	10	calls	8 hours/call	1	80	0.05
Staff training (all PW staff)	-	1	1	training	4 hours/year	40	160	0.09
GIS mapping, field work and office	-	monthly			2 days/month	2	384	0.22
Stream channel observations	-	monthly			1 day/month	1	96	0.05
Private facility maintenance enforcement	-	ongoing	-	-	12 hrs/month	1	144	0.08
Illicit discharge investigation and enforcement	-	as needed	5	Events	20 hrs/event	1	100	0.06
Stormwater Administration							792	0.45
Stormwater administration[c]	-	ongoing	-	-	-	n/a	792	0.45
Total							**11,628**	**6.60**

[a]Calculations of FTE are based on 1760 working hours per year, account for sick leave, vacation, holidays, training, and breaks not directly related to the work.

[b]System replacements are dependent on annual budget. The values in the table reflect an annual replacement budget of $100,000.

[c]Includes administration of the stormwater utility fee and general administration of the stormwater program such as the portion of the public works director paid by the stormwater program.

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Section 6

Integrated Management Strategy

This section provides a summary of recommendations to address future regulatory objectives and capital project recommendations to address existing storm system capacity deficiencies, future storm system needs, and water quality objectives.

Section 6.1 includes programmatic recommendations for maintenance activities, water quality programs, and staffing. The programmatic recommendations also include one-time projects that are needed to implement the stormwater management program. Section 6.2 focuses on the development of larger capital improvement projects (CIPs), integrated to address capacity and water quality concerns. Section 6.3 outlines several ongoing infrastructure expenses to replace aging infrastructure and enhance water quality through retrofits.

6.1 Programmatic Recommendations

The regulatory evaluation summarized in Section 5 assessed the ability of the City of Newberg's (City) stormwater program to meet Total Maximum Daily Load (TMDL) program requirements. A review of the City's Standard Design Manual (2013 Draft and 2014 Draft) was delivered as a separate memorandum. The City's stormwater program currently contains many of the elements of a successful and regulatory compliant program; therefore, the following recommendations include only minor adjustments and additions to the existing program.

6.1.1 Maintenance Recommendations

In addition to providing ongoing responsive maintenance to identified problem areas, the City is strongly encouraged to move the maintenance program toward a more proactive, preventive maintenance approach, to provide an increased level of service to the community at reasonable cost. Over time, as the condition of the system is documented, repairs made where required, and systems cleaned before they become problems, the number of customer service investigations should be reduced. With a fully functional preventive maintenance program, the long-term costs associated with future repairs, rehabilitation, and replacement will be minimized. Specific recommendations include the following:

- Establish a proactive inspection schedule to evaluate structures visually and record videos of storm lines. Routine inspections likely will result in more work orders for cleaning, based on inspection results. In addition to identifying maintenance needs, routine inspections can be used to meet illicit discharge screening requirements of the City's TMDL Implementation Plan. The recommended inspection plan includes the following:
  - Visual inspection (and cleaning as needed) of 20 percent of catch basins, manholes, and inlets each year
  - Video inspection of 20 percent of storm lines (12 inches in diameter and greater) each year. The City's video schedule would aim to cover higher risk storm lines (those in the downtown and older areas of Newberg) once every 3 years and the remainder of the city on a 6- to 8-year cycle. More frequent evaluation of older pipes is needed to identify deteriorating pipes that are in need of replacement.

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- Purchase electronic tablets that will allow field data entry of maintenance activities into a cartegraph system. This will save staff time that is currently spent transferring field records from paper notes into the electronic system.

6.1.2 Program Recommendations

The City's programmatic stormwater activities are on track to meet TMDL compliance obligations and to provide a responsive level of service for customer complaints, development review, and capital project management. In addition to continuing with current TMDL implementation activities, development review, and capital project management, the following recommendations would allow the City to improve understanding of the existing drainage infrastructure and enhance water quality related services.

- Allocate staff time for ongoing field data collection to improve the accuracy of the City's geographic information system (GIS) stormwater database. The suggested schedule is to have two staff members spend 1 day per month collecting field data. Importing data and making adjustments to the GIS database are expected to take another 8 to 16 hours per month.
- After mapping of the public system is complete, continue monthly GIS mapping activities to locate and document the type and condition of private stormwater management facilities. The City's stormwater management code now requires private owners to conduct and document regular facility maintenance. The City will need facility locations to contact property owners and enforce the municipal code. Mapping and tracking maintenance on private facilities may also allow the City to take credit for the water quality improvement from private facilities if TMDL benchmarking becomes a regulatory requirement for the City.
- Develop a Water Quality-Sensitive Operations and Maintenance (O&M) Manual (or standard operating procedures [SOP]), as required by the TMDL Implementation Plan. The SOPs can be developed using template documents available from regulatory agencies or by adopting an existing maintenance manual developed by another jurisdiction with similar obligations.
- Conduct annual training for all public works staff on TMDL-related topics. For 2014/2015, the training should be focused on illicit discharge identification and reporting. Future trainings could cover the updated stormwater design standards, the water quality maintenance manual, or other water quality-related topics.
- Establish programs to implement the stormwater code (NMC 13.25). These programs include illicit discharge investigation and response and private facility maintenance tracking.
- Conduct regular field screenings of outfalls and other areas of previously observed stream bank erosion to document changes in bank conditions and identify locations for stream bank stability projects. Allocating at least 1 day per month for stream observation would allow City staff to visit areas of concern several times a year on a rotational basis.
- Continue participation in watershed groups and professional associations to understand how monitoring data are being collected by other small communities and utilized by regulatory agencies. Observing regulatory trends among other Oregon jurisdictions will allow the City to evaluate the need for a stormwater monitoring program in the future.

6.1.3 Staffing Recommendations

Implementing the recommended stormwater program activities will require 6.60 total full-time equivalents (FTE) to support the stormwater program. This is an increase of approximately 1.2 FTE over 2013/2014 levels. Additional staffing would allow the City to implement a preventive maintenance program and increase water quality programs in compliance with the City's TMDL Implementation Plan. The analysis in Section 5.6 recommends funding approximately 3.6 FTE in Maintenance, 2.55 FTE in Engineering, and 0.45 FTE in Administration.

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6.1.4 Engineering Projects and Studies

The City's stormwater program would see benefits from funding several one-time engineering projects and studies that would support implementation of the stormwater program. Recommended engineering projects and studies include the following:

- Water Quality Sensitive O&M Manual – as described in Section 6.1.2.
- System Development Charge (SDC) Rate Study – This Stormwater Master Plan (Master Plan) includes a preliminary assessment of the City's current stormwater program funding (see Section 7.3). While stormwater utility rates are reviewed regularly by the City's Citizen's Rate Review Committee, the stormwater SDCs also may need to be adjusted to support the projects identified in this plan.
- Master Plan Update – This Master Plan is intended to identify stormwater management activities and projects over the next 10 to 15 years. As the projects in this Master Plan are completed and new developments are constructed, the City will need to complete a Master Plan Update.

Table 6-1 identifies the required funding and proposed schedule to implement engineering projects and studies.

Table 6-1. Engineering Projects and Studies

Project number	Program name	Total cost, $	Timeline
P-1	Water Quality Sensitive O&M Manual	25,000	2014/2015
P-2	SDC Rate Study Revision (one time)	15,000	2014/2015
P-3	Master Plan Update (one time)	250,000	2025

6.2 Integrated CIP Development

This section identifies the projects designed to address the problem areas identified in Section 3. Problem areas include capacity problems identified through SWMM modeling and shown on Figures 3-1 and 3-1 as well as reported problem areas listed in Table 3-10 and depicted on Figure 3-3. To the extent possible, CIPs were developed as integrated solutions to address multiple objectives (e.g., flood control with enhanced water quality treatment or pipe replacement/realignment with capacity improvement) or to address multiple drainage problem areas with a single, comprehensive project.

6.2.1 Project Identification

CIP locations were identified by reviewing the model results presented in Table 3-9 and the reported problem areas in Table 3-10. Field visits to reported and modeled problem areas were also used to evaluate surrounding conditions and potential solutions and to identify problem areas that could be grouped into a single project location.

Many of the reported problems have a clearly identifiable solution. Examples of this are pipes located under private property that require realignment (DP-C-1, DP-C-4, and DP-C-10), deteriorating pipes needing replacement in River Street (DP-C-9), and areas lacking existing infrastructure (DP-C2, DP-H-1, DP-H-2, and DP-H-5).

The SWMM model was utilized to evaluate potential solutions for identified capacity problems. Potential solutions included upsizing of existing pipes, expansion of infrastructure, or installation of additional storage features such as underground vaults or regional detention ponds. In most cases, capacity

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problems are related to short stretches of undersized pipes. Upsizing existing pipe is more cost effective than acquiring property to add detention storage at the flooding locations. In addition, the stream channel vulnerability assessment showed that the natural stream channels are generally stable under current flow and development conditions, which indicates that significant upstream detention storage is not needed for existing development. Future development areas may need to utilize regional storage systems to meet the City's stormwater design standards and prevent any further degradation.

Following these evaluations, a strategy meeting was conducted with City staff to review the problem areas and potential alternative solutions. Small improvements along the same pipe network were combined into larger projects that provide a longer term solution. To integrate development of the flood control and water quality CIPs, the identified capacity problem areas were reviewed to determine whether water quality facilities (such as a rain garden, stormwater planter, or green street design) could be sized and located to address the capacity problem or to provide treatment in addition to a upsized conveyance pipe. In areas where the capacity problem is a result of undersized trunklines, opportunities for adding additional water quality treatment were limited.

The resulting project list includes 15 capital projects, including small pipe and culvert replacements, larger realignments of existing drainage networks, and construction of new stormwater infrastructure in underserved neighborhoods.

6.2.2 Unit Cost Estimates

Unit cost information for construction elements of the CIP facilities was compiled using bid tabulations from recent local construction projects and *Site Work & Landscaping Cost Data* (RS Means, 2012) was referenced for additional work not covered by recent bid tabs. The unit costs were adjusted based on results of bids on recent City projects.

Preliminary CIP cost estimates are based on the unit cost information for construction elements plus a 30 percent contingency. Permitting, surveying and design, and construction administration costs are based on a general percentage of the total construction cost. Land acquisition costs are not included in the estimates.

Project unit costs and detailed cost estimates for each CIP are located in Appendix D. CIPs with multiple components contain a detailed cost estimate for each project component.

6.2.3 CIP Sizing and Conceptual Design

This section includes a summary of the CIP sizing and conceptual design criteria based on the type of system improvement proposed. System improvements include piping improvements, infiltration planter boxes for water quality, and bank stabilization and outfall protection for channel improvements. Proposed CIPs may reflect a combination of these system improvements.

Conveyance – Design criteria for new conveyance piping are based the City's September 2013 Draft Standard Design Manual. In most areas of the City, pipes were sized to convey the 25-year future conditions flow. In areas where the cumulative drainage area exceeds 250 acres, the 50-year future condition flow was the design standard.

Stormwater Planters and Rain Gardens – Infiltration planter boxes were sized according to available space in the existing planter strips. These water quality systems will be installed on an opportunistic basis, retrofitting existing streets that currently do not have water quality treatment measures. In most cases, an overflow system will need to be installed to allow for bypass of storm events that exceed the design capacity of the planter or rain garden. Bypass flows will be discharged into the existing conveyance system via gutter flow to the nearest catch basin or piped overflow to the nearest storm drain.

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6.2.4 CIP Project Summary

Table 6-2 includes a CIP designation, a problem description, and project description for each CIP. The CIPs are presented and numbered by each of the three basins. The following CIP designations are applicable:

- flood control (FC)
- improve drainage infrastructure network (IDIN)
- pipe replacement – location (PR-L)
- pipe replacement – material (PR-M)
- reduce maintenance frequency (RMF)
- structural integrity (SI)
- stream bank protection (SP)
- water quality (WC)

Figure 6-1 shows the location of each of the proposed CIPs. Detailed CIP fact sheets are provided in Appendix D and include additional conceptual design detail and a map locating the proposed system improvements. Appendix D also contains detailed cost estimates for each project. Section 7 provides a priority ranking of CIPs and the planned schedule for implementation.

6.3 Ongoing Capital Projects

The capital projects listed in Table 6-2 address specific infrastructure needs. The City's stormwater system also faces long term challenges related to asset management. The stormwater program would benefit by allocating funds each fiscal year to upgrade existing infrastructure and enhance water quality treatment. Two ongoing capital projects are recommended, as described below.

6.3.1 Annual Pipe Replacement Program

The City's stormwater infrastructure is a significant asset. Stormwater pipes typically have a design life of 50-100 years. The longevity of the infrastructure depends on many factors, including pipe material, installation methods, site conditions, traffic loads, and maintenance frequency. While a preventative maintenance program can extend the life of the pipe network, some areas of the City are still composed of clay tile pipe. Other areas are deteriorating and will need replacement as part of the City's asset management strategy.

The areas in greatest need of pipe replacement include pipes located under private residences and the deteriorating clay tile pipe in South River Street. These known problem areas will require significant capital projects, and have been included in the Table 6-2 CIP list. Future areas that require replacement would be identified through the preventative maintenance inspection program. An annual pipe replacement program would establish "system replacement" as an annually recurring capital project. This funding would allow the City to replace aging pipes and structures that show significant deterioration during preventive maintenance inspections.

Targeted pipe replacement can be completed by City maintenance crews or by contractors from the City's small works roster. This is a cost effective way to upgrade infrastructure without incurring the engineering and administrative costs that come with larger capital projects. Funding annual pipe replacement at $100,000 per year would allow the City to replace only a small percentage (less than one percent) of the total existing pipe each year. However, the annual pipe replacement program is an ongoing investment in asset management that will allow the City to address small needs before they grow into larger, more costly problems.

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6.3.2 Water Quality Retrofit Program

As with the Annual Pipe Replacement program, the Water Quality Retrofit Program would set aside funds each year to enhance water quality treatment as opportunities arise on other capital projects. It is recommended that the water quality retrofit program be funded at a rate of $50,000 per year.

In general, water quality retrofits take the form of rain gardens, stormwater planters, and other "green street" elements. These types of facilities provide localized water quality treatment to surface runoff. Infiltration is utilized to manage small flows. Underdrains and overflow piping convey peak flows to the stormwater conveyance system. Water quality retrofits are most cost effective when combined with another capital project. Transportation projects, such as road widening, traffic calming, and pedestrian/bike improvements all lend themselves well to incorporating water quality retrofit projects. Two projects – one on Springbrook Road and one on College Street – are currently underway to improve water quality and stormwater management in conjunction with transportation system upgrades. Having an annual fund for water quality retrofits gives the City the ability to capitalize on opportunities as they become available.

Figure 6-2 shows the two current project areas, as well as additional locations around the City, that may be considered for future water quality improvements. The locations were selected based on:

- Existing transportation/stormwater project locations. Examples include Springbrook Road and College Street.
- Proposed stormwater capital projects where water quality elements may be incorporated into the final design. Examples include Dayton Avenue (CIP C-8), River Street (C-6), Elliot Avenue (CIP H-1), and North/Franklin/Sherman/Sheridan Streets (CIP H-2).
- Locations that are not fully served by the existing stormwater infrastructure that look to have potential opportunities for the addition of planters or rain gardens within the existing right-of-way. Examples include 2nd Street, 3rd Street, Sitka Avenue, and Hulet Avenue. In these locations, the water quality retrofit project may need to replace existing landscaping or on-street parking areas. Coordination with local residents will be an important aspect of project evaluation and development.
- Locations where future development may bring roadway improvements that could incorporate water quality treatment. Examples include Crestview Drive east of Villa Road and Carter Lane between Hazelnut Drive and Kemper Crest Drive.

At $50,000 per year, the Water Quality Retrofit Program will not fund significant stand-alone projects. Rather, the funding should be utilized to enhance water quality in association with other capital projects. Funds from the Water Quality Retrofit Program could also be utilized as matching funds to secure grants for larger enhancement projects down the road.

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Table 6-2. Comprehensive CIP Summary

CIP number	CIP type	CIP name	Proposed CIP location	Event(s) deficiency occurs	Problem description	CIP description	Length of conveyance improvements, linear feet (LF)	Associated subcatchment	Contributing drainage area, acres	Estimated capital implementation cost total, $
Basin 1 - Chehalem Creek										
C-1	PR-L; SI; FC	S Blaine Street Improvements	S Blaine Street, between E 6th and E 7th Streets	Existing and future 10-year	Currently a reach of 12"-18" stormwater pipe runs through private property and under several houses. Flooding along E 6th and S Blaine Streets occurs during the current and future conditions 10-year storm events.	Decommission the stormwater pipes which are in private property and add a 24" stormwater pipe along S Blaine Street and a 12" pipe along E 1st Street. Connect the stormwater system from E 6th Street to S Blaine Street to provide conveyance and storage. Upsize existing stormwater pipes to 24" and 18" to convey existing and future flows.	2,887	SC_STMG1227, SC_STMG1215, SC_STMG121, SC_STMG1219, and SC_STMG1320	62.0	1,161,000
C-2	PR-L; SI; FC	S Center Street Improvements	S Center Street, between E 3rd and E 9th Streets	Existing and future 10-year	Currently a reach of 21" stormwater pipe runs through private property and under several houses. Flooding along E 8th, E 7th, and S Center Streets occurs during the current and future conditions 10-year storm events.	Decommission the stormwater pipes which are on private property and add a 30" stormwater pipe along S Center Street. Upsize existing stormwater pipes to 30", 24", and 18" to convey existing and future flows.	3,860	SC_STMG1245, SC_STMG128, SC_STMG1317, SC_STMG133, SC_STMG135, SC_STMG1310, SC_STMG1311, and SC_STMG1323	100.1	1,404,000
C-3	FC	E Columbia Drive Improvements	E Columbia Drive, west of N College Street	Existing and future 10-year	Flow is currently limited by three undersized 18" pipes which restrict flow from larger-diameter upstream pipes. Hydraulic modeling shows overflow from manholes during the 10-year existing/future flow event. Downstream pipe segments are 24" diameter and have capacity for current and future 10-year flow events.	Upsize existing stormwater pipes to 24" to convey existing and future flows.	92	SC_STMG0924, SC_J5064, SC_STMG1029, and SC_STMG0919	56.7	79,000
C-4	FC	Oxford Street Improvements	Oxford Street, between Winchester and E Mountainview Drives	Existing and future 10-year	Flow is currently restricted by 14 undersized pipes. Flooding from manholes is shown to occur during the 10-year existing/future flow event. Pipe diameters increase and decrease in numerous places throughout this alignment. The City has installed some upsized pipes to address acute problems. This project provides a wider solution to provide long term capacity.	Upsize existing stormwater pipes to 36" to provide capacity for future flows. Utilize existing structures where possible.	1,860	SC_STMG0765, SC_STMG0755, SC_STMG0714, SC_STMH072, SC_STMG0733, SC_STMH081, SC_STMG0721, SC_STMG0750, SC_STMG0744, SC_STMG0769, SC_STMG0768, SC_STMG077, SC_STMG0830, SC_STMG0860, SC_STMG0847, SC_STMG088, SC_STIG0837, SC_STMG0846, SC_STMG0814, SC_STMG085, SC_STMG0811, and SC_STMG082	167.4	1,092,000
C-5	FC	N College Street Improvements	N College and Dahlia Streets, between Natalie and Foothills Drives	Existing and future 10-year	Flow is currently restricted by four undersized pipes during the current and future conditions 10-year storm events.	Upsize existing stormwater pipes to 24" to convey existing and future flows.	691	SC_STMG0774, SC_STIG07112, SC_STMG0775, and STMG0772	102.8	260,000
C-6	PR-M	S River Street Improvements	S River Street and E 11th Court	No capacity issues	Carry-over project from the 2001 Stormwater Master Plan.	Two clay sewer tile pipe segments will be replaced with 18" pipe to convey existing and future flows.	507	SC_STMG1412 and SC_STMG1413	27.0	160,000
C-7	PR-M	S College Street at Andrew Street Improvements	S College Street, south of Andrew Street	No capacity issues	Existing pipe system under S College Street is composed of multiple pipe materials, causing maintenance problems and concerns over long term stability.	Replace two existing culverts with 130 LF of 48" culvert.	260	SC_STMG1245, SC_STMG1317, SC_STMG128, SC_STMG135, SC_STMG133, SC_STMG1311, SC_STMG1310, SC_STMG1323, SC_STMG138, SC_STMG1412, SC_STMG1413, SC_J-CCT1-07, SC_STMG142, SC_STMG143, SC_STMG149, and SC_J3498	171.5	196,000
C-8	FC; WC	Dayton Avenue Green Street Conveyance	Dayton Avenue, south of 5th Street in the vicinity of W Johanna Court	Not modeled	The City has reported drainage problems along Dayton Avenue near W Johanna Court. The resident at 606 NE Dayton Avenue has reported frequent driveway flooding driveway.	Add stormwater planters (low impact development (LID)/green stormwater infrastructure design) along Dayton Avenue to provide storage capacity and water quality improvements.	n/a	SC_STIF1324	13.4	196,000

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Table 6-2. Comprehensive CIP Summary

CIP number	CIP type	CIP name	Proposed CIP location	Event(s) deficiency occurs	Problem description	CIP description	Length of conveyance improvements, linear feet (LF)	Associated subcatchment	Contributing drainage area, acres	Estimated capital implementation cost total, $
Basin 2 – Hess Creek										
H-1	IDIN	N Elliot Road Improvements	N Elliot Road, north of Highway 99W	Not modeled	The City has reported drainage problems along N Elliot Road as the area does not have a public drainage system, resulting in frequent ponding during storm events.	Add a drainage system to convey flows from N Elliot Road to the existing system to the east. The proposed pipe system is sized to convey both current and future flows.	757	SC_STMI111 and SC_STII1179	17.8	239,000
H-2	IDIN; FC	N Edwards Street Improvements	N Edwards Street, from Vermillion Street to E Sheridan Street	Existing and future 10-year	The City has reported drainage problems along Vermillion Street between N College Street and the railroad tracks. Currently a flat and undersized pipe discharges stormwater along the railroad tracks. This neighborhood has some bubblers at intersections, but does not have a defined connection to the public stormwater system.	Add a drainage system to convey flows from Vermillion Street to the existing drainage system at E Sheridan Street. Proposed pipes are sized to convey both current and future flows.	4,340	SC_J-HC-18, SC_J4620, SC_J4818, and SC_J3628	38.0	1,217,000
H-3	FC; WC	E 3rd Street Improvements	E 3rd and S Church Streets	Existing and future 10-year	Modeling shows flooding problems along E 3rd and S Church Streets during the current and future conditions 10-year storm events.	Add a 24" stormwater pipe to connect the stormwater system from E 3rd Street to S Church Street to provide conveyance and storage. Upsize existing stormwater pipes to 30", 24", and 18", as determined by modeling. Install stormwater planters (LID/green stormwater infrastructure design) along E 1st Street to provide additional storage capacity and water quality improvements.	2,427	SC_STMH1253, SC_J4290, SC_STMH1233, and SC_STMH1223	40.7	887,000
H-4	PR-M; FC	Villa Road Improvements	Villa Road, north of Carol Ann Drive	No capacity issues	The culvert on Hess Creek at Villa road is a mix of corrugated metal pipe and concrete box culverts. This is an area of maintenance attention during large storm events to prevent flood waters from impeding traffic on Villa Road.	The existing culvert will be upsized from a 30" culvert to a 60" culvert to convey current and future flows.	75	SC_J-HC-31, SC_STIH107, SC_STMH0919, SC_STMH097, SC_STMH096, SC_STMH098, SC_STMH095, SC_STMH0911, SC_J4002, SC_J-HC-03, SC_J5480, SC_J-HC-34, SC_STMH1024, SC_J-HC-35, SC_J-HC-36, SC_STII0940, SC_J-HC-37, SC_J-HC-38, SC_STIH081, SC_J4956, SC_J-HC-39, SC_J-HC-40, SCa_J5090, SC_J5284, SC_J-HC-42, SC_J3938, SC_J4576, SCb_J5090, SCc_J5090, SC_J5324, SC_J-HC-43, and SC_J3936	1,174.4	104,000
Basin 3 – Spring Brook										
S-1	FC	N Springbrook Road Improvements	N Springbrook Road, north of Hwy 99W	Existing and future 10-year	Modeling shows flooding problems along N Springbrook Road during the current and future conditions 10-year storm event. The upstream stormwater system along N Springbrook Road was upgraded during installation of traffic improvements, but flows are constricted from a 30" pipe down to an 8" to 12" section of pipe near Middlebrook Drive.	Upsize the stormwater pipes along N Springbrook Road to 30" diameter and connect the system to the existing system to the south. The proposed pipe system is sized for both current and future flows.	1,735	SC_STII0965, SC_STII0975, SC_STII0990, SC_STII1030, and SC_STII1080	55.9	777,000
S-2	FC; RMF	Libra Street Improvements	Libra Street and Victoria Way	Existing and future 10-year	Modeling shows flooding problems along Libra Street during the current and future conditions 10-year storm event. This system needs frequent maintenance to address silt accumulation.	Upsize existing stormwater pipes along Libra Street to 18" to convey current and future flows.	804	SC_STII0988, SC_STIJ0911, and SC_STMJ1022	14.4	246,000
City-Wide										
A-1	SP	Stream Bank Protection Projects	Multiple locations	No capacity issues	Erosion of stream banks in locations near outfalls or high energy portions of the stream channels. Locations determined based on field observation.	Reconstruct storm drainage outfalls that are well placed along stream banks. Add bank protection and replant riparian areas.	n/a	n/a	n/a	190,000

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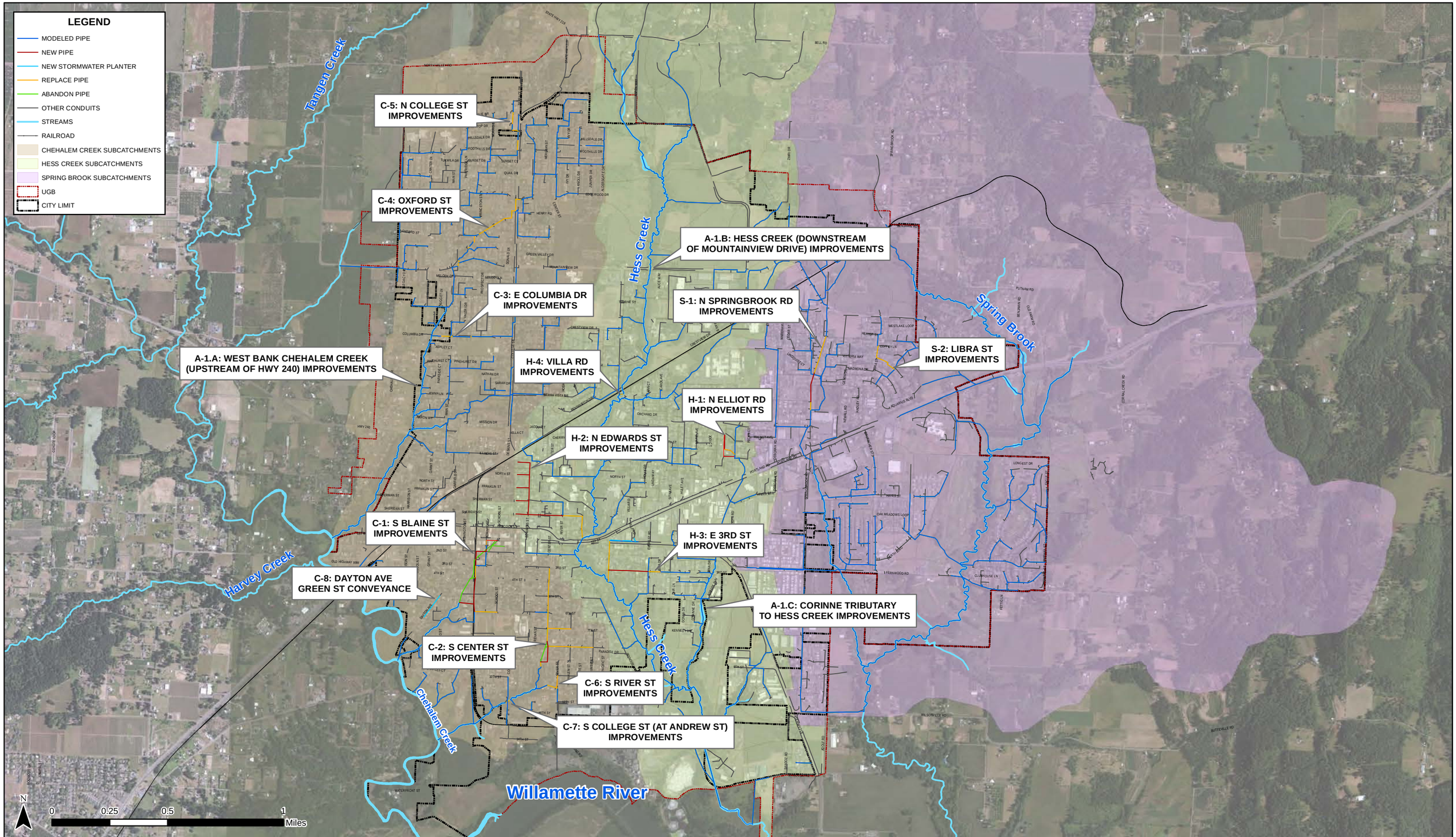

STORMWATER MASTER PLAN UPDATE

FIGURE 6-1. CAPITAL IMPROVEMENT PROJECTS

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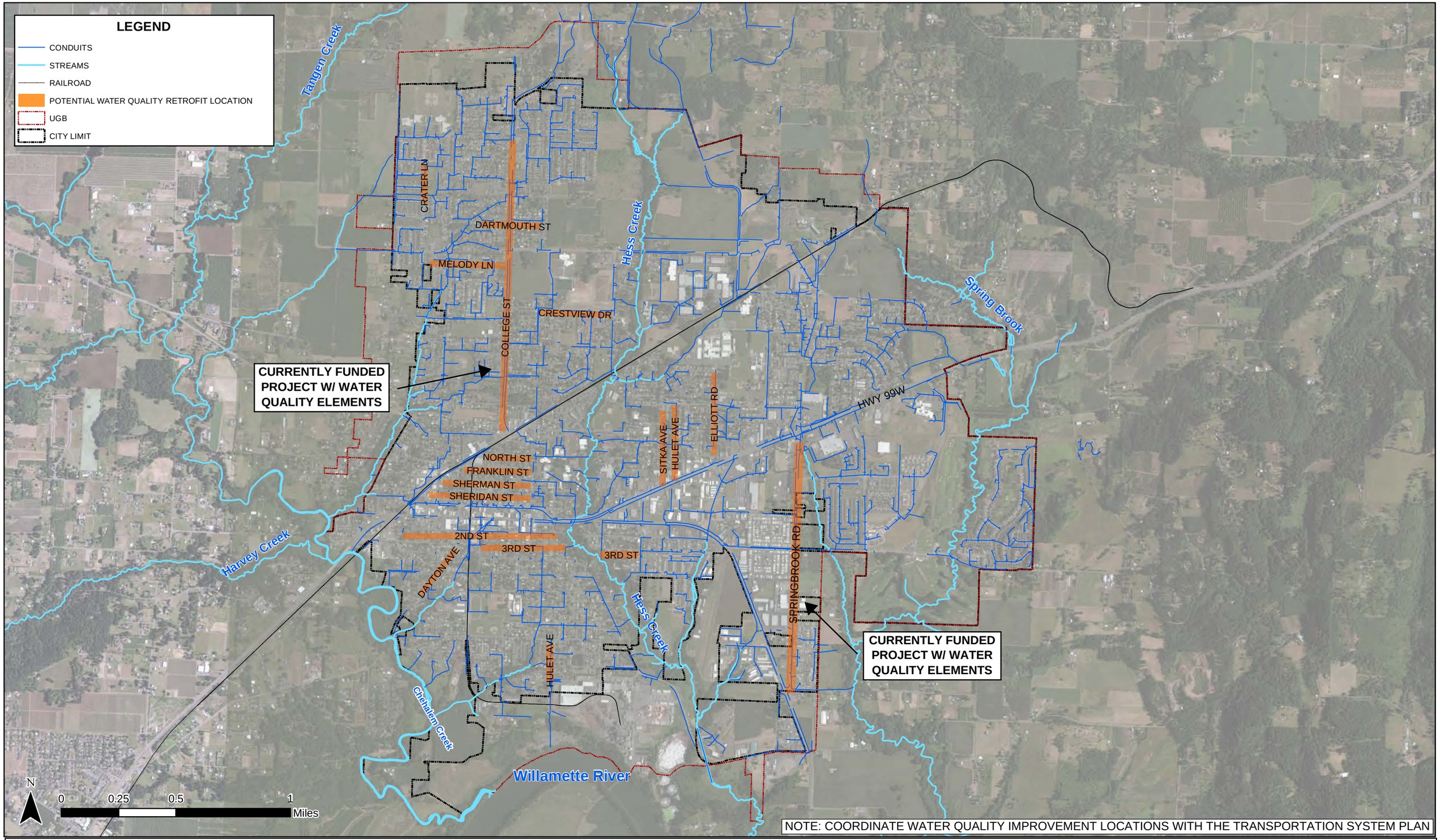

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STORMWATER MASTER PLAN UPDATE

FIGURE 6-2. POTENTIAL WATER QUALITY RETROFIT LOCATIONS

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Section 7

Implementation Plan

This section presents a proposed implementation plan for the capital projects and program recommendations outlined in Chapter 6. The plan includes capital project prioritization, so that the City of Newberg (City) can budget for projects in 5-year increments. The City is not under regulatory obligations to complete stormwater-related capital projects. Instead, the implementation timeline is based on local priorities, which were established during the development of this Stormwater Master Plan (Master Plan). Following the capital project prioritization, Section 7.2 presents a financial analysis to evaluate the funding needed to implement this Master Plan.

7.1 Capital Improvement Project (CIP) Priority Evaluation

The capital projects presented in Section 6.2 represent a long term strategy to address flooding, capacity upgrades, stream bank stability, and water quality enhancements. Effective implementation of this Master Plan requires prioritizing projects and establishing a schedule for design and construction.

7.1.1 Prioritization Criteria

Two strategy meetings were conducted with City staff to review project alternatives and establish implementation priorities. A list of prioritization criteria was developed to align with local priorities. Each criterion was also assigned a weighting factor (WF), so that project prioritization will emphasize the issues of greatest concern. For example, the health and safety issue associated with structural stability of existing pipes is a top priority for City staff. Aging pipes located under existing buildings need to be moved into the public right-of-way and the existing pipes need to be decommissioned in a method that reduces the likelihood of a pipe failure.

Following are the CIP prioritization criteria used in this plan:

Safety/Liability – Does the project address safety concerns, structural stability, or other potential liability concerns for the City? (WF: 1.0)

Complexity – Can the project can be designed and constructed quickly or will it require significant attention to address challenging design or construction issues? (WF: 0.5)

Impact – Will the project benefit a large area of the city or is the problem limited to a few individual properties? (WF: 0.5)

Environmental Benefit – Are there direct water quality or habitat-related environmental benefits associated with the project? (WF: 0.5)

Long-Term Maintenance – Will the project increase or decrease the maintenance activities required by City staff? (WF: 1.0)

Sustainability/Livability – Will the project improve quality of life and provide a long-term solution that is aligned with community values? (WF: 0.5)

Cost is not listed as a prioritization criterion at this time. Instead, the City will use the prioritization criteria to identify top groups of project (i.e., projects to be constructed in the first 5 years, second 5 years, etc.). Project cost will then be used to schedule projects based on the funding available and long-term savings required to implement the preferred solution.

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The detailed scoring and weighting criteria are included in Appendix D.

7.1.2 CIP Prioritization

Based on the prioritization criteria, the City evaluated each of the proposed capital projects and calculated a total prioritization score. Higher scoring projects are of higher priority. The details of the scoring are presented in Appendix D. Table 7-1 provides the total prioritization score for reach project, along with an estimated timeline for implementing projects.

Table 7-1. CIP Prioritization and Implementation Timeline

Basin	CIP number	Project name	Cost, $	Prioritization score	Estimated timeline
Chehalem Creek	C-1	Blaine Street Improvements - Design	180,000	n/a[a]	Short-term
	C-1A	Highway 99W to 2nd Street Parking Lot Pipe Decommissioning/Replacement	131,000	10.0	Short-term
	C-1B	S Blaine Street Pipe Replacement	384,000	9.0	Short-term
	C-1C	E 2nd Street to E 5th Street Pipe Decommissioning/ Replacement	291,000	10.0	Short-term
	C-1D	E 6th and S Blaine Streets Pipe Replacement	176,000	6.5	Long-term
	C-2	S Center Street Improvements - Design	180,000	n/a[a]	Short-term
	C-2A	E 9th Street to S Center Street Pipe Decommissioning	294,000	10.5	Short-term
	C-2B	S Center, E 8th, and E 7th Streets Pipe Replacement	930,000	7.0	Long-term
	C-3	E Columbia Drive Improvements	79,000	8.0	Mid-term
	C-4	Oxford Street Improvements	1,092,000	7.5	Mid-term
	C-5	N College Street Improvements	260,000	6.5	Long-term
	C-6	S River Street Improvements	160,000	9.0	Short-term
	C-7	S College Street at Andrew Street Improvements	196,000	7.0	Long-term
	C-8	Dayton Avenue Green Streets	125,000	7.5	Mid-term
Hess Creek	H-1	N Elliot Road Improvements	239,000	5.5	Long-term[b]
	H-2	N Edwards Street Improvements	1,217,000	6.0	Long-term
	H-3	E 3rd Street Improvements - Design	142,000	n/a[a]	Long-term
	H-3A	S Church and E 1st Street Improvements	404,000	6.0	Long-term
	H-3B	E 3rd Street Improvements	341,000	5.5	Long-term
	H-4	Villa Road Improvements	104,000	8.0	Mid-term[c]
Spring Brook	S-1	N Springbrook Road Improvements	777,000	6.5	Long-term[c]
	S-2	Libra Street Improvements	246,000	7.0	Long-term
City-wide	A-1	Stream Bank Protection Projects	190,000	8.0	Mid-term
		Total	8,137,000		

[a] Design work for phased projects should be prioritized based on the highest scoring construction phase.

[b] Project to be constructed with roadway improvement project. Schedule dependent on transportation program priorities.

[c] Project to be designed and constructed with water and wastewater system improvements. Schedule based on joint priorities.

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Short-term projects that include the highest priority health and safety concerns are the highest priority, and will be the focus of construction over the next 5 or 6 years. Mid- and long-term projects will be constructed, depending on funding availability. Short-term priority projects include the following:

- C-1, C-1A, C-1B, and C-1C. Blaine Street Improvements (Design and the first three phases of construction)
- C-2 and C-2A. South Center Street Improvements (Design and the first phase of construction)
- C-6. South River Street Improvements

In addition to addressing the safety and liability concerns of having public infrastructure located under private structures, these seven projects will replace aging infrastructure and serve as part of the annual pipe replacement program recommended as part of the City's maintenance program.

Ultimately, the project schedule will be dependent on funding availability. In addition, some projects are dependent on the construction of other infrastructure, such as the need to replace the existing culvert under Villa Road when the roadway is widened (Project H-4). Stormwater projects that are affiliated with another infrastructure project will be scheduled as those projects are funded. This could adjust the schedule in which stormwater projects are completed.

7.2 Financial Analysis

This financial analysis is a preliminary assessment of the funding needed to implement the stormwater program recommendations and proposed capital funding. The assessment is based on stormwater program revenue sources available and proposed as of 2014. The City is not under regulatory obligations to complete the identified capital projects, so the implementation timeline may be adjusted to align with available funding.

7.2.1 Current Funding

The City's stormwater program is currently funded through two sources: the Stormwater Utility Fee and System Development Charges (SDCs) on new development. In the 2013/2014 budget, the City has projected revenue of $976,000 from the Stormwater Utility Fee, $42,000 from SDCs, and $7,400 in miscellaneous income, such as interest and development review fees.

In 2014, the stormwater utility rate is $7.30 per month per single family residential property. Other land uses (multifamily, commercial, industrial) pay $7.30 per month per equivalent residential unit, which is calculated based on the property's impervious area coverage. The stormwater rate structure includes an opportunity for rate payers to receive fee credits for performing stormwater management activities. Under Newberg Municipal Code 13.20.080 single family residences can receive credit for installing systems to infiltrate runoff onsite. Commercial, industrial, and multi-family property owners can apply for a rate credit in exchange for educating their employees or residents about runoff and water quality principles or installing stormwater facilities that exceed the City's current standards.

The City's Citizen Rate Review Committee (CRRC) meets regularly to evaluate future utility rates for stormwater, water, and wastewater utilities. Through the review process, stormwater utility rates have risen steadily to support increasing program costs. In 2014, the CRRC is considering a recommendation to raise stormwater utility rates by 9 percent to increase capital project funding to $250,000 per year.

SDCs are another source of capital project funding, though the portion of projects funded by SDCs must be tied to the future growth. CIP fact sheets in Appendix D document the percentage of each capital project that can be attributed to future growth, and therefore, the approximate percentage of the project that could be funded through SDCs.

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7.2.2 Personnel Services

For fiscal year 2013/2014, the stormwater management program is funding staff at 5.38 full-time equivalents (FTEs). Personnel services, which include salary, benefits, and other related expenses total $542,923.

Increasing the stormwater program staffing to 6.60 FTEs as recommended in Chapter 6 would increase the personnel services budget by approximately $125,000 per year. The CRRC is currently considering a recommendation to add 0.50 FTE to the stormwater program budget to support the preventive maintenance program. The City may consider future rate increases to fund an additional 0.70 FTE or evaluate an alternative (or delayed) schedule of implementing additional maintenance and stormwater related programs.

7.2.3 Capital Projects

The 2014 CRRC recommendation would fund $450,000 in capital projects in the first year, followed by $250,000 per year in future years. SDCs are expected to bring in an additional $100,000 to $150,000 per year, though those funds will need to be directed to growth-related projects.

At the proposed funding rate, the seven short-term projects identified in Table 7-1, which total $1.6 million, can be constructed in 5 years, along with completing the Water Quality Sensitive Operations and Maintenance Manual and the SDC Rate Study (identified as engineering projects P-1 and P-2). To expedite the completion of short-term capital projects, it is recommended that the ongoing capital projects (Annual Pipe Replacement and Water Quality Retrofit Program) be delayed until after the short-term projects are completed. The short-term capital projects address some of the greatest pipe replacement needs and will incorporate water quality elements, effectively meeting the goals of the two ongoing capital projects. As more capital project funds are identified, pipe replacement and water quality retrofits can be added to the annual capital project budget.

At the proposed funding rate, mid-term capital projects, which total $1.6 million would be completed in years 6 through 12. Long-term capital projects, which total $4.9 million would require an additional 15 years to complete.

If additional funding is identified to support the stormwater program, the proposed capital projects could be completed on an expedited schedule. Additional funding could come in the form of increased utility revenue, SDCs collected from new development, grant funding, municipal bonds, or the formation of local improvement districts to fund specific projects. This Master Plan gives the City the flexibility to implement capital projects based on the available funding sources.

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Appendix A: Modeled Drainage System Maps

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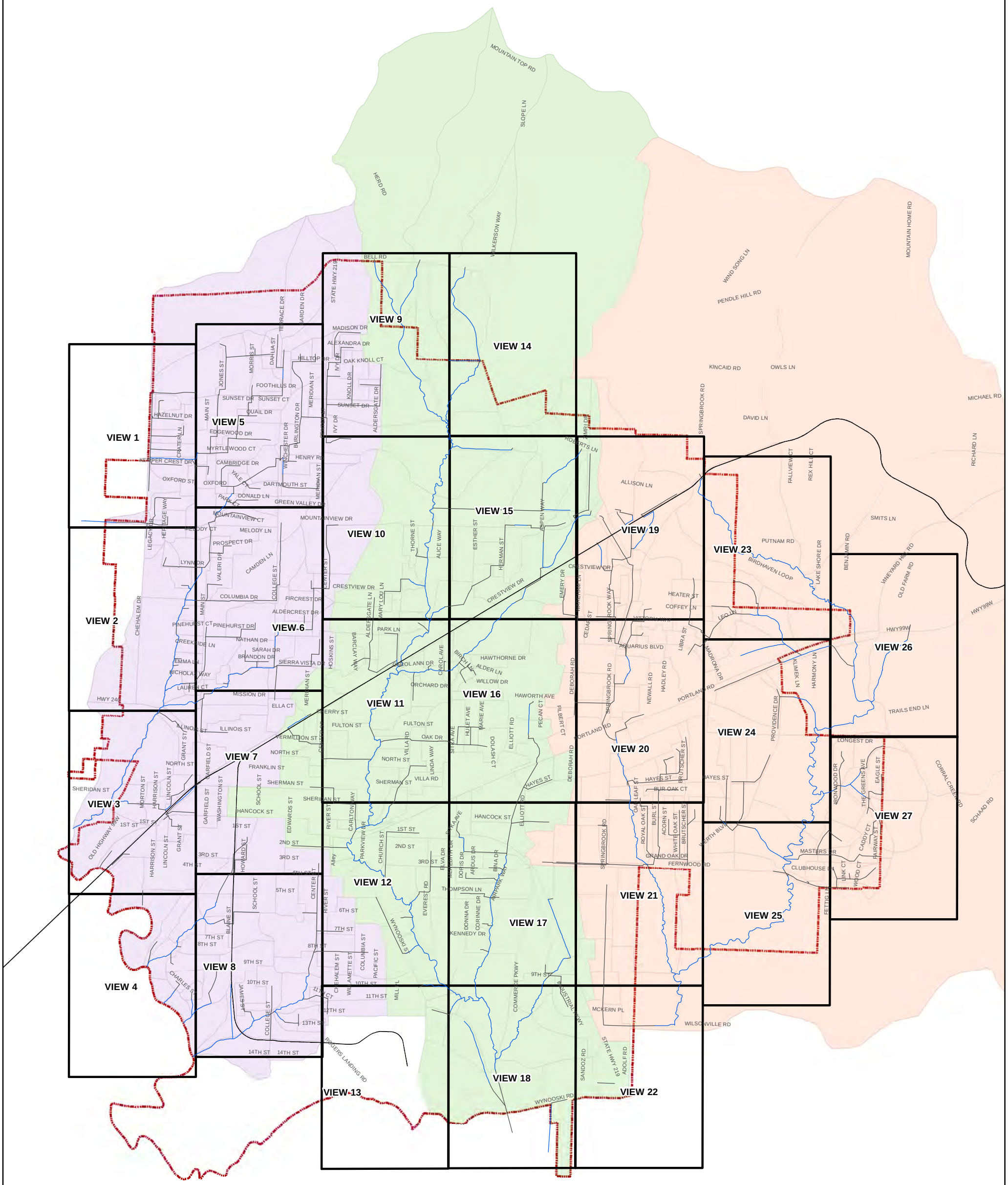
KEY MAP



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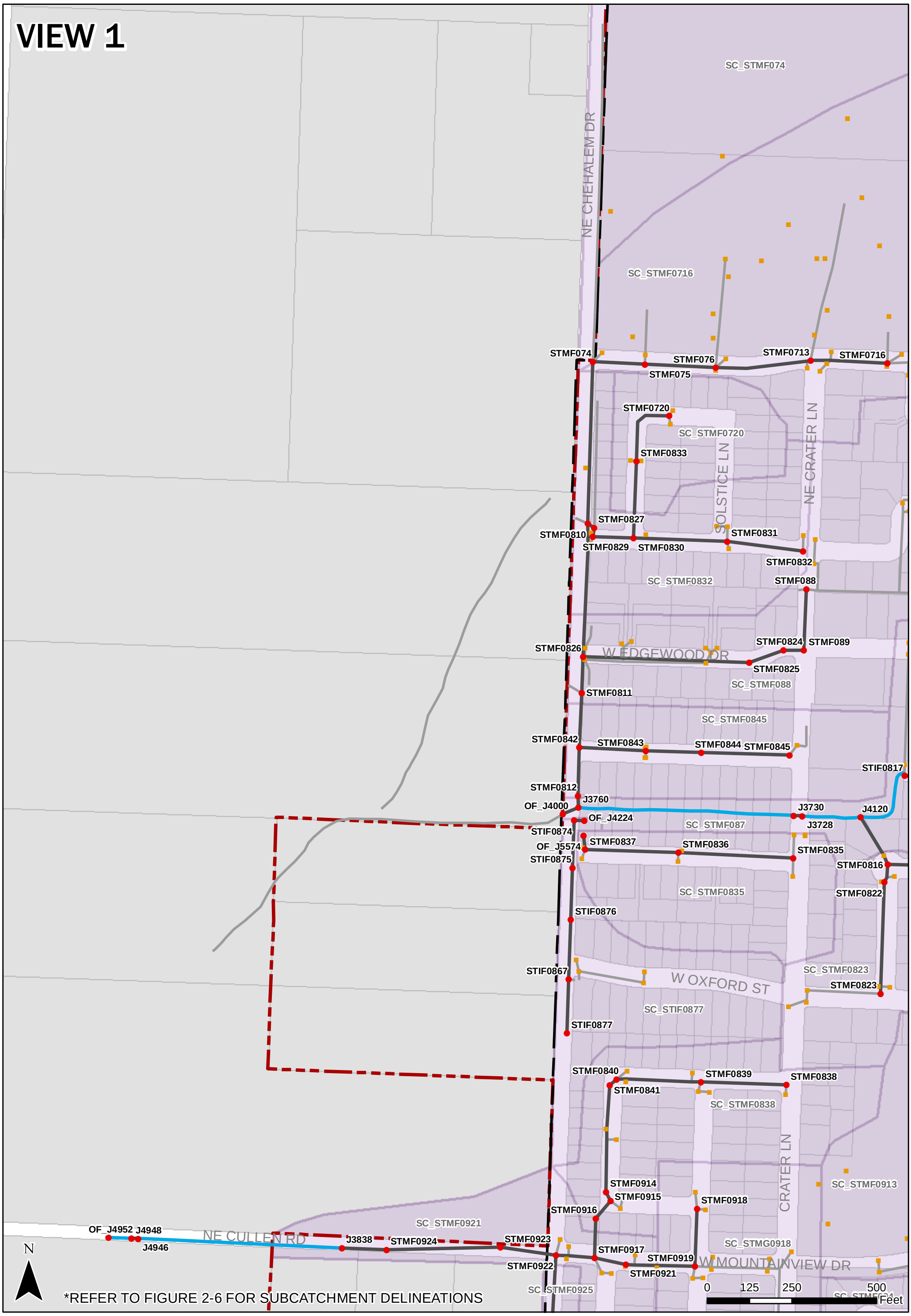
CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
KEY MAP

- RAILROAD
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- MAP VIEW
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 1



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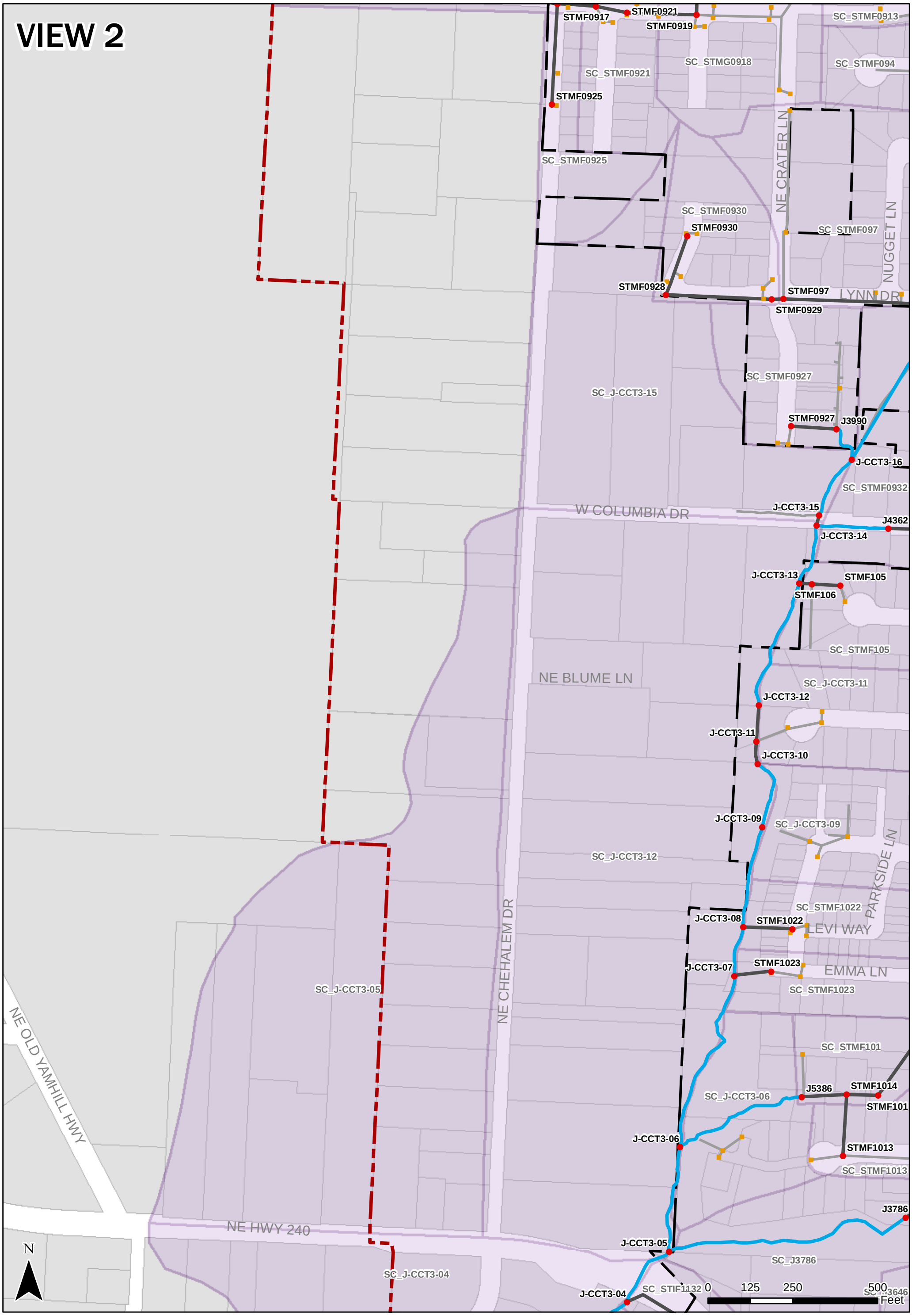
CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 1

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 2



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SWMM MODEL SYSTEM MAPPING
VIEW 2

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
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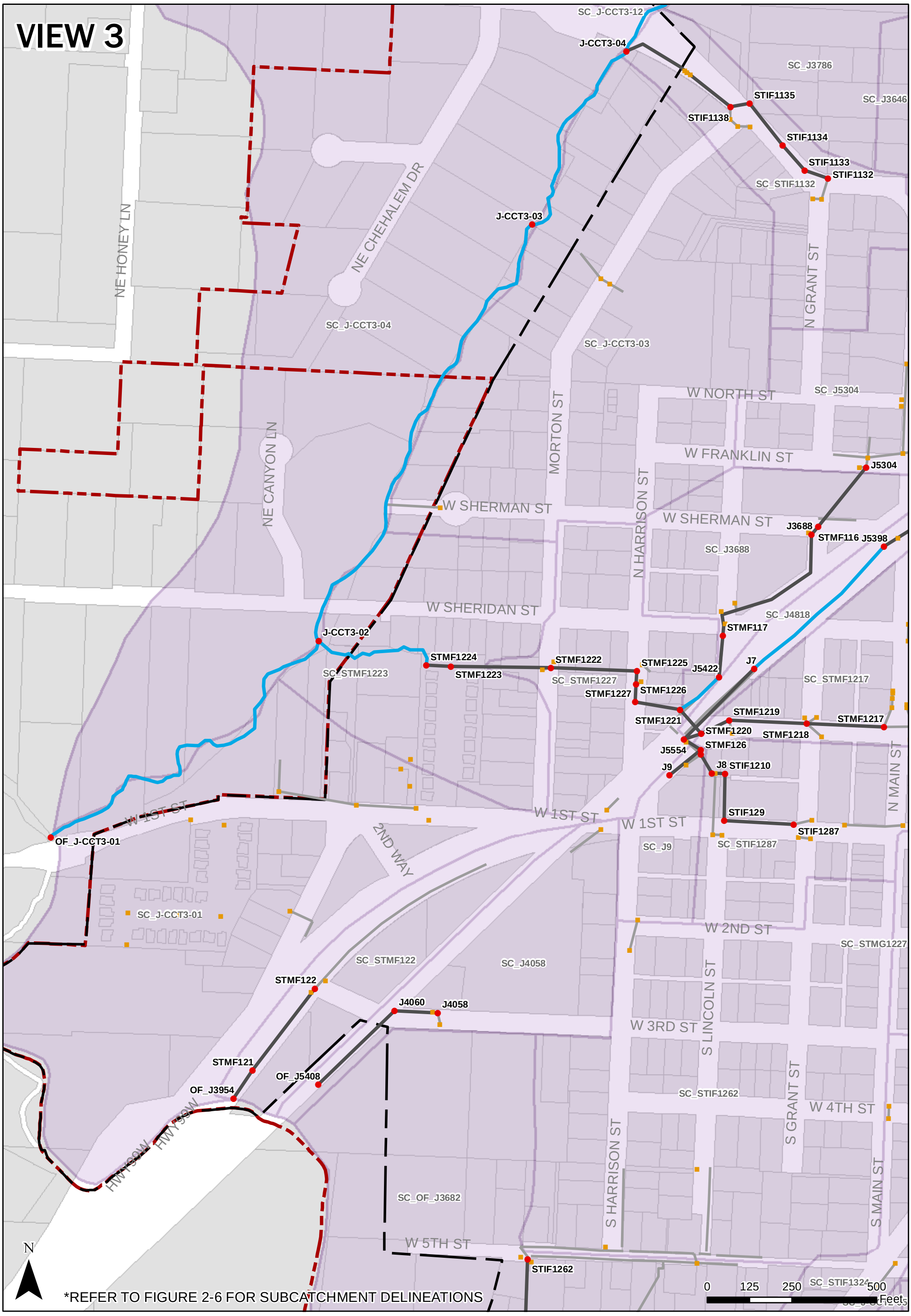

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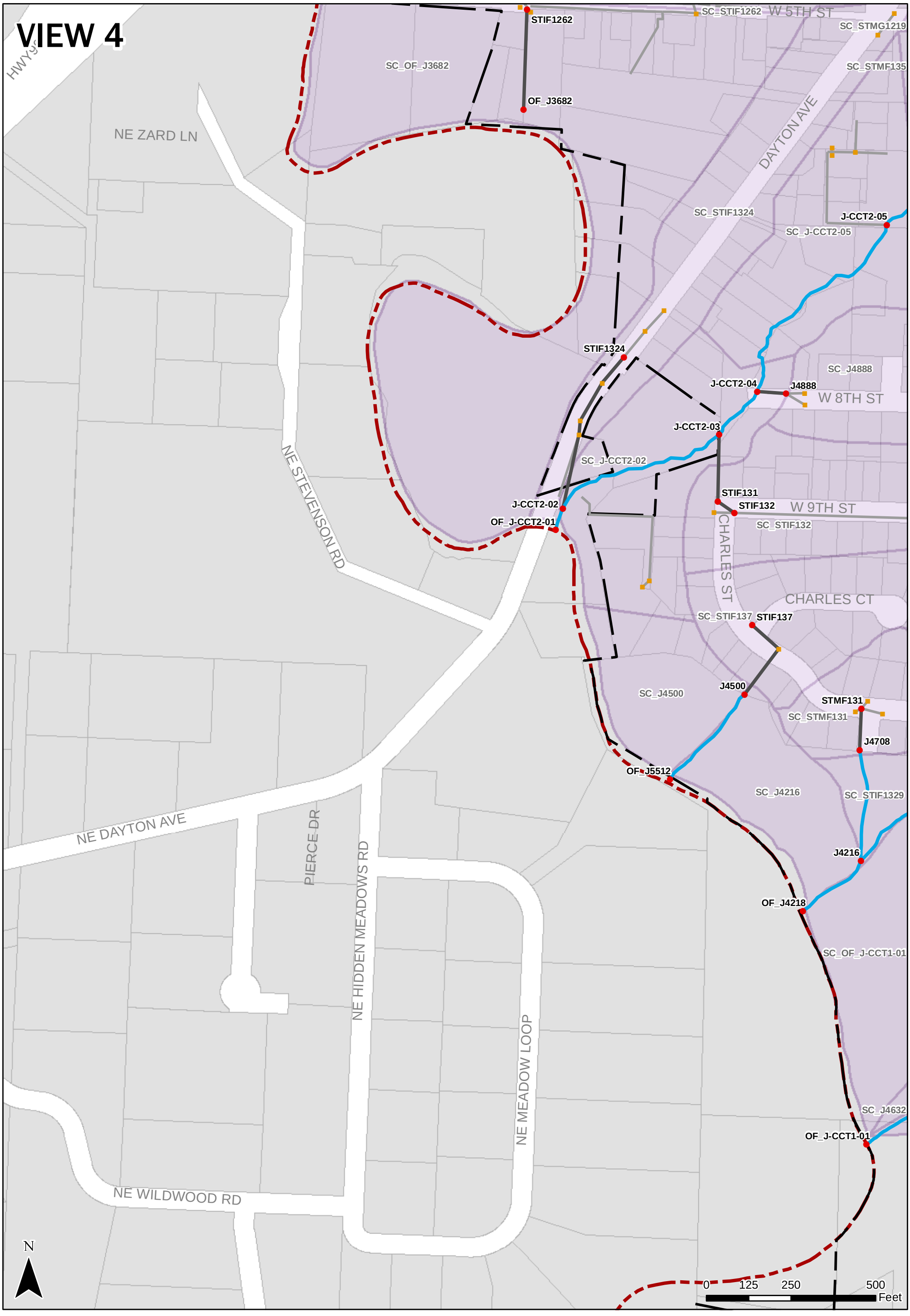
CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 3

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 4



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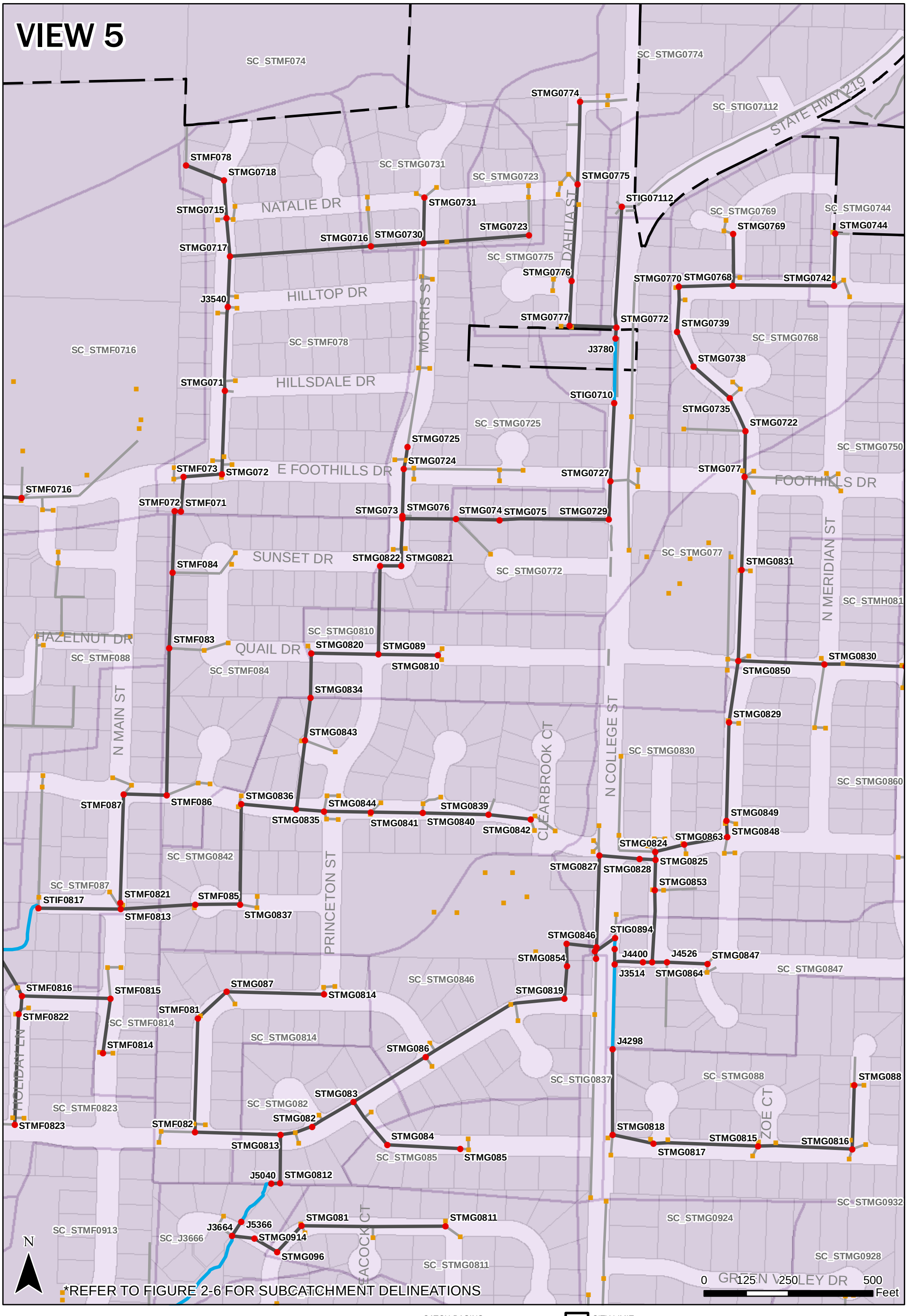
CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 4

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg



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CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 5

- CATCH BASINS
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- TAX LOTS
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- MODELED OPEN CHANNELS
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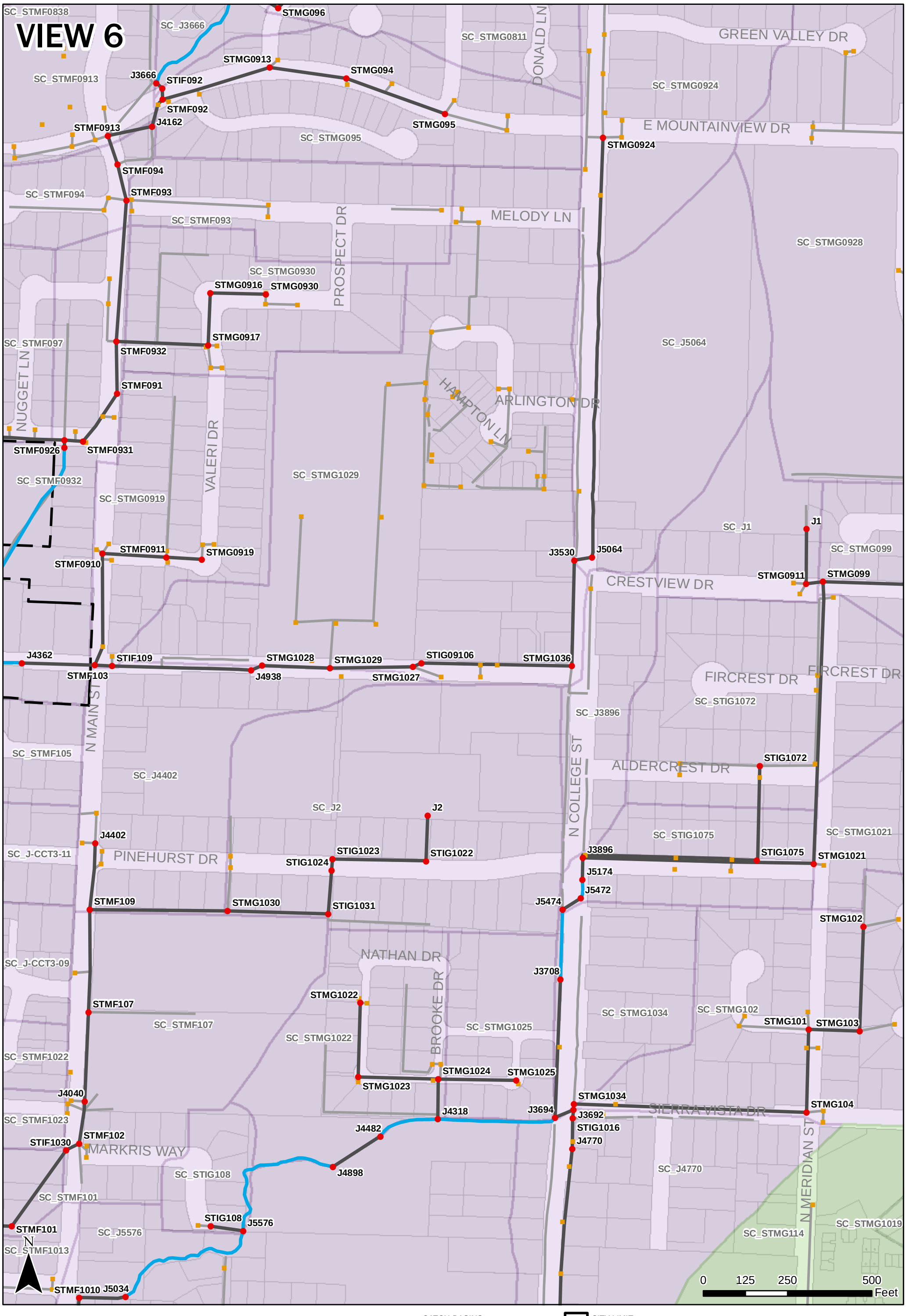
- SPRING BROOK SUBCATCHMENTS

City of Newberg



Brown AND Caldwell

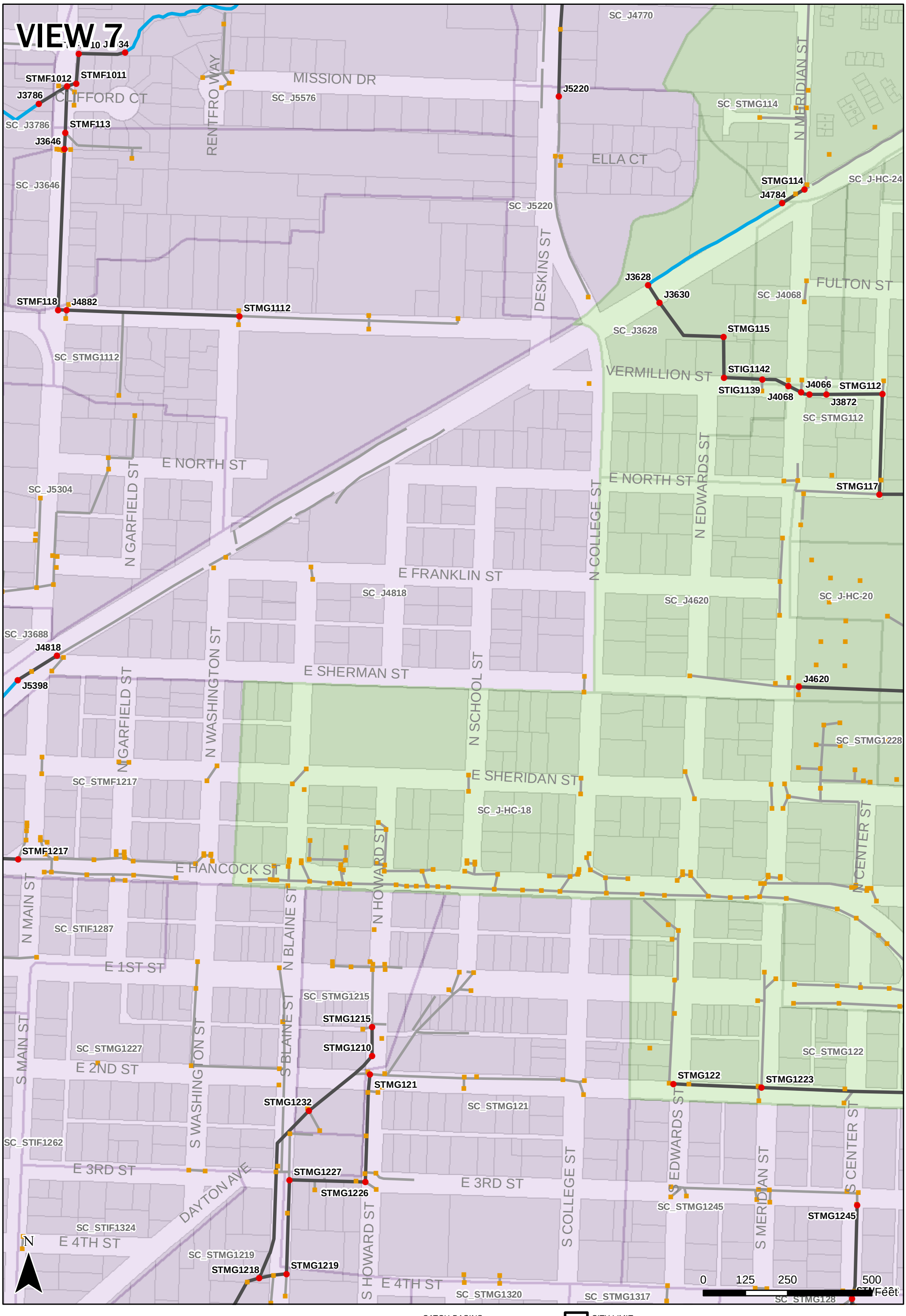
JUNE 2014

CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 6

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg



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JUNE 2014

CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 7

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 8

STMG1218
STMG1219
SC_STMG121
E 4TH ST
SC_STMG1245
STMG128
S MAIN ST
SC_STIF1324
DAYTON AVE
SC_STMG1219
S HOWARD ST
S SCHOOL ST
S COLLEGE ST
S EDWARDS ST
E 5TH ST
SC_STMG1320
SC_STMG1317
SC_STMG128
STMF135
SC_STMF135
STMG1319
STMG1321
STMG1320
E 6TH ST
STMG1317
STMG1316
J-CCT2-06
STMG1326
J-CCT2-05
J4142
STMG1325
STIG1348
SC_STMG1325
STIG1349
SC_J-CCT2-05
S MERIDIAN ST
STMG133
E 7TH ST
SC_STIG1348
SC_STMG133
S GARFIELD ST
E 7TH ST
SC_J4888
E 8TH ST
S BLAINE ST
E 8TH ST
STMG132
STMG1322
STMG1323
STMG1315
S CENTER ST
SC_STIF132
SC_STMG1323
E 9TH ST
STMG1324
STIF1329
J4572
SC_STIF137
S SCHOOL ST
S COLLEGE ST
SC_STIF1329
J4632
E 10TH ST
SC_STMG138
STMG138
SC_STMF131
SC_STMG144
SC_J-CCT1-07
SC_STMG1412
STMF134
JAMES ST
J4634
J3932
STMG144
MICHELLE CT
STMG1411
J-CCT1-07
STMG136
J-CCT1-06
J4894
STMG141
STMG1410
J-CCT1-05
SC_STMG1413
STIG1416
STMG147
STMG143
J3700
J-CCT1-04
E 12TH ST
J5354
SC_STMG143
J-CCT1-03
STMG146
STMG145
SC_OF_J-CCT1-01
SC_J-CCT1-04
STMG142
STMG149
E 13TH ST
SC_STMG142
SC_J4632
J-CCT1-02
J3498
SC_STMG149
SC_J3498
N
SC_J-CCT1-02
E 14TH ST
0 125 250 500 Feet

*REFER TO FIGURE 2-6 FOR SUBCATCHMENT DELINEATIONS

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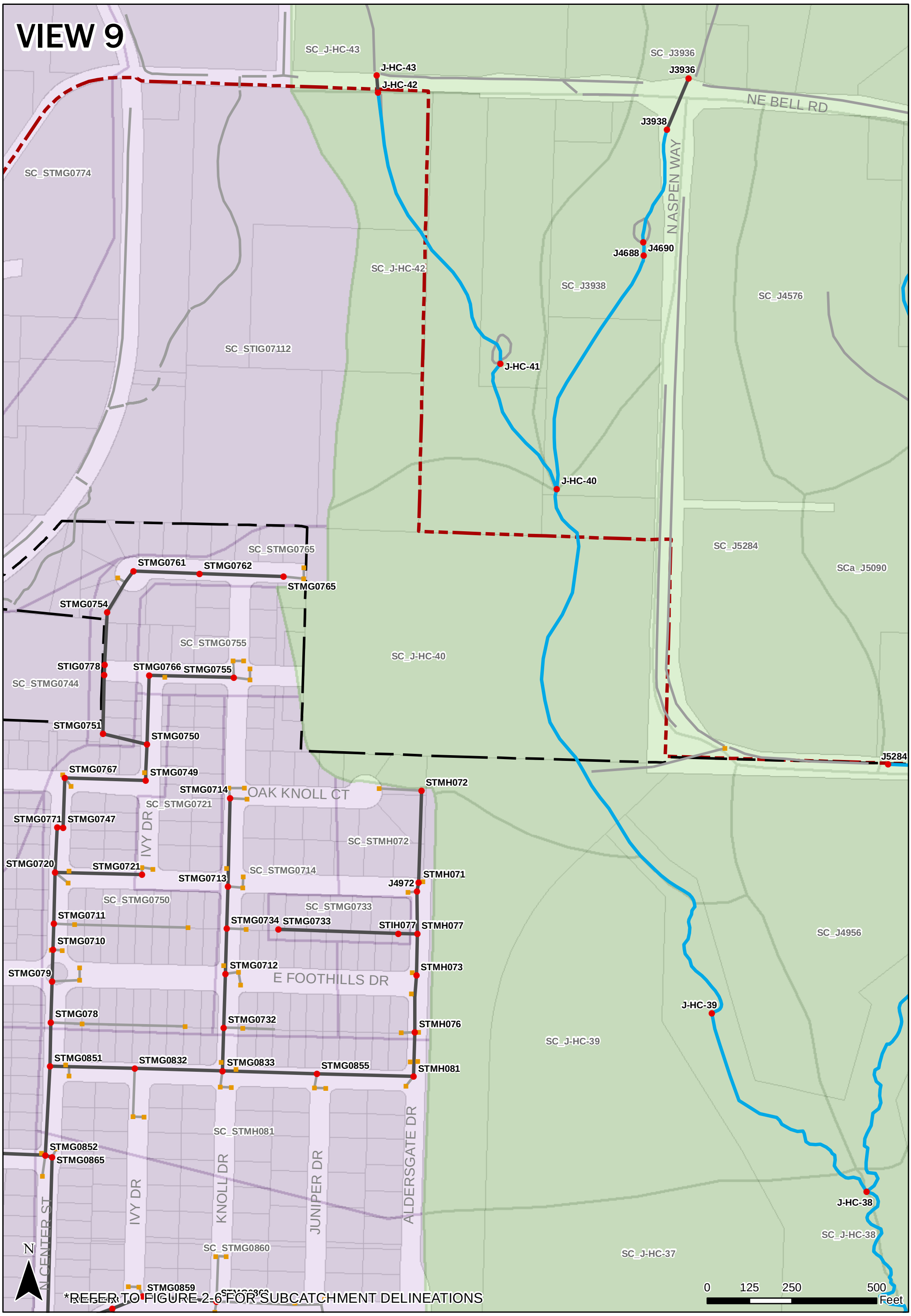
CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 8

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg



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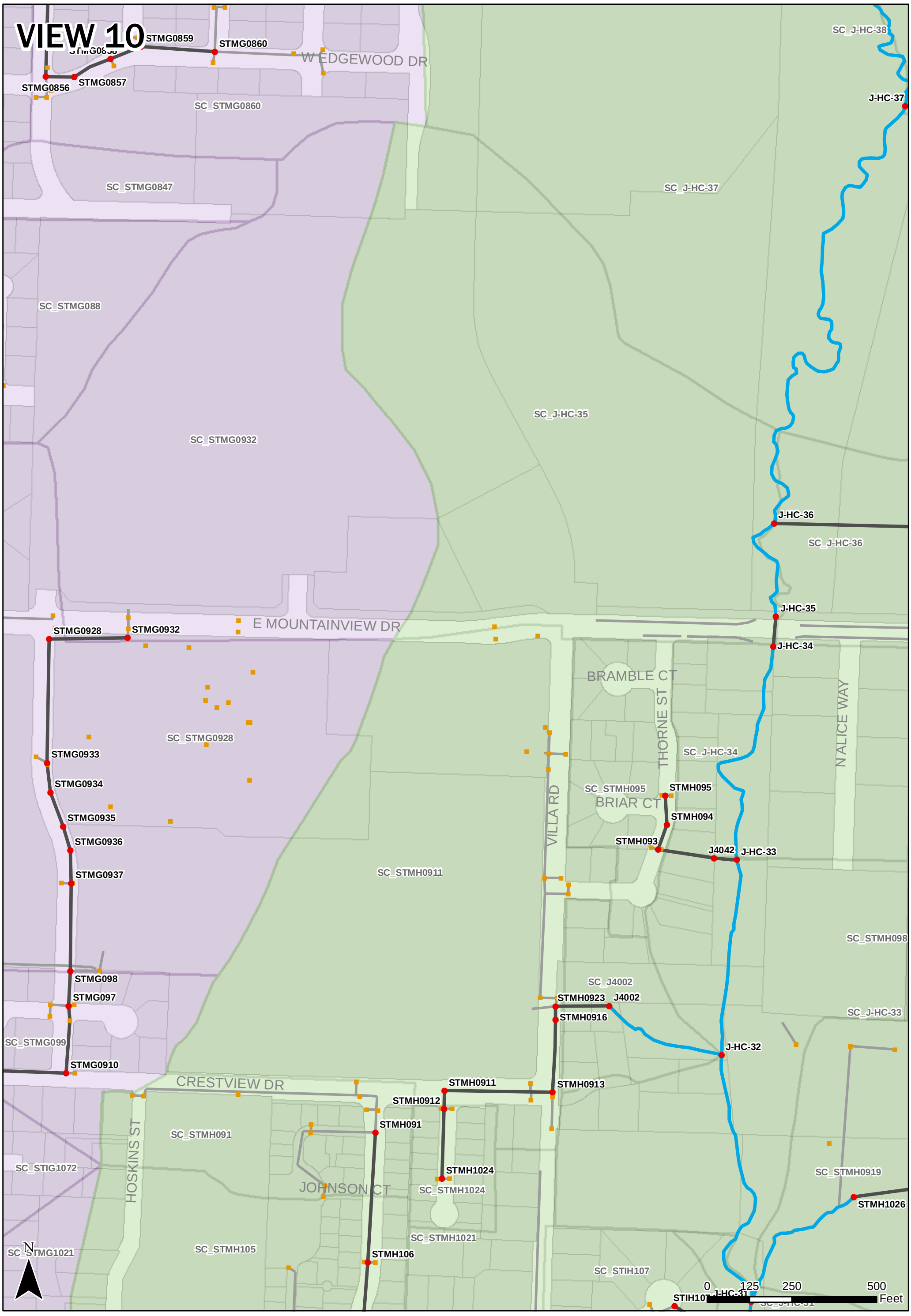
CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 9

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg



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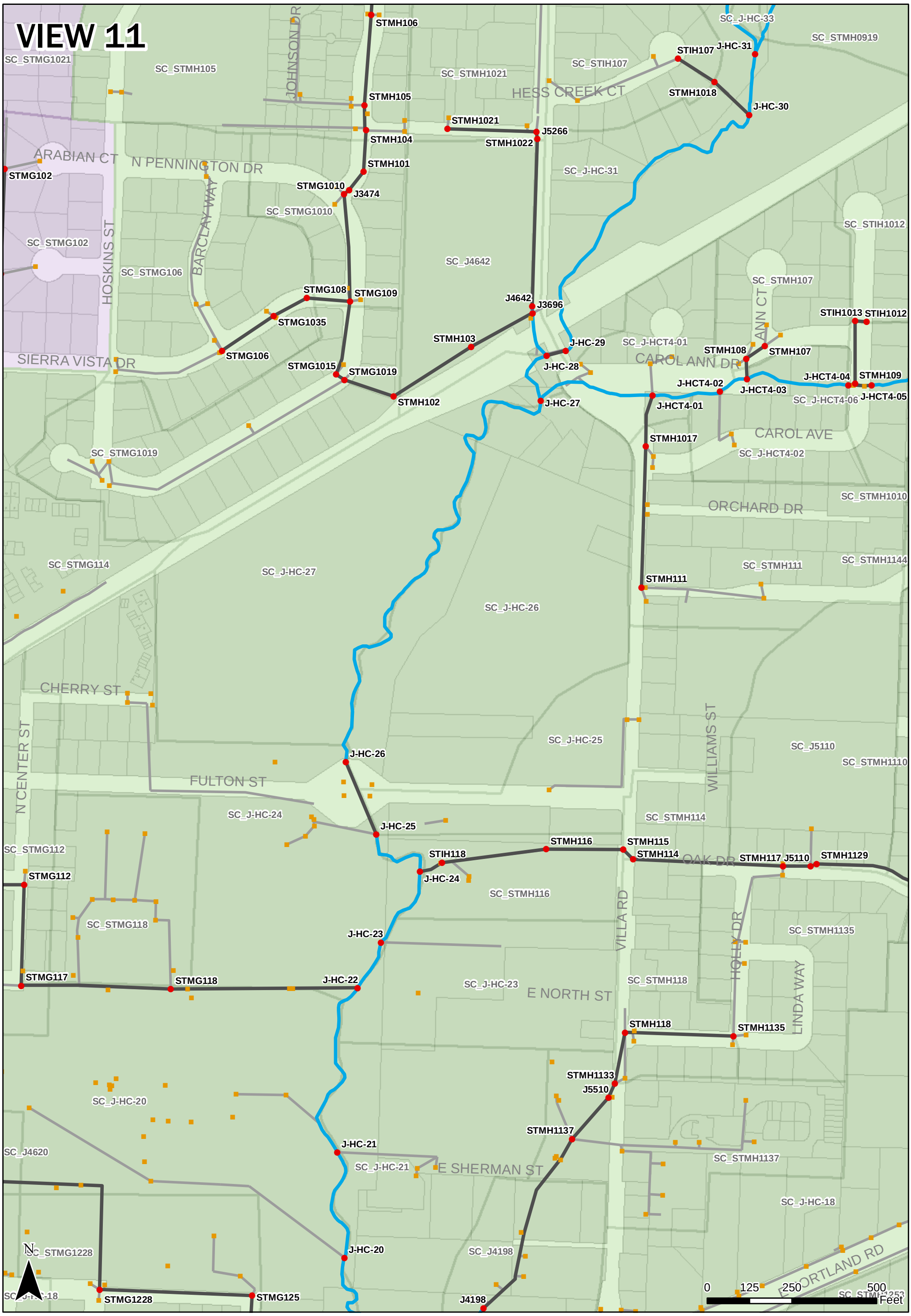
CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 10

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg



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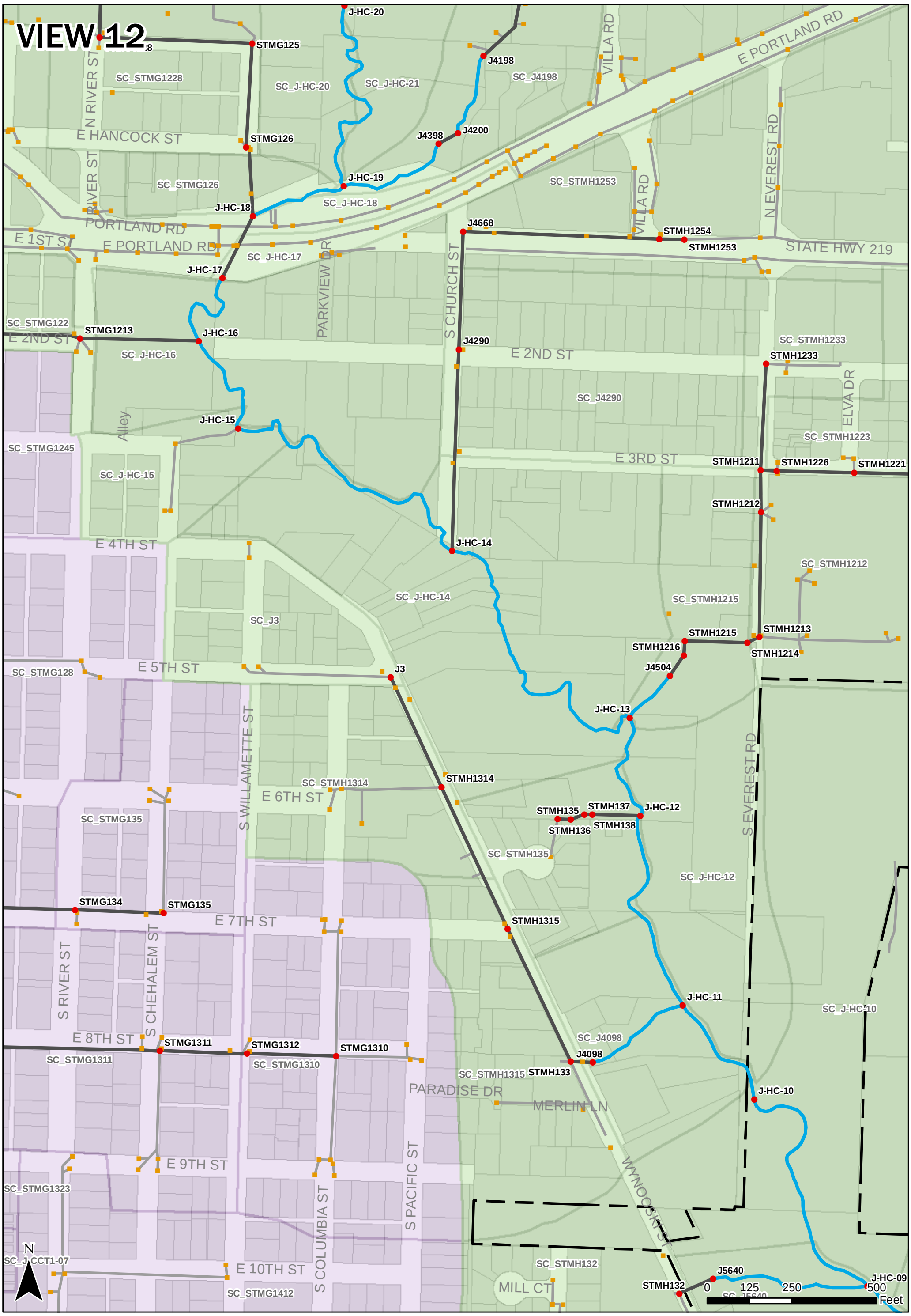
CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 11

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg



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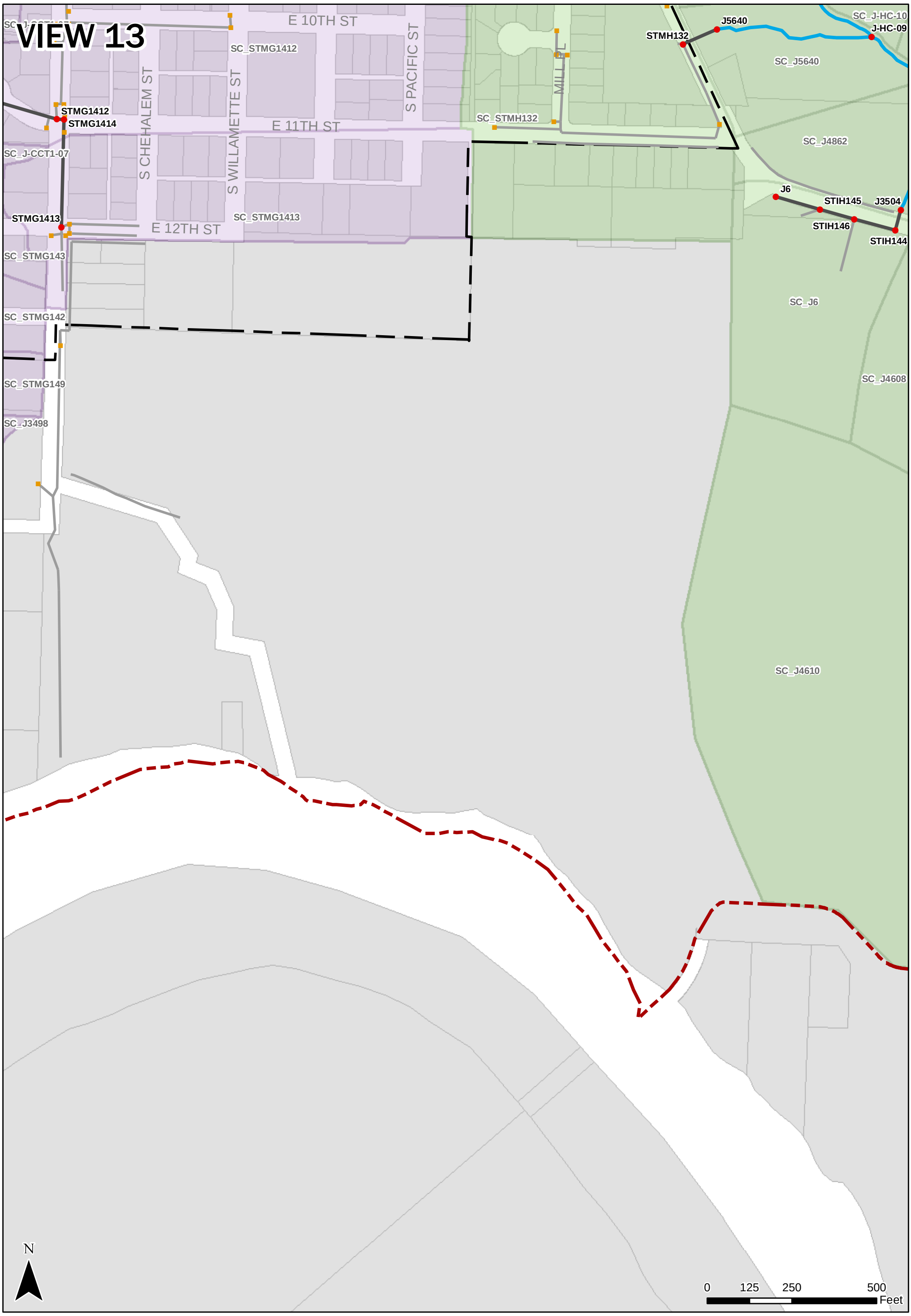
CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 12

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 13



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CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 13

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 14

SC_J3936
SC_J5324
J5324
J5326
NE BELL RD
SC_J4576
SCb_J5090
J4576
SCc_J5090
SCa_J5090
SC_J5284
J5284
J5090
J4956
N ASPEN WAY
SC_J-SB-16
SC_J4956
SC_J4554
SC_J-HC-38
SC_J4556
NE ROBERTS LN
SC_J-HC-37
SC_STIH081

N

*REFER TO FIGURE 2-6 FOR SUBCATCHMENT DELINEATIONS

0 125 250 500 Feet

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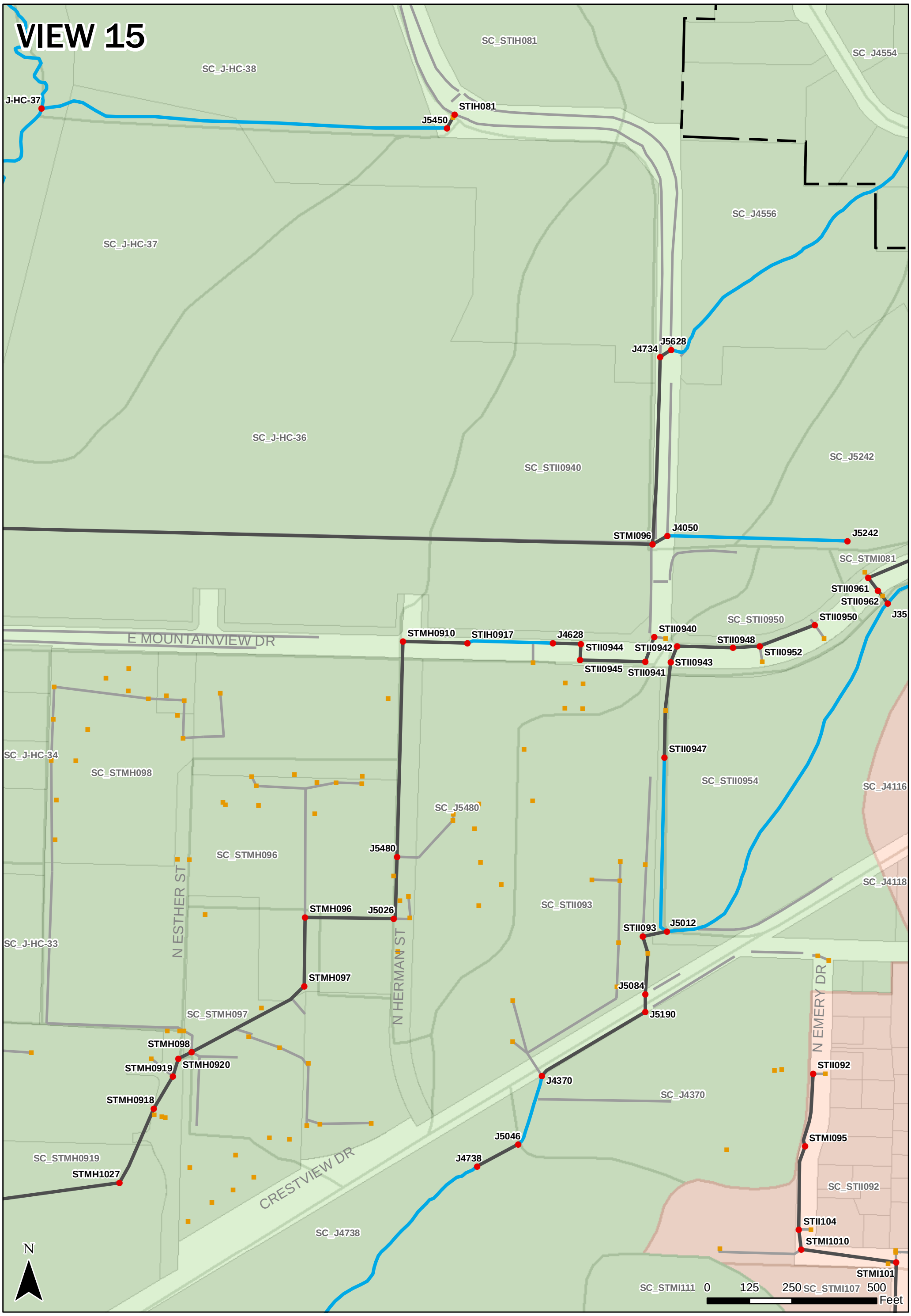
CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 14

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg



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CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 15

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 16

SC_J-HC-31
SC_J4738
SC_STIH1012
J4740
STIH1035
STIH1036
J-HCT4-06
STIH1043
SC_STHI1043
HAWTHORNE DR
STMH1014
STMH1010
STIH1038
STMH1015
STMH1011
STMH1013
STIH1033
SC_STIH1033
SC_STMI111
SC_J-HCT4-06
SC_STMH1010
ELM LN
STIH1040
WILLOW DR
SC_STIH1040
SC_STMH111
HAWORTH AVE
MARIE AVE
SC_STMH1125
N ELLIOTT RD
STMI111
J5484
J5444
SC_STMH1144
JODI CT
J3588
SC_J5110
SC_STMH1110
STMH1110
J4918
STMH1112
STMH1125
STMH1144
STMH1124
SC_STII1179
STII1179
STMI1140
STMI1141
STMI1122
J4872
SC_STMH1116
OAK DR
STMH1127
STMH1128
STMH1116
STMH1126
SC_STMH1135
DOLASH CT
ELLIOTT RD
SC_J4872
E PORTLAND RD
STII11281
STII11135
STMI117
SITKA AVE
HULET AVE
SC_J-HC-18
SC_STII118
STMI112
STII118
STII116
STMI114
J4234
J3762
STMI113
SC_STMH128
SC_STMI122
SC_J3960
SC_STIH12182
STMH129
N ELLIOTT RD
SC_STII092
STMI101
STMI107
SC_STMI107
STMI1020
STMI106
STMI1021
SC_STII1078
SC_STMI1021
STII102
STMI1121
SC_J4834
WALNUT AVE
STMI1110
SC_STMI1110
DEBORAH RD
SC_J-SBT1-08
SC_STMI112

N

0 125 250 500 Feet

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STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 16

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
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- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 17

SC_J-HC-18
STMH129
SC_STMH128
N ELLIOTT RD
SC_STMI122
SC_J3960
SC_STMH1253
SC_STIH12182
STIH12182
E HANCOCK ST
STMI121
STMI122
STMH128
STIH12125
STMH125
J4636
SC_STMH127
S ELLIOTT RD
STMH127
SC_STMH1233
SC_J4636
SC_STML1232
STIH12139
STMH1224
STMH1227
STMH1231
J-HCT3-09
E 2ND ST
SC_STMI125
SC_STMH1223
J-HCT3-08
DORIS DR
ARDUS DR
SC_STMH1229
STMI125
STMI1229
J4
STML1232
STMH1220
STMH1230
STMH1223
STMH1229
J-HCT3-07
E 3RD ST
STMH1222
STMH1228
J-HCT3-06
STMH1242
SC_STMH1252
STMH1252
SC_STMH1242
J-HCT3-05
SC_J3614
STMH1243
STMH1244
STMH1245
SC_STMI123
J-HCT3-04
SC_STMH1212
LAIR LN
AIRPARK WAY
CESSNA LN
SC_STMH1248
SC_STMH1238
STMH1239
STMH1240
STMH1238
STMH1241
HANGER WAY
STMH1248
J-HCT3-03
STATE HWY 219
J3614
J3612
SC_STMI139
SC_J3612
DONNA DR
CORINNE DR
SC_STMH1311
CONNER DR
J4282
STMH1311
STMH1310
J-HCT3-02
SC_J-HCT3-02
KENNEDY DR
SC_J5562
SC_J-HC-10
SC_STMH1313
SC_STMI1312
STMH1313
STMH1312
J-HCT3-01
J5562
J5560
SC_J5560
STMI1312
SC_J-HC-06
STMI1311
J4160
E 9TH ST
STMI131
STMI132
J-HCT2-03
SC_STMI132
SC_STMI141
SC_J5640
N
0 125 250 500 Feet

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CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 17

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 18

SC_STMI1312
SC_J5560
SC_J5640
J-HC-08
J-HC-07
J4862
J-HC-06
SC_J4862
SC_STMI132
STMI135
SC_STMI141
STMI141
J3504
STIH144
SC_J-HC-06
J-HCT2-02
SC_J6
J4608
SC_J-HCT2-02
J-HCT2-01
SC_J4608
SC_J-HCT2-01
J-HC-05
WYNOOSKI ST
J-HC-04
J4610
SC_J-HC-04
SC_J4610
STII151
STMI151
J4974
J-HC-03
NE WYNOOSKI RD
SC_STII151
NE DOG RIDGE RD
OF_J-HC-02
OF_J-HC-01

N

*REFER TO FIGURE 2-6 FOR SUBCATCHMENT DELINEATIONS

0 125 250 500 Feet

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CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 18

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 19

SC_J4554
J4554
J4556
STMI081
SC_J4556
NE ZIMRI DR
SC_STMI081
STIL085
SC_J5242
STMI0911
STII0956
STII0955
SC_STII0953
STII0957
STII0953
STII0954
STII0962
J35
SC_STII0954
STII0965
STII0966
STII0967
STII0968
SC_STII0965
STII0970
SC_STII09101
SC_J-SB-16
NE SPRINGBROOK RD
J-SB-16
J-SB-15
ALLISON LN
SC_STIJ081
STIJ081
STII081
STII09126
STII09125
STII09124
STII09111
J4270
STII09101
STII09104
STII09103
J5236
STII09106
J5
STII09112
J4268
SC_J4268
SC_J-SB-14
J4848
SC_J5236
STII0972
STII0975
SC_J4116
STII0977
J4116
J4118
STII0980
STII0913
J3668
SC_STIJ0911
STII0982
SC_STII0916
STII0928
SC_J4118
STII0916
SC_STII0975
STII0926
STII0983
STII0985
J4114
STII0915
STII0986
STII0988
STMI099
SC_J4370
J5124
STMI0910
E CRESTVIEW DR
STMI094
STII0990
SC_STIJ0916
STII0991
E CRESTVIEW DR
STIJ0911
WAREHAM LN
SC_STMI0910
STII0992
STMI093
SC_STII0990
STMI092
DOGWOOD AVE
STMI091
SC_STMI1023
SC_STII1033
SC_STMJ092
SC_STMJ1011
SC_STII092
CEDAR ST
STII09100
HEATER ST
STMJ092
STII10109
STMJ091
STMI1014
STMI1023
STII1030
SC_STMI1015
SC_STMI1013
SC_STMI1014
STII1034
STII1033
COFFEY LN
STMJ1022
SC_STII1030
STII1029
SC_STMJ1022
GEMINI ST
STMI101
STMI1013
STMI109
STMI105
SC_STMI1022
STII1050
STMI1015
J3524
SC_J3852
N
0 125 250 500 Feet

*REFER TO FIGURE 2-6 FOR SUBCATCHMENT DELINEATIONS

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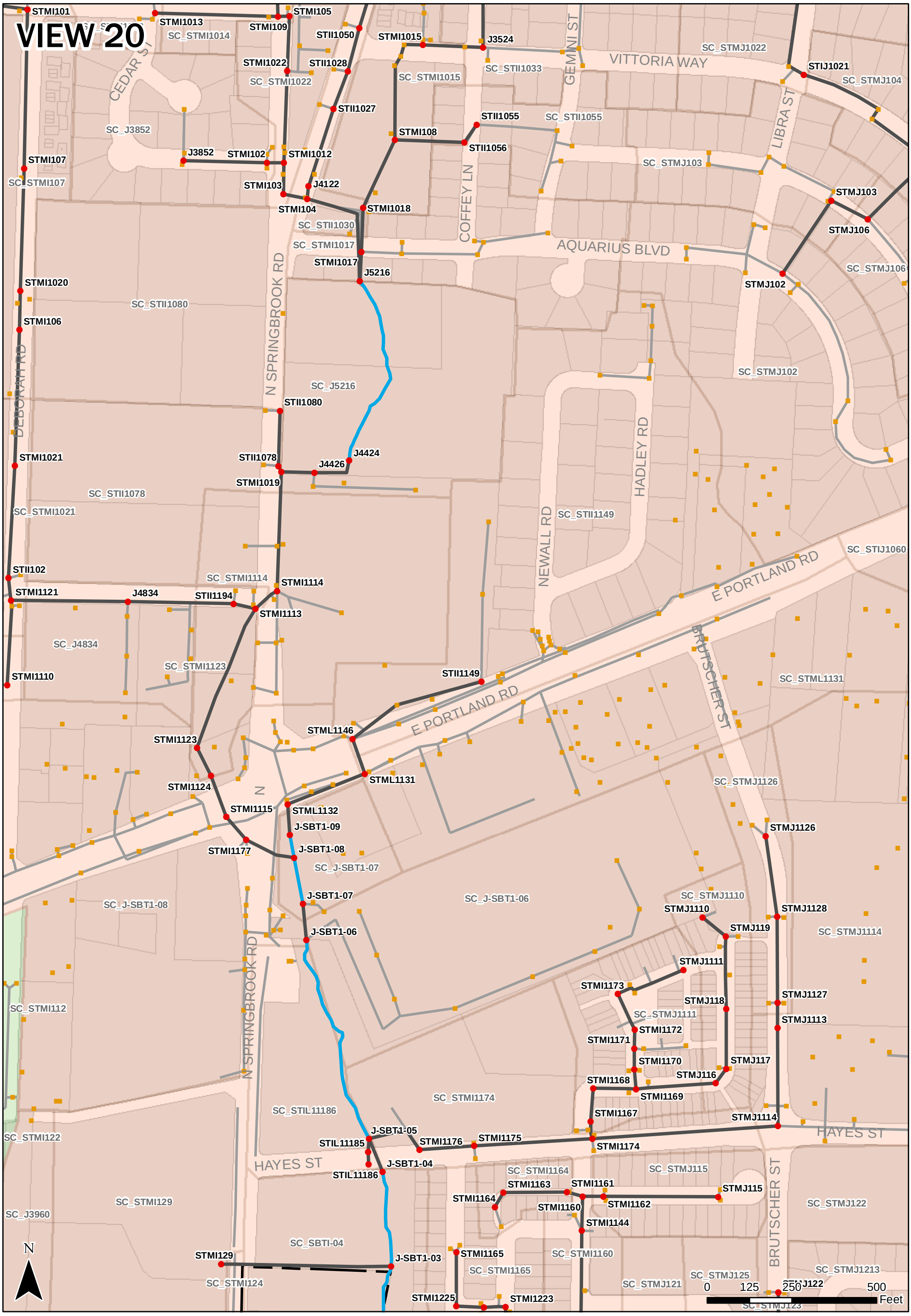
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 19

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg



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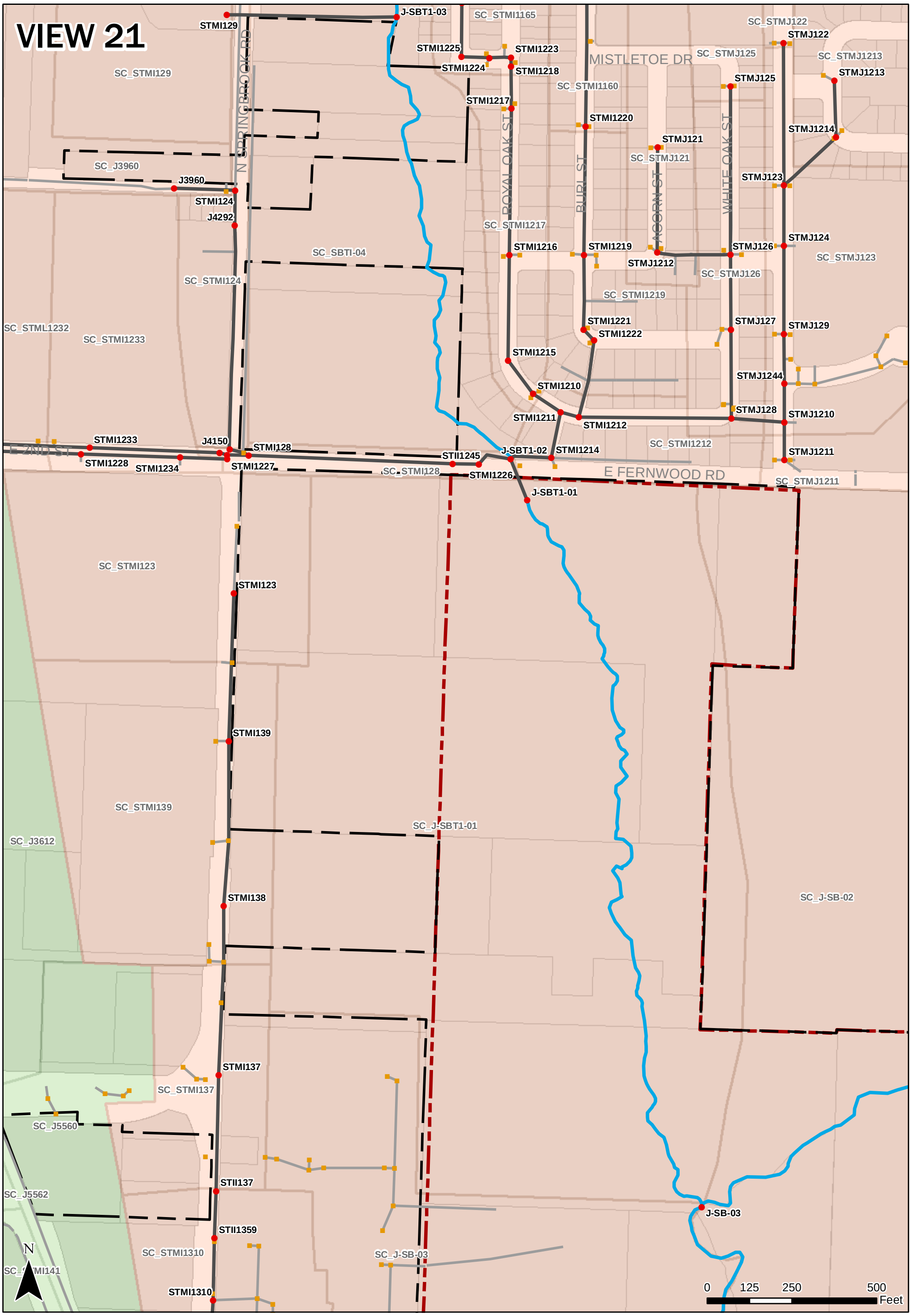
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 20

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 21



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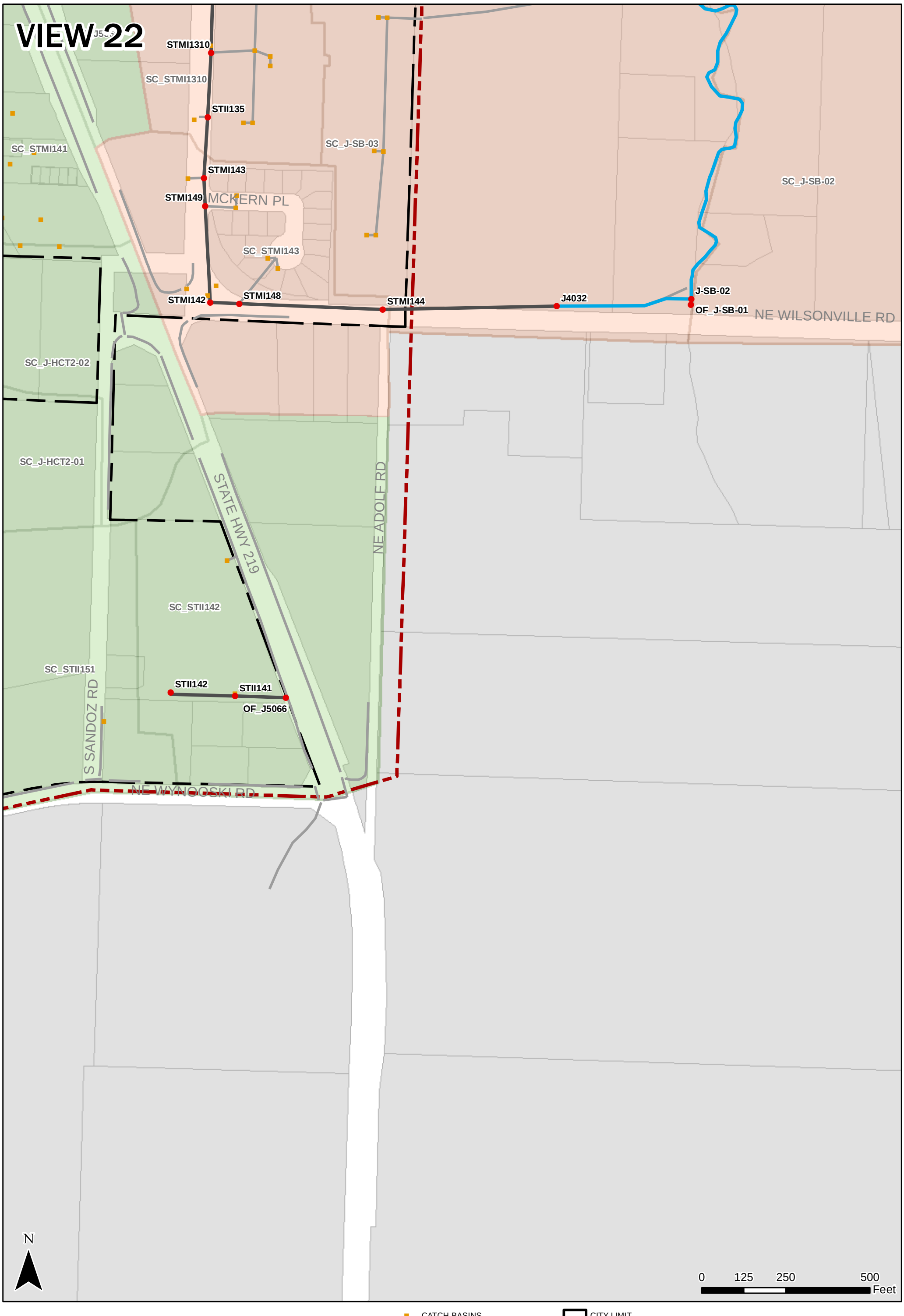
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 21

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg



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CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 22

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 23

NE BENJAMIN RD
NE FALLVIEW CT
REX HILL CT
NE PUTNAM RD
NE BIRDHAVEN LOOP
NE LAKE SHORE DR
NE BLUE HERON CT
CRESTVIEW DR

J-SB-15
J-SB-14
J-SB-13
SC_J-SB-13
SC_J-SB-14
SC_J-SB-12
SC_STIJ0911
SC_STIJ0916
SC_STMJ092
SC_STMJ1011
SC_STMJ1022
SC_STMJ107
SC_STMJ104
SC_J5178
SC_J4092
SC_J-SBT7-01

STIJ0916
STIJ0917
STIJ0919
STIJ0923
STIJ0924
STIJ0927
STIJ0915
STIJ10111
STIJ10112
J5382
STMJ1011
STMJ1013
STMJ1015
STIJ102
STMJ108
J5176
J5178
STMJ107
STMJ104
J3522
STMJ105

N

0 125 250 500 Feet

*REFER TO FIGURE 2-6 FOR SUBCATCHMENT DELINEATIONS

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STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 23

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

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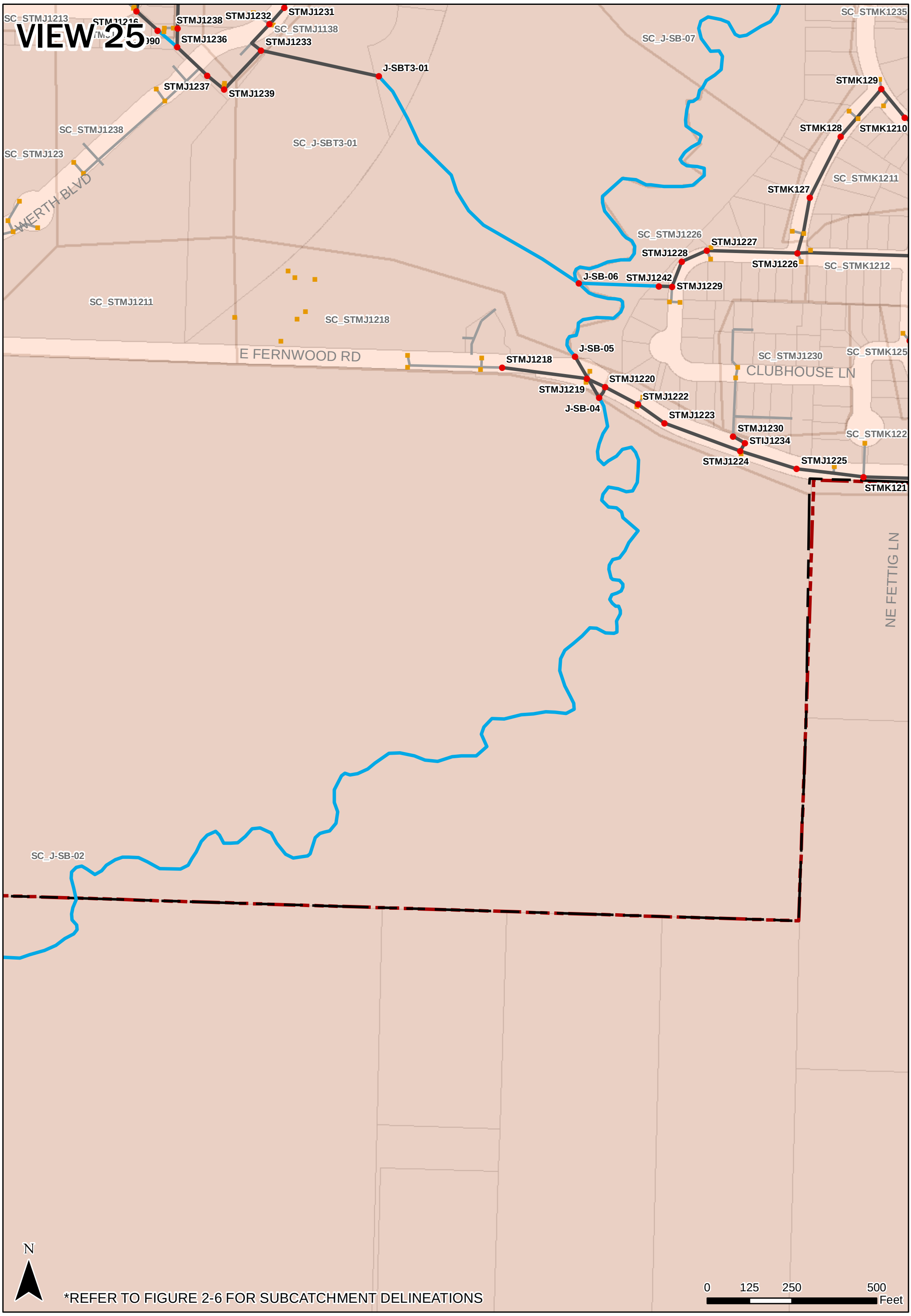
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 24

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 25



Brown AND Caldwell

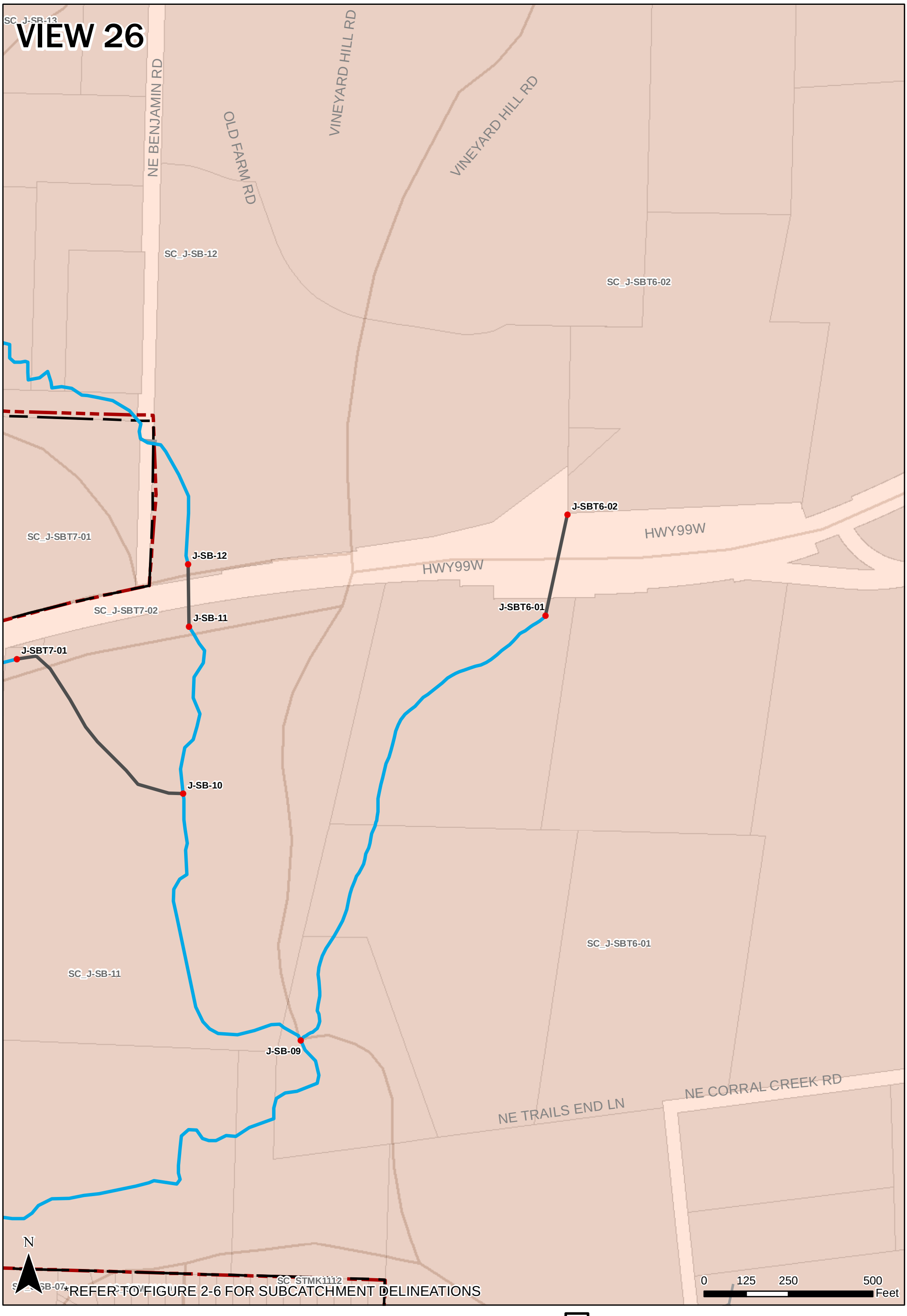
JUNE 2014

CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 25

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg



*REFER TO FIGURE 2-6 FOR SUBCATCHMENT DELINEATIONS

Brown AND Caldwell

JUNE 2014

CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 26

- CATCH BASINS
- MODELED JUNCTIONS/MANHOLES
- TAX LOTS
- MODELED CONDUITS
- MODELED OPEN CHANNELS
- OTHER CONDUITS
- CITY LIMIT
- URBAN GROWTH BOUNDARY
- CHEHALEM CREEK SUBCATCHMENTS
- HESS CREEK SUBCATCHMENTS
- SPRING BROOK SUBCATCHMENTS

City of Newberg

VIEW 27

SC_J-SB-11
LONGEST DR
SC_STMK1112
STMK1112
STMK1111
STMK1120
SC_STMK1120
STMK1119
STMK1110
IRONWOOD DR
STMK117
STMK1118
STMK1117
STMK118
EAGLE ST
SC_J-SBT6-01
STMK119
STIK117
STMK1116
J-SBT4-05
STMK1122
SC_J-SBT4-02
SC_J-SB-07
SC_STMK1122
STMK1114
STMK1113
J-SBT4-02
STMK1121
J-SBT4-01
STMK113
STMK114
STMK116
STMK1115
STMK115
J-SBT4-03
STIK116
STMK111
NE CORRAL CREEK RD
STMK1235
STMK1214
STMK1215
SC_STMK1235
SC_STMK1216
STMK1213
STMK1216
STMK1219
SC_STIK116
SC_STMK1213
STMK1217
STMK129
STMK1210
STMK1220
STMK1218
STMK1221
SC_STMK1211
STMK1211
SC_STMK1222
SC_STMK1218
STMK1222
FAIRWAY ST
SC_STMK1223
SC_STMK1212
STMK1225
STMK1223
STMK126
STMK1212
STMK1224
STMK1227
STMK1226
SC_STMK125
STMK125
STMK1232
SC_STMK1233
STMK1233
SC_STMK1232
STMK1231
STMK124
STMK1228
STMK1230
SC_J-SB-02
SC_STMK122
STMK1229
SC_STMK123
STMK122
STMK123
NE FERNWOOD RD
NE FETTIG LN

N

*REFER TO FIGURE 2-6 FOR SUBCATCHMENT DELINEATIONS

0 125 250 500 Feet

Brown AND Caldwell

JUNE 2014

CITY OF NEWBERG
STORMWATER MASTER PLAN UPDATE

SWMM MODEL SYSTEM MAPPING
VIEW 27

- CATCH BASINS
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City of Newberg

Appendix B: Hydrologic and Hydraulic Modeling Inputs/Results Tables

Use of contents on this sheet is subject to the limitations specified on the title page of this document.

Table B-1. Hydrologic Input Data and Peak Flow Results

Subcatchment Name	Area (acre)	Average Slope (%)	Pervious Curve Number	Impervious Area (%)			Subcatchment Peak Flow (cfs)							
							Existing Land Use Scenario				Future Land Use Scenario			
				Existing Land Use	Future Land Use	Percent Increase	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm
CHEHALEM CREEK														
SC_J1	4.4	1.5	79.5	31.8	59.4	87%	0.8	1.4	1.8	1.9	1.2	1.9	2.2	2.4
SC_J2	15.5	2.9	79.5	40.6	51.5	27%	3.8	6.2	7.4	7.9	4.3	6.7	7.9	8.4
SC_J3498	8.4	2.0	79.0	19.7	84.8	330%	1.1	2.3	2.9	3.2	3.0	4.3	5.0	5.2
SC_J3646	10.7	1.7	79.0	27.9	50.7	82%	1.4	2.5	3.2	3.4	2.4	3.8	4.5	4.9
SC_J3666	3.0	7.3	79.0	38.4	50.0	30%	0.8	1.2	1.4	1.5	0.9	1.3	1.5	1.6
SC_J3688	6.5	4.3	79.0	78.4	78.4	0%	2.3	3.3	3.8	4.0	2.3	3.3	3.8	4.0
SC_J3786	7.1	3.4	79.0	26.9	50.0	86%	1.4	2.5	3.1	3.3	1.9	3.0	3.6	3.8
SC_J3896	3.8	3.0	79.0	57.1	57.1	0%	1.1	1.7	2.0	2.1	1.1	1.7	2.0	2.1
SC_J4058	6.9	4.8	79.0	70.6	73.7	4%	2.3	3.3	3.9	4.1	2.3	3.4	3.9	4.1
SC_J4216	3.5	23.5	81.9	10.0	14.3	43%	0.7	1.3	1.5	1.6	0.8	1.3	1.6	1.7
SC_J4402	8.8	3.6	79.7	42.9	49.5	15%	2.2	3.6	4.2	4.5	2.4	3.7	4.4	4.7
SC_J4500	3.3	16.9	81.4	13.5	30.5	126%	0.6	1.1	1.4	1.5	0.8	1.3	1.6	1.7
SC_J4632	19.4	1.2	79.0	24.7	33.9	37%	2.8	5.4	6.8	7.4	3.4	6.2	7.7	8.3
SC_J4770	10.1	2.3	79.0	40.4	52.2	29%	2.3	3.9	4.7	5.0	2.7	4.3	5.1	5.4
SC_J4818	25.4	2.7	79.0	66.4	66.4	0%	8.1	12.0	13.9	14.7	8.1	12.0	13.9	14.7
SC_J4888	8.6	2.6	79.0	56.9	60.0	5%	2.5	3.8	4.5	4.7	2.6	3.9	4.6	4.8
SC_J5064	11.2	2.0	79.0	22.2	78.9	255%	1.4	2.8	3.6	3.9	3.8	5.6	6.4	6.8
SC_J5220	7.0	2.7	79.0	50.6	62.9	24%	1.9	3.0	3.5	3.7	2.2	3.2	3.8	4.0
SC_J5304	11.9	3.6	79.0	61.3	61.7	1%	3.7	5.4	6.4	6.7	3.7	5.5	6.4	6.7
SC_J5576	18.4	2.8	79.6	48.1	48.1	0%	5.1	7.9	9.3	9.8	5.1	7.9	9.3	9.8
SC_J9	2.3	3.8	79.0	86.5	86.5	0%	0.9	1.2	1.4	1.5	0.9	1.2	1.4	1.5
SC_J-CCT1-02	17.0	3.1	79.0	12.0	54.6	355%	2.4	5.0	6.3	6.8	4.8	7.4	8.7	9.2
SC_J-CCT1-04	7.8	16.1	79.0	18.8	58.3	210%	1.6	2.7	3.3	3.5	2.4	3.5	4.1	4.4
SC_J-CCT1-07	11.8	7.4	79.0	45.5	66.4	46%	3.3	5.0	5.9	6.2	3.8	5.6	6.5	6.9
SC_J-CCT2-02	6.9	17.0	79.6	17.0	54.6	221%	1.4	2.4	2.9	3.1	2.1	3.1	3.6	3.8
SC_J-CCT2-05	8.2	2.8	79.0	22.0	52.8	140%	1.7	2.9	3.5	3.7	2.4	3.6	4.2	4.4
SC_J-CCT3-01	24.8	2.2	79.1	54.3	56.3	4%	7.0	10.8	12.8	13.5	7.2	11.0	12.9	13.7
SC_J-CCT3-03	22.4	7.5	79.0	43.9	56.5	29%	5.8	9.2	10.9	11.6	6.6	10.0	11.7	12.4
SC_J-CCT3-04	38.5	2.8	79.0	23.9	31.2	31%	6.4	12.3	15.2	16.4	7.4	13.4	16.3	17.5
SC_J-CCT3-05	26.9	3.0	79.6	15.4	30.0	95%	2.7	5.7	7.4	8.2	4.1	7.6	9.5	10.3
SC_J-CCT3-06	4.2	14.3	79.0	26.4	50.1	90%	1.0	1.6	1.9	2.0	1.2	1.8	2.1	2.3
SC_J-CCT3-09	4.1	3.7	79.0	45.4	50.0	10%	1.1	1.7	2.0	2.2	1.2	1.8	2.1	2.2
SC_J-CCT3-11	3.7	3.2	79.0	42.9	50.0	17%	1.0	1.5	1.8	1.9	1.0	1.6	1.9	2.0
SC_J-CCT3-12	35.8	3.3	80.4	20.5	54.1	164%	4.5	9.1	11.6	12.7	9.0	14.5	17.3	18.4
SC_J-CCT3-15	12.2	2.3	79.0	19.6	58.4	198%	1.4	2.8	3.6	3.9	3.2	5.0	6.0	6.3
SC_OF_J3682	32.2	2.7	79.3	21.5	53.8	150%	5.2	10.1	12.6	13.6	8.7	13.8	16.3	17.3
SC_OF_J-CCT1-01	12.2	9.6	78.9	22.5	24.9	11%	2.3	4.2	5.1	5.5	2.4	4.3	5.2	5.6
SC_STIF0877	5.9	2.5	79.2	55.2	55.2	0%	1.7	2.6	3.0	3.2	1.7	2.6	3.0	3.2
SC_STIF1132	6.9	4.8	79.0	49.7	57.3	15%	1.9	3.0	3.5	3.7	2.1	3.1	3.6	3.9
SC_STIF1262	22.5	3.2	79.0	62.3	62.3	0%	7.0	10.4	12.1	12.8	7.0	10.4	12.1	12.8
SC_STIF1287	8.7	3.8	79.0	90.1	90.1	0%	3.3	4.6	5.3	5.6	3.3	4.6	5.3	5.6
SC_STIF132	7.2	2.0	79.0	46.4	60.0	29%	1.8	3.0	3.5	3.8	2.2	3.3	3.8	4.0
SC_STIF1324	13.4	3.2	79.0	61.5	61.5	0%	4.1	6.1	7.2	7.6	4.1	6.1	7.2	7.6
SC_STIF1329	11.8	2.5	79.0	45.4	52.1	15%	2.9	4.8	5.7	6.0	3.2	5.0	5.9	6.3
SC_STIF137	5.3	2.7	79.0	49.4	60.0	21%	1.4	2.2	2.6	2.8	1.6	2.4	2.8	3.0
SC_STIG07112	49.8	11.7	78.5	20.7	32.6	57%	7.9	15.6	19.4	20.9	10.0	17.8	21.6	23.1

Table B-1. Hydrologic Input Data and Peak Flow Results

Subcatchment Name	Area (acre)	Average Slope (%)	Pervious Curve Number	Impervious Area (%)			Subcatchment Peak Flow (cfs)							
							Existing Land Use Scenario				Future Land Use Scenario			
				Existing Land Use	Future Land Use	Percent Increase	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm
SC_STIG0837	1.2	3.5	79.0	62.4	62.4	0%	0.4	0.6	0.7	0.7	0.4	0.6	0.7	0.7
SC_STIG1072	10.4	7.9	80.6	47.6	50.0	5%	3.0	4.5	5.3	5.6	3.0	4.6	5.4	5.7
SC_STIG1075	4.6	3.1	80.9	47.3	50.0	6%	1.3	2.0	2.3	2.5	1.3	2.0	2.4	2.5
SC_STIG108	2.0	4.1	80.1	47.5	47.5	0%	0.6	0.9	1.0	1.1	0.6	0.9	1.0	1.1
SC_STIG1348	9.8	1.5	79.0	32.5	42.9	32%	2.0	3.5	4.3	4.6	2.3	3.9	4.6	4.9
SC_STMF0716	25.7	8.8	82.1	53.3	53.3	0%	7.4	11.4	13.5	14.3	7.4	11.4	13.5	14.3
SC_STMF0720	3.8	6.3	81.4	58.2	60.0	3%	1.2	1.8	2.1	2.2	1.2	1.8	2.1	2.2
SC_STMF074	99.3	27.4	79.3	14.5	28.4	96%	18.8	33.7	41.0	44.0	22.7	37.4	44.9	47.9
SC_STMF078	15.9	8.7	76.3	51.6	51.6	0%	4.4	6.7	7.9	8.4	4.4	6.7	7.9	8.4
SC_STMF0814	2.2	3.6	79.4	58.2	58.2	0%	0.7	1.0	1.2	1.3	0.7	1.0	1.2	1.3
SC_STMF0823	6.5	4.2	79.0	55.4	55.4	0%	1.9	2.9	3.4	3.6	1.9	2.9	3.4	3.6
SC_STMF0832	6.6	5.2	79.7	58.5	58.5	0%	2.0	3.0	3.5	3.7	2.0	3.0	3.5	3.7
SC_STMF0835	5.8	5.3	79.5	54.0	54.0	0%	1.7	2.6	3.0	3.2	1.7	2.6	3.0	3.2
SC_STMF0838	7.4	6.3	79.0	56.9	56.9	0%	2.2	3.3	3.9	4.1	2.2	3.3	3.9	4.1
SC_STMF084	8.8	2.8	79.3	50.3	50.3	0%	2.5	3.8	4.5	4.8	2.5	3.8	4.5	4.8
SC_STMF0845	5.8	3.5	81.6	49.2	50.0	2%	1.6	2.5	3.0	3.2	1.6	2.5	3.0	3.2
SC_STMF087	9.1	5.0	81.1	46.1	50.0	8%	2.6	4.0	4.7	5.0	2.7	4.1	4.8	5.0
SC_STMF088	14.7	4.9	79.1	49.7	50.0	1%	4.2	6.3	7.5	7.9	4.2	6.4	7.5	7.9
SC_STMF0913	8.6	2.5	79.0	54.7	54.7	0%	2.5	3.8	4.5	4.7	2.5	3.8	4.5	4.7
SC_STMF0921	6.6	3.8	79.6	42.3	42.3	0%	1.6	2.6	3.2	3.4	1.6	2.6	3.2	3.4
SC_STMF0925	2.7	4.8	80.0	38.7	57.1	48%	0.7	1.1	1.3	1.4	0.8	1.2	1.4	1.5
SC_STMF0927	3.8	2.7	79.0	21.1	54.3	157%	0.6	1.2	1.5	1.6	1.1	1.6	1.9	2.1
SC_STMF093	5.7	3.3	79.0	49.2	50.1	2%	1.6	2.4	2.8	3.0	1.6	2.4	2.9	3.0
SC_STMF0930	3.2	3.0	79.0	46.1	59.8	30%	0.8	1.3	1.6	1.7	1.0	1.5	1.7	1.8
SC_STMF0932	8.9	3.7	79.0	34.2	50.0	46%	2.1	3.4	4.1	4.4	2.5	3.8	4.5	4.8
SC_STMF094	3.2	6.3	79.0	52.5	52.5	0%	0.9	1.4	1.6	1.7	0.9	1.4	1.6	1.7
SC_STMF097	6.5	7.8	79.0	42.2	51.1	21%	1.7	2.7	3.2	3.4	1.9	2.8	3.3	3.5
SC_STMF101	2.2	3.0	79.6	29.7	50.0	68%	0.5	0.9	1.0	1.1	0.6	1.0	1.2	1.2
SC_STMF1013	2.0	4.0	79.0	55.5	55.5	0%	0.6	0.9	1.1	1.1	0.6	0.9	1.1	1.1
SC_STMF1022	2.6	3.1	79.0	52.2	52.2	0%	0.8	1.1	1.3	1.4	0.8	1.1	1.3	1.4
SC_STMF1023	2.4	3.1	79.7	42.1	50.0	19%	0.6	1.0	1.2	1.3	0.7	1.0	1.2	1.3
SC_STMF105	3.3	2.6	79.0	38.3	50.0	31%	0.8	1.3	1.6	1.7	0.9	1.4	1.7	1.8
SC_STMF107	10.7	1.5	80.4	46.9	46.9	0%	2.5	4.2	5.0	5.4	2.5	4.2	5.0	5.4
SC_STMF1217	12.4	3.0	79.0	78.6	78.6	0%	4.3	6.2	7.2	7.6	4.3	6.2	7.2	7.6
SC_STMF122	5.4	2.0	79.0	84.0	85.0	1%	1.9	2.8	3.2	3.4	2.0	2.8	3.2	3.4
SC_STMF1223	10.3	6.4	79.0	39.1	52.5	34%	2.6	4.2	4.9	5.2	3.0	4.5	5.3	5.6
SC_STMF1227	7.4	5.7	79.0	64.0	64.0	0%	2.3	3.4	4.0	4.2	2.3	3.4	4.0	4.2
SC_STMF131	2.8	3.4	79.0	49.7	58.2	17%	0.8	1.2	1.4	1.5	0.8	1.3	1.5	1.6
SC_STMF135	6.7	4.1	79.0	37.4	60.8	63%	1.5	2.6	3.1	3.3	2.0	3.0	3.5	3.8
SC_STMG0714	6.9	7.8	80.3	59.3	59.3	0%	2.1	3.2	3.7	3.9	2.1	3.2	3.7	3.9
SC_STMG0721	2.7	13.2	79.3	55.8	55.8	0%	0.8	1.2	1.4	1.5	0.8	1.2	1.4	1.5
SC_STMG0723	1.7	9.9	75.0	42.2	50.0	18%	0.4	0.7	0.8	0.8	0.4	0.7	0.8	0.9
SC_STMG0725	8.3	7.1	80.9	46.6	50.0	7%	2.3	3.5	4.2	4.4	2.4	3.6	4.3	4.5
SC_STMG0731	3.9	2.6	69.6	48.0	50.0	4%	0.9	1.5	1.7	1.9	0.9	1.5	1.8	1.9
SC_STMG0733	1.3	24.7	65.8	31.4	60.0	91%	0.2	0.4	0.5	0.5	0.4	0.6	0.6	0.7
SC_STMG0744	5.0	13.8	78.3	32.1	50.2	56%	1.1	1.9	2.2	2.4	1.4	2.1	2.5	2.7
SC_STMG0750	8.1	7.2	79.0	59.1	59.1	0%	2.5	3.7	4.3	4.6	2.5	3.7	4.3	4.6

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Subcatchment Name	Area (acre)	Average Slope (%)	Pervious Curve Number	Impervious Area (%)			Subcatchment Peak Flow (cfs)							
							Existing Land Use Scenario				Future Land Use Scenario			
				Existing Land Use	Future Land Use	Percent Increase	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm
SC_STMG0755	3.3	13.7	63.5	44.3	50.1	13%	0.6	1.1	1.4	1.4	0.7	1.2	1.4	1.5
SC_STMG0765	3.4	11.1	65.3	44.9	50.9	13%	0.7	1.2	1.5	1.5	0.8	1.3	1.5	1.6
SC_STMG0768	6.8	5.9	79.2	55.3	55.5	0%	2.0	3.0	3.6	3.8	2.0	3.0	3.6	3.8
SC_STMG0769	3.0	12.2	79.0	51.9	58.9	13%	0.9	1.3	1.6	1.7	0.9	1.4	1.6	1.7
SC_STMG077	10.5	5.1	79.0	61.6	62.5	1%	3.1	4.8	5.6	5.9	3.2	4.8	5.6	5.9
SC_STMG0772	9.3	5.0	81.0	49.6	54.1	9%	2.7	4.1	4.8	5.1	2.8	4.2	4.9	5.2
SC_STMG0774	38.5	11.3	78.7	22.0	29.7	35%	6.4	12.4	15.3	16.5	7.4	13.5	16.4	17.6
SC_STMG0775	5.1	10.0	78.3	45.2	50.0	11%	1.4	2.1	2.5	2.7	1.4	2.2	2.6	2.7
SC_STMG0810	5.3	7.1	80.9	48.8	50.0	2%	1.5	2.3	2.7	2.9	1.6	2.3	2.7	2.9
SC_STMG0811	6.3	5.8	79.0	57.1	57.1	0%	1.9	2.8	3.3	3.5	1.9	2.8	3.3	3.5
SC_STMG0814	6.3	3.8	79.0	48.8	50.0	2%	1.8	2.7	3.2	3.4	1.8	2.7	3.2	3.4
SC_STMG082	3.9	2.9	79.0	48.9	50.0	2%	1.1	1.7	2.0	2.1	1.1	1.7	2.0	2.1
SC_STMG0830	17.6	3.7	79.0	55.3	55.3	0%	5.1	7.8	9.1	9.7	5.1	7.8	9.1	9.7
SC_STMG0842	16.5	5.0	80.2	48.9	50.0	2%	4.8	7.2	8.5	9.0	4.8	7.2	8.5	9.0
SC_STMG0846	8.8	1.8	79.0	50.8	50.8	0%	2.4	3.7	4.4	4.7	2.4	3.7	4.4	4.7
SC_STMG0847	9.6	4.3	79.0	45.0	45.0	0%	2.5	4.0	4.7	5.0	2.5	4.0	4.7	5.0
SC_STMG085	3.9	3.5	79.0	45.6	50.0	10%	1.0	1.6	1.9	2.0	1.1	1.7	2.0	2.1
SC_STMG0860	16.8	6.4	79.2	47.2	47.2	0%	4.6	7.1	8.4	8.9	4.6	7.1	8.4	8.9
SC_STMG088	14.3	5.1	79.0	38.8	50.0	29%	3.5	5.7	6.8	7.2	4.0	6.1	7.2	7.7
SC_STMG0918	6.7	4.4	79.0	56.9	56.9	0%	2.0	3.0	3.5	3.7	2.0	3.0	3.5	3.7
SC_STMG0919	7.9	4.1	79.0	49.0	50.4	3%	2.2	3.4	4.0	4.2	2.2	3.4	4.0	4.2
SC_STMG0924	10.0	5.1	79.0	41.8	59.7	43%	2.6	4.1	4.8	5.1	3.1	4.5	5.3	5.6
SC_STMG0928	33.0	4.5	79.8	31.7	48.6	53%	7.9	12.8	15.3	16.3	9.3	14.2	16.8	17.8
SC_STMG0930	6.6	2.9	79.0	45.1	50.0	11%	1.7	2.7	3.2	3.4	1.8	2.8	3.3	3.5
SC_STMG0932	26.8	2.1	80.0	14.8	49.9	237%	4.1	8.3	10.3	11.1	7.2	11.4	13.5	14.3
SC_STMG095	9.3	6.8	79.0	51.5	53.8	4%	2.7	4.0	4.8	5.0	2.8	4.1	4.8	5.1
SC_STMG099	6.3	4.4	80.5	48.0	49.2	3%	1.8	2.7	3.2	3.4	1.8	2.7	3.2	3.4
SC_STMG102	13.7	4.2	79.0	46.7	50.7	9%	3.6	5.7	6.8	7.2	3.8	5.9	6.9	7.3
SC_STMG1021	3.8	4.7	79.0	40.4	50.0	24%	0.9	1.5	1.8	1.9	1.0	1.6	1.9	2.0
SC_STMG1022	7.2	2.9	80.1	37.2	41.6	12%	1.8	2.9	3.5	3.7	1.9	3.0	3.5	3.8
SC_STMG1025	4.1	1.7	81.1	53.5	56.2	5%	1.2	1.8	2.1	2.2	1.2	1.8	2.1	2.3
SC_STMG1029	27.6	3.8	80.0	54.2	57.1	5%	8.1	12.3	14.4	15.3	8.3	12.5	14.6	15.5
SC_STMG1034	4.8	2.7	80.6	42.0	50.1	19%	1.1	1.9	2.3	2.4	1.3	2.0	2.4	2.5
SC_STMG1112	18.6	2.0	79.0	67.2	67.2	0%	6.0	8.8	10.2	10.8	6.0	8.8	10.2	10.8
SC_STMG121	20.4	3.3	79.0	85.7	85.7	0%	7.4	10.6	12.2	12.8	7.4	10.6	12.2	12.8
SC_STMG1215	5.0	3.5	79.0	89.8	89.8	0%	1.9	2.6	3.0	3.2	1.9	2.6	3.0	3.2
SC_STMG1219	11.0	4.2	79.0	50.7	50.7	0%	3.1	4.8	5.6	5.9	3.1	4.8	5.6	5.9
SC_STMG1227	14.0	3.8	79.0	83.6	83.6	0%	5.0	7.2	8.3	8.7	5.0	7.2	8.3	8.7
SC_STMG1245	11.7	1.7	79.0	69.4	69.4	0%	3.8	5.6	6.5	6.9	3.8	5.6	6.5	6.9
SC_STMG128	15.8	1.9	79.0	69.0	69.0	0%	5.2	7.5	8.8	9.3	5.2	7.5	8.8	9.3
SC_STMG1310	15.4	1.9	79.0	63.1	63.1	0%	4.9	7.1	8.3	8.8	4.9	7.1	8.3	8.8
SC_STMG1311	12.8	3.2	79.0	64.5	64.5	0%	4.0	5.9	6.9	7.3	4.0	5.9	6.9	7.3
SC_STMG1317	9.6	3.2	79.0	63.9	63.9	0%	2.9	4.4	5.2	5.5	2.9	4.4	5.2	5.5
SC_STMG1320	11.7	2.3	79.0	65.0	65.0	0%	3.6	5.4	6.3	6.7	3.6	5.4	6.3	6.7
SC_STMG1323	7.9	3.9	79.0	56.7	57.7	2%	2.4	3.5	4.1	4.4	2.4	3.6	4.2	4.4
SC_STMG1325	3.9	2.9	79.0	54.6	65.9	21%	1.2	1.7	2.0	2.2	1.3	1.9	2.2	2.3
SC_STMG133	18.7	2.6	79.0	57.8	57.8	0%	5.6	8.4	9.8	10.4	5.6	8.4	9.8	10.4

Table B-1. Hydrologic Input Data and Peak Flow Results

Subcatchment Name	Area (acre)	Average Slope (%)	Pervious Curve Number	Impervious Area (%)			Subcatchment Peak Flow (cfs)							
							Existing Land Use Scenario				Future Land Use Scenario			
				Existing Land Use	Future Land Use	Percent Increase	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm
SC_STMG135	8.2	2.6	79.0	68.9	68.9	0%	2.7	3.9	4.6	4.8	2.7	3.9	4.6	4.8
SC_STMG138	8.8	2.8	79.0	57.0	62.7	10%	2.6	3.9	4.6	4.9	2.7	4.1	4.8	5.0
SC_STMG1412	16.9	2.6	79.0	56.2	56.7	1%	5.0	7.5	8.8	9.3	5.0	7.5	8.8	9.4
SC_STMG1413	10.1	7.2	79.0	58.4	61.1	5%	3.1	4.6	5.4	5.7	3.1	4.6	5.4	5.7
SC_STMG142	2.8	3.7	79.0	41.5	60.0	45%	0.7	1.1	1.4	1.4	0.9	1.3	1.5	1.6
SC_STMG143	6.6	2.4	79.0	51.1	60.0	17%	1.8	2.8	3.3	3.6	2.0	3.0	3.5	3.7
SC_STMG144	7.8	7.1	79.0	59.4	62.1	5%	2.4	3.6	4.2	4.4	2.5	3.6	4.2	4.5
SC_STMG149	5.9	1.6	79.0	47.3	70.2	48%	1.3	2.2	2.6	2.8	1.8	2.7	3.2	3.4
SC_STMH072	4.2	21.1	72.3	56.4	56.4	0%	1.2	1.8	2.1	2.2	1.2	1.8	2.1	2.2
SC_STMH081	11.2	4.3	79.6	55.3	55.3	0%	3.3	5.0	5.8	6.2	3.3	5.0	5.8	6.2
HESS CREEK														
SC_J3	5.4	3.0	79.0	66.2	66.2	0%	1.7	2.5	3.0	3.1	1.7	2.5	3.0	3.1
SC_J3612	18.9	2.1	80.4	74.0	74.0	0%	6.5	9.4	10.9	11.5	6.5	9.4	10.9	11.5
SC_J3614	4.3	2.4	79.0	99.7	99.7	0%	1.7	2.4	2.7	2.9	1.7	2.4	2.7	2.9
SC_J3628	8.6	2.5	79.0	65.6	68.9	5%	2.7	4.0	4.7	4.9	2.8	4.1	4.8	5.0
SC_J3936	129.6	17.0	69.2	11.9	11.9	0%	10.0	24.5	33.4	36.9	10.0	24.5	33.4	36.9
SC_J3938	7.4	11.6	80.9	18.8	49.9	165%	1.5	2.6	3.2	3.4	2.1	3.2	3.8	4.1
SC_J4002	3.6	6.0	79.0	24.0	50.0	108%	0.7	1.2	1.5	1.6	1.0	1.5	1.8	1.9
SC_J4068	3.3	3.7	79.0	49.3	52.2	6%	0.9	1.4	1.6	1.7	0.9	1.4	1.7	1.8
SC_J4098	5.5	19.3	79.6	21.4	60.0	180%	1.2	2.0	2.4	2.6	1.7	2.5	3.0	3.1
SC_J4198	6.9	15.3	79.3	70.5	70.5	0%	2.3	3.4	3.9	4.1	2.3	3.4	3.9	4.1
SC_J4290	11.4	3.3	79.0	52.8	62.5	18%	3.2	4.9	5.8	6.2	3.5	5.2	6.1	6.5
SC_J4370	12.3	1.9	81.0	49.8	49.8	0%	3.3	5.3	6.2	6.6	3.3	5.3	6.2	6.6
SC_J4554	19.2	10.9	70.4	18.7	50.0	167%	1.6	3.4	4.5	4.9	4.0	6.5	7.9	8.4
SC_J4556	27.8	15.9	76.9	18.5	50.0	170%	4.3	8.6	10.7	11.5	7.3	11.5	13.6	14.5
SC_J4576	15.8	14.3	71.6	10.4	49.6	377%	1.5	3.4	4.6	5.0	3.6	6.1	7.2	7.7
SC_J4608	11.9	2.1	79.2	68.7	75.0	9%	3.8	5.6	6.5	6.9	4.0	5.8	6.8	7.1
SC_J4610	43.8	13.1	79.8	39.0	74.9	92%	10.9	17.6	21.0	22.3	15.0	21.7	25.1	26.5
SC_J4620	10.0	3.6	79.0	63.8	63.8	0%	3.1	4.6	5.4	5.7	3.1	4.6	5.4	5.7
SC_J4636	7.9	1.7	79.3	77.3	77.3	0%	2.7	4.0	4.6	4.8	2.7	4.0	4.6	4.8
SC_J4642	6.6	4.0	79.2	23.5	50.0	113%	1.1	2.2	2.7	2.9	1.7	2.8	3.3	3.5
SC_J4738	33.9	3.1	81.1	56.6	56.6	0%	9.6	14.9	17.6	18.7	9.6	14.9	17.6	18.7
SC_J4862	4.6	8.4	79.0	16.4	73.4	348%	0.9	1.6	1.9	2.1	1.6	2.3	2.6	2.8
SC_J4872	6.7	2.7	79.3	88.7	88.7	0%	2.5	3.5	4.0	4.3	2.5	3.5	4.0	4.3
SC_J4956	27.2	5.2	79.4	14.5	50.0	245%	3.6	7.5	9.6	10.4	6.9	11.2	13.3	14.2
SC_J5110	7.7	3.2	79.7	42.5	42.5	0%	1.8	3.1	3.7	3.9	1.8	3.1	3.7	3.9
SC_J5242	8.1	5.4	82.0	12.2	50.0	310%	0.9	1.9	2.4	2.6	2.0	3.2	3.8	4.1
SC_J5284	16.2	11.4	74.4	26.5	49.6	87%	2.7	5.2	6.4	6.9	4.0	6.5	7.7	8.2
SC_J5324	38.7	5.2	68.6	18.4	18.4	0%	3.2	7.3	9.8	10.8	3.2	7.3	9.8	10.8
SC_J5480	9.3	5.0	81.2	76.9	76.9	0%	3.3	4.7	5.4	5.7	3.3	4.7	5.4	5.7
SC_J5560	8.7	2.2	79.0	60.0	75.0	25%	2.6	3.9	4.6	4.8	2.9	4.3	5.0	5.2
SC_J5562	13.0	3.2	80.1	26.7	74.8	180%	2.7	4.7	5.7	6.1	4.4	6.4	7.4	7.9
SC_J5640	4.2	21.2	79.0	12.1	61.5	408%	0.8	1.4	1.7	1.8	1.3	1.9	2.3	2.4
SC_J6	6.8	1.6	79.0	79.0	79.0	0%	2.4	3.4	4.0	4.2	2.4	3.4	4.0	4.2
SC_J-HC-04	18.3	3.1	79.0	41.9	75.0	79%	4.0	6.8	8.3	8.8	6.1	8.9	10.4	11.0
SC_J-HC-06	44.7	6.8	79.7	11.3	50.3	345%	6.4	13.2	16.7	18.0	12.1	19.0	22.5	23.9
SC_J-HC-10	27.2	7.0	79.1	10.8	44.2	309%	3.5	7.3	9.3	10.2	6.4	10.7	12.8	13.7

Table B-1. Hydrologic Input Data and Peak Flow Results

Subcatchment Name	Area (acre)	Average Slope (%)	Pervious Curve Number	Impervious Area (%)			Subcatchment Peak Flow (cfs)							
							Existing Land Use Scenario				Future Land Use Scenario			
				Existing Land Use	Future Land Use	Percent Increase	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm
SC_J-HC-12	8.1	13.1	79.7	13.6	51.7	280%	1.3	2.5	3.2	3.4	2.3	3.5	4.1	4.4
SC_J-HC-14	19.3	13.9	80.1	28.3	62.8	122%	3.8	6.9	8.4	9.0	5.9	8.9	10.4	11.0
SC_J-HC-15	3.7	2.4	79.6	48.6	58.5	20%	1.0	1.6	1.9	2.0	1.1	1.7	2.0	2.1
SC_J-HC-16	12.8	2.0	80.1	35.0	48.0	37%	3.0	5.0	6.0	6.4	3.5	5.5	6.5	6.9
SC_J-HC-17	1.6	2.3	79.0	99.4	99.4	0%	0.7	0.9	1.0	1.1	0.7	0.9	1.0	1.1
SC_J-HC-18	64.4	3.6	79.1	76.7	76.7	0%	21.9	31.9	36.9	39.0	21.9	31.9	36.9	39.0
SC_J-HC-20	18.2	4.0	79.0	49.6	49.6	0%	4.9	7.7	9.1	9.7	4.9	7.7	9.1	9.7
SC_J-HC-21	10.1	7.4	79.5	44.9	44.9	0%	2.7	4.2	5.0	5.3	2.7	4.2	5.0	5.3
SC_J-HC-23	6.5	2.7	79.0	43.1	43.1	0%	1.5	2.5	3.0	3.2	1.5	2.5	3.0	3.2
SC_J-HC-24	13.8	3.1	79.0	53.4	53.4	0%	3.9	6.0	7.1	7.5	3.9	6.0	7.1	7.5
SC_J-HC-25	8.0	4.4	79.0	47.8	47.8	0%	2.1	3.3	3.9	4.2	2.1	3.3	3.9	4.2
SC_J-HC-26	14.6	3.5	79.0	28.7	41.3	44%	2.7	4.9	6.0	6.5	3.3	5.6	6.7	7.2
SC_J-HC-27	14.5	3.0	79.3	57.6	57.6	0%	4.3	6.5	7.6	8.1	4.3	6.5	7.6	8.1
SC_J-HC-31	12.0	12.7	80.0	28.9	43.9	52%	2.5	4.4	5.3	5.7	3.1	4.9	5.9	6.2
SC_J-HC-33	16.5	19.5	79.4	28.3	47.6	68%	3.9	6.3	7.5	8.0	4.7	7.1	8.3	8.8
SC_J-HC-34	10.1	5.8	80.4	25.3	59.7	136%	2.3	3.8	4.6	4.9	3.2	4.7	5.4	5.8
SC_J-HC-35	29.1	5.4	79.0	14.5	50.0	245%	4.2	8.7	10.9	11.8	7.7	12.2	14.5	15.4
SC_J-HC-36	40.0	5.7	79.3	15.1	50.7	236%	4.2	9.0	11.8	12.9	9.5	15.6	18.7	19.9
SC_J-HC-37	47.8	5.9	79.4	10.1	50.0	395%	4.4	9.7	12.7	13.9	11.1	18.2	21.9	23.4
SC_J-HC-38	19.4	8.9	80.4	12.1	50.0	313%	2.1	4.5	5.9	6.5	4.7	7.7	9.2	9.8
SC_J-HC-39	25.4	6.2	79.1	10.4	50.0	381%	2.6	5.7	7.5	8.2	6.1	10.0	12.0	12.8
SC_J-HC-40	27.0	11.5	77.2	14.7	49.6	237%	3.1	6.7	8.7	9.5	6.5	10.6	12.7	13.6
SC_J-HC-42	16.8	13.1	80.8	10.7	46.0	330%	2.3	4.8	6.1	6.6	4.2	6.9	8.2	8.8
SC_J-HC-43	180.7	19.3	70.3	12.9	12.9	0%	14.1	33.9	46.1	51.0	14.1	33.9	46.1	51.0
SC_J-HCT2-01	29.6	10.0	79.0	14.2	74.8	427%	4.0	8.4	10.6	11.5	9.9	14.5	16.8	17.8
SC_J-HCT2-02	15.6	3.8	79.0	27.2	72.3	166%	2.2	4.2	5.3	5.8	4.9	7.3	8.6	9.1
SC_J-HCT3-02	16.4	4.1	79.0	10.1	40.5	301%	1.7	3.8	4.9	5.4	3.4	5.9	7.2	7.7
SC_J-HCT4-01	3.7	4.6	79.0	57.8	57.8	0%	1.1	1.7	1.9	2.1	1.1	1.7	1.9	2.1
SC_J-HCT4-02	3.8	6.2	79.0	49.0	50.0	2%	1.1	1.6	1.9	2.0	1.1	1.7	1.9	2.1
SC_J-HCT4-06	2.8	15.9	79.3	40.5	50.0	23%	0.8	1.2	1.4	1.5	0.8	1.2	1.5	1.5
SC_STHI1043	4.4	3.2	80.4	51.2	51.2	0%	1.3	1.9	2.3	2.4	1.3	1.9	2.3	2.4
SC_STIH081	6.2	19.9	79.1	32.7	50.0	53%	1.4	2.4	2.8	3.0	1.7	2.7	3.1	3.3
SC_STIH1012	2.6	2.3	80.0	46.3	49.9	8%	0.7	1.1	1.3	1.4	0.7	1.1	1.3	1.4
SC_STIH1033	2.8	3.1	79.0	50.6	50.6	0%	0.8	1.2	1.4	1.5	0.8	1.2	1.4	1.5
SC_STIH1040	4.3	3.9	79.0	54.7	54.7	0%	1.3	1.9	2.2	2.4	1.3	1.9	2.2	2.4
SC_STIH107	4.4	5.1	79.0	46.2	50.0	8%	1.1	1.8	2.2	2.3	1.2	1.9	2.2	2.4
SC_STIH12182	5.7	3.9	79.0	98.0	98.0	0%	2.2	3.1	3.6	3.8	2.2	3.1	3.6	3.8
SC_STII093	12.8	3.3	81.0	71.7	74.2	3%	4.3	6.2	7.2	7.6	4.3	6.3	7.3	7.7
SC_STII0940	18.3	3.9	82.0	16.8	50.9	203%	1.9	3.8	4.9	5.4	4.3	6.8	8.2	8.8
SC_STII0950	3.2	2.4	79.4	32.0	56.2	76%	0.7	1.2	1.4	1.5	0.9	1.4	1.7	1.7
SC_STII0953	1.2	2.5	81.4	25.9	83.7	223%	0.2	0.4	0.5	0.5	0.4	0.6	0.7	0.7
SC_STII0954	12.6	3.1	80.9	12.3	75.0	510%	1.7	3.5	4.5	4.9	4.3	6.2	7.2	7.6
SC_STII1179	9.8	3.2	79.8	59.4	59.5	0%	3.0	4.5	5.2	5.5	3.0	4.5	5.2	5.5
SC_STII118	7.9	2.5	79.6	94.8	94.8	0%	3.0	4.3	4.9	5.1	3.0	4.3	4.9	5.1
SC_STII142	17.6	2.5	79.4	47.6	62.4	31%	4.7	7.4	8.8	9.3	5.5	8.1	9.5	10.0
SC_STII151	30.4	1.8	79.9	26.0	74.3	186%	4.2	8.0	10.2	11.0	9.8	14.5	16.9	17.9
SC_STMG1010	4.2	6.3	79.0	54.2	54.2	0%	1.2	1.9	2.2	2.3	1.2	1.9	2.2	2.3

Table B-1. Hydrologic Input Data and Peak Flow Results

Subcatchment Name	Area (acre)	Average Slope (%)	Pervious Curve Number	Impervious Area (%)			Subcatchment Peak Flow (cfs)							
							Existing Land Use Scenario				Future Land Use Scenario			
				Existing Land Use	Future Land Use	Percent Increase	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm
SC_STMG1019	9.1	2.4	79.0	52.7	56.3	7%	2.5	3.9	4.6	4.9	2.6	4.0	4.7	5.0
SC_STMG106	9.3	6.1	81.1	49.1	49.1	0%	2.7	4.1	4.8	5.1	2.7	4.1	4.8	5.1
SC_STMG112	7.6	3.7	79.0	59.8	59.8	0%	2.3	3.5	4.0	4.3	2.3	3.5	4.0	4.3
SC_STMG114	12.6	3.4	79.0	61.4	67.0	9%	3.7	5.7	6.7	7.1	3.9	5.9	6.9	7.3
SC_STMG118	5.4	2.8	79.0	70.9	70.9	0%	1.8	2.6	3.0	3.2	1.8	2.6	3.0	3.2
SC_STMG122	9.6	4.1	79.0	93.9	93.9	0%	3.7	5.2	5.9	6.2	3.7	5.2	5.9	6.2
SC_STMG1228	9.3	3.1	79.0	70.1	70.1	0%	3.1	4.5	5.2	5.5	3.1	4.5	5.2	5.5
SC_STMG126	2.1	16.7	80.8	54.8	54.8	0%	0.7	1.0	1.1	1.2	0.7	1.0	1.1	1.2
SC_STMH091	6.6	4.8	79.0	63.3	63.3	0%	2.1	3.1	3.6	3.8	2.1	3.1	3.6	3.8
SC_STMH0911	27.1	3.8	79.0	29.6	43.1	46%	4.9	9.0	11.1	12.0	6.2	10.4	12.5	13.4
SC_STMH0919	18.0	5.8	79.4	45.2	47.4	5%	4.6	7.4	8.8	9.3	4.7	7.5	8.9	9.5
SC_STMH095	5.0	9.5	79.0	53.6	53.6	0%	1.5	2.2	2.6	2.8	1.5	2.2	2.6	2.8
SC_STMH096	7.5	8.7	81.3	96.1	96.1	0%	2.9	4.1	4.7	4.9	2.9	4.1	4.7	4.9
SC_STMH097	9.8	3.6	79.5	78.8	78.8	0%	3.4	4.9	5.7	6.0	3.4	4.9	5.7	6.0
SC_STMH098	15.0	3.9	79.1	61.8	74.9	21%	4.5	6.8	8.0	8.4	5.0	7.3	8.5	9.0
SC_STMH1010	4.9	9.7	81.3	50.7	50.7	0%	1.5	2.2	2.6	2.7	1.5	2.2	2.6	2.7
SC_STMH1021	5.3	3.5	79.0	40.5	56.4	39%	1.3	2.1	2.5	2.7	1.6	2.4	2.8	2.9
SC_STMH1024	2.1	2.5	79.0	57.8	60.0	4%	0.6	0.9	1.1	1.2	0.6	0.9	1.1	1.2
SC_STMH105	12.7	4.6	81.0	47.9	54.0	13%	3.3	5.3	6.3	6.7	3.6	5.5	6.5	6.9
SC_STMH107	4.0	4.6	79.0	47.6	50.0	5%	1.1	1.7	2.0	2.1	1.1	1.7	2.0	2.1
SC_STMH111	8.2	5.0	79.0	44.3	45.7	3%	2.1	3.4	4.0	4.3	2.2	3.4	4.0	4.3
SC_STMH1110	6.8	2.7	80.1	51.2	51.2	0%	2.0	3.0	3.5	3.8	2.0	3.0	3.5	3.8
SC_STMH1116	7.5	2.7	79.3	51.1	59.3	16%	2.1	3.2	3.8	4.1	2.3	3.4	4.0	4.2
SC_STMH1125	7.8	4.1	79.2	51.5	51.5	0%	2.2	3.4	4.0	4.2	2.2	3.4	4.0	4.2
SC_STMH1135	7.1	3.2	79.7	55.1	60.8	10%	2.1	3.2	3.7	3.9	2.2	3.3	3.8	4.1
SC_STMH1137	7.4	2.8	79.7	74.6	74.6	0%	2.5	3.7	4.2	4.5	2.5	3.7	4.2	4.5
SC_STMH114	1.9	2.7	79.0	43.5	59.3	36%	0.5	0.8	0.9	1.0	0.6	0.8	1.0	1.0
SC_STMH1144	10.9	5.9	79.5	52.7	52.7	0%	3.2	4.8	5.7	6.0	3.2	4.8	5.7	6.0
SC_STMH116	3.7	3.8	79.0	68.2	68.2	0%	1.2	1.8	2.0	2.2	1.2	1.8	2.0	2.2
SC_STMH118	4.1	3.0	80.1	51.2	58.7	15%	1.1	1.8	2.1	2.2	1.2	1.9	2.2	2.3
SC_STMH1212	7.7	2.7	79.0	65.0	68.7	6%	2.5	3.6	4.2	4.5	2.5	3.7	4.3	4.5
SC_STMH1215	4.8	3.0	79.0	45.4	62.8	38%	1.2	1.9	2.3	2.5	1.4	2.2	2.6	2.7
SC_STMH1223	8.8	1.6	79.0	57.7	58.2	1%	2.5	3.9	4.5	4.8	2.5	3.9	4.6	4.8
SC_STMH1229	5.8	4.4	79.4	58.1	60.2	4%	1.8	2.6	3.1	3.3	1.8	2.7	3.1	3.3
SC_STMH1233	3.6	2.1	79.0	67.8	67.8	0%	1.2	1.7	2.0	2.1	1.2	1.7	2.0	2.1
SC_STMH1238	5.9	3.7	79.0	57.3	59.5	4%	1.8	2.7	3.1	3.3	1.8	2.7	3.1	3.3
SC_STMH1242	4.4	4.1	79.0	64.9	64.9	0%	1.4	2.0	2.4	2.5	1.4	2.0	2.4	2.5
SC_STMH1248	9.7	3.3	79.0	26.3	55.3	110%	2.2	3.6	4.3	4.6	2.9	4.3	5.1	5.4
SC_STMH1252	1.5	6.3	79.0	60.9	60.9	0%	0.5	0.7	0.8	0.9	0.5	0.7	0.8	0.9
SC_STMH1253	16.9	1.7	79.0	90.3	90.3	0%	6.4	9.0	10.3	10.9	6.4	9.0	10.3	10.9
SC_STMH127	11.1	5.0	79.6	72.5	76.8	6%	3.7	5.4	6.3	6.6	3.8	5.5	6.4	6.7
SC_STMH128	20.4	2.4	79.5	78.8	79.9	1%	7.1	10.2	11.9	12.5	7.2	10.3	11.9	12.6
SC_STMH1311	6.6	1.4	79.0	48.5	59.7	23%	1.8	2.8	3.3	3.5	2.0	3.0	3.5	3.7
SC_STMH1313	5.9	2.3	79.0	31.8	59.8	88%	1.3	2.2	2.7	2.8	1.8	2.7	3.1	3.3
SC_STMH1314	7.1	2.3	79.0	67.9	67.9	0%	2.3	3.4	3.9	4.2	2.3	3.4	3.9	4.2
SC_STMH1315	8.3	1.5	79.0	35.5	60.0	69%	1.5	2.7	3.3	3.6	2.3	3.6	4.2	4.5
SC_STMH132	13.3	4.7	79.0	53.9	60.0	11%	3.9	5.8	6.9	7.3	4.1	6.1	7.1	7.5

Table B-1. Hydrologic Input Data and Peak Flow Results

Subcatchment Name	Area (acre)	Average Slope (%)	Pervious Curve Number	Impervious Area (%)			Subcatchment Peak Flow (cfs)							
							Existing Land Use Scenario				Future Land Use Scenario			
				Existing Land Use	Future Land Use	Percent Increase	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm
SC_STMH135	4.9	14.7	80.5	30.7	60.0	95%	1.1	1.9	2.2	2.4	1.5	2.2	2.6	2.8
SC_STMI081	13.6	7.8	77.4	37.1	62.5	68%	2.3	4.1	5.0	5.4	3.7	5.7	6.7	7.2
SC_STMI111	40.4	3.3	80.0	41.0	47.0	15%	8.9	15.2	18.3	19.6	9.8	16.1	19.2	20.5
SC_STMI112	6.0	2.2	79.6	91.7	91.7	0%	2.3	3.2	3.7	3.9	2.3	3.2	3.7	3.9
SC_STMI122	19.2	2.5	79.3	80.7	80.7	0%	6.8	9.7	11.2	11.8	6.8	9.7	11.2	11.8
SC_STMI1312	18.5	1.4	80.2	23.7	69.5	193%	2.1	3.9	5.0	5.4	5.4	8.2	9.6	10.2
SC_STMI132	11.6	25.4	79.1	53.1	71.4	34%	3.5	5.2	6.0	6.4	3.9	5.7	6.6	6.9
SC_STMI141	11.3	2.1	79.0	87.1	87.1	0%	4.1	5.9	6.8	7.1	4.1	5.9	6.8	7.1
SCa_J5090	14.1	12.8	70.5	14.9	49.4	232%	1.1	2.7	3.7	4.1	3.0	5.1	6.1	6.6
SCb_J5090	13.6	16.2	74.2	10.0	49.9	399%	1.2	2.8	3.7	4.1	3.1	5.2	6.2	6.6
SCc_J5090	360.5	22.2	69.2	11.9	26.0	118%	23.8	59.7	80.1	89.3	41.5	83.6	108.1	117.9
SPRING BROOK														
SC_J3852	5.7	3.0	79.0	50.0	60.1	20%	1.6	2.5	2.9	3.1	1.8	2.6	3.0	3.2
SC_J3960	6.5	2.1	81.7	19.1	75.0	293%	1.2	2.2	2.7	2.9	2.2	3.2	3.8	4.0
SC_J4092	21.5	4.3	80.2	17.1	66.7	290%	2.6	5.4	7.0	7.6	6.5	9.9	11.6	12.3
SC_J4116	6.8	3.6	79.0	17.1	75.0	339%	0.9	1.9	2.4	2.6	2.3	3.3	3.9	4.1
SC_J4118	5.9	1.7	79.0	26.5	71.0	168%	1.0	1.9	2.3	2.5	1.9	2.8	3.3	3.5
SC_J4268	13.1	3.1	78.3	22.9	75.7	231%	2.2	4.2	5.2	5.6	4.4	6.4	7.5	7.9
SC_J4834	4.1	3.4	79.7	93.3	93.3	0%	1.6	2.2	2.5	2.7	1.6	2.2	2.5	2.7
SC_J5178	16.5	5.3	80.9	15.4	52.2	239%	2.3	4.7	6.0	6.5	4.4	7.0	8.3	8.8
SC_J5216	9.4	3.4	80.7	14.4	61.6	328%	1.3	2.7	3.5	3.8	2.8	4.3	5.0	5.3
SC_J5236	6.3	4.2	82.4	17.4	85.0	389%	1.1	2.1	2.6	2.8	2.3	3.3	3.8	4.0
SC_J-SB-02	970.6	4.5	73.1	12.5	12.5	0%	58.3	131.6	179.1	199.7	58.3	131.6	179.1	199.7
SC_J-SB-03	35.2	8.3	78.5	31.5	64.3	104%	7.6	13.1	15.7	16.8	11.0	16.3	19.0	20.1
SC_J-SB-07	55.2	11.4	79.7	13.8	67.2	387%	7.4	15.4	19.6	21.3	17.3	25.9	30.2	32.0
SC_J-SB-11	67.5	3.7	79.8	12.2	21.6	77%	9.1	18.8	23.9	26.0	10.8	21.2	26.4	28.5
SC_J-SB-12	137.5	16.6	75.1	13.1	13.1	0%	14.9	33.2	43.2	47.2	14.9	33.2	43.2	47.2
SC_J-SB-13	513.0	20.1	71.7	13.8	13.8	0%	35.1	84.4	112.7	124.9	35.1	84.4	112.7	124.9
SC_J-SB-14	113.3	8.1	79.7	18.0	23.2	29%	19.4	37.2	45.9	49.4	21.4	39.2	47.8	51.3
SC_J-SB-16	465.1	9.8	71.0	13.4	26.0	94%	28.7	64.0	87.1	97.1	51.8	94.0	120.3	131.4
SC_J-SBT1-01	58.4	3.5	76.7	11.9	66.5	459%	5.9	12.9	17.1	18.8	17.3	26.4	30.9	32.8
SC_J-SBT1-06	12.9	2.9	79.6	86.2	86.2	0%	4.7	6.7	7.8	8.2	4.7	6.7	7.8	8.2
SC_J-SBT1-07	2.3	6.6	79.0	53.7	85.0	58%	0.7	1.0	1.2	1.3	0.8	1.2	1.4	1.4
SC_J-SBT1-08	26.3	1.9	79.5	78.6	84.3	7%	9.2	13.2	15.3	16.1	9.5	13.6	15.7	16.5
SC_J-SBT3-01	26.7	7.4	80.9	11.7	75.8	548%	4.1	8.3	10.4	11.2	9.2	13.3	15.4	16.3
SC_J-SBT4-02	6.3	6.2	81.3	19.8	50.0	153%	1.3	2.3	2.8	3.0	1.8	2.8	3.3	3.5
SC_J-SBT5-01	9.3	9.9	79.4	10.0	40.5	305%	1.4	2.8	3.5	3.8	2.3	3.7	4.4	4.7
SC_J-SBT6-01	380.8	13.1	71.6	13.6	13.6	0%	29.7	70.8	95.5	105.7	29.7	70.8	95.5	105.7
SC_J-SBT6-02	219.1	12.4	71.8	18.4	18.4	0%	20.4	46.1	61.0	67.0	20.4	46.1	61.0	67.0
SC_J-SBT7-01	16.5	5.9	79.7	10.4	67.1	545%	1.8	3.8	4.9	5.4	5.0	7.6	8.9	9.5
SC_J-SBT7-02	7.4	20.8	79.5	75.0	75.0	0%	2.5	3.7	4.2	4.5	2.5	3.7	4.2	4.5
SC_SBT5-01	19.7	11.8	80.1	53.7	53.7	0%	5.9	8.8	10.3	10.9	5.9	8.8	10.3	10.9
SC_SBTI-04	23.3	7.1	79.0	15.3	67.2	339%	3.5	7.1	8.9	9.6	7.4	11.0	12.8	13.5
SC_STII09101	36.1	4.8	77.4	24.8	64.7	161%	4.8	9.3	11.9	12.9	10.3	15.8	18.7	19.8
SC_STII0916	2.9	3.4	83.3	52.7	75.0	42%	0.9	1.3	1.6	1.7	1.0	1.5	1.7	1.8
SC_STII092	9.8	4.2	79.0	43.8	47.1	8%	2.6	4.0	4.8	5.1	2.7	4.1	4.9	5.2
SC_STII0965	2.7	2.5	79.0	41.5	82.4	99%	0.6	1.1	1.3	1.4	1.0	1.4	1.6	1.7

Table B-1. Hydrologic Input Data and Peak Flow Results

Subcatchment Name	Area (acre)	Average Slope (%)	Pervious Curve Number	Impervious Area (%)			Subcatchment Peak Flow (cfs)							
							Existing Land Use Scenario				Future Land Use Scenario			
				Existing Land Use	Future Land Use	Percent Increase	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm
SC_STII0975	4.6	2.0	81.8	39.2	83.6	113%	1.2	1.9	2.3	2.4	1.7	2.4	2.7	2.9
SC_STII0990	3.3	3.4	79.0	41.5	82.2	98%	0.8	1.3	1.6	1.7	1.2	1.7	1.9	2.0
SC_STII1030	2.2	2.1	82.9	70.8	70.8	0%	0.7	1.1	1.2	1.3	0.7	1.1	1.2	1.3
SC_STII1033	22.8	6.2	80.3	29.2	72.1	147%	4.8	8.4	10.1	10.8	7.6	11.1	12.9	13.6
SC_STII1055	3.5	2.9	80.4	50.0	52.7	5%	1.0	1.5	1.8	1.9	1.0	1.6	1.8	2.0
SC_STII1078	7.5	2.8	81.7	59.4	60.1	1%	2.4	3.5	4.1	4.3	2.4	3.5	4.1	4.3
SC_STII1080	10.0	2.0	79.5	79.9	79.9	0%	3.5	5.0	5.8	6.2	3.5	5.0	5.8	6.2
SC_STII1149	19.2	3.0	79.0	64.9	64.9	0%	6.0	8.9	10.4	11.0	6.0	8.9	10.4	11.0
SC_STIJ081	16.3	15.3	77.6	24.4	78.9	223%	2.7	5.3	6.5	7.0	5.6	8.1	9.4	9.9
SC_STIJ0911	18.2	3.5	80.1	12.4	64.2	418%	2.6	5.4	6.8	7.3	5.6	8.5	9.9	10.5
SC_STIJ0916	13.9	4.4	79.4	28.9	28.9	0%	3.2	5.3	6.3	6.7	3.2	5.3	6.3	6.7
SC_STIJ1060	6.6	1.8	79.0	88.1	88.1	0%	2.5	3.5	4.0	4.2	2.5	3.5	4.0	4.2
SC_STIK116	17.9	13.8	69.4	11.3	13.2	17%	1.3	3.2	4.4	4.9	1.4	3.4	4.6	5.1
SC_STIL11186	4.3	13.8	79.0	35.9	84.9	136%	1.0	1.7	2.0	2.1	1.6	2.2	2.5	2.7
SC_STMI0910	10.8	3.7	80.4	48.3	54.8	13%	2.8	4.5	5.3	5.7	3.0	4.7	5.6	5.9
SC_STMI1013	3.4	1.9	79.0	54.8	54.8	0%	1.0	1.5	1.8	1.9	1.0	1.5	1.8	1.9
SC_STMI1014	4.3	3.9	81.4	55.9	55.9	0%	1.3	2.0	2.3	2.5	1.3	2.0	2.3	2.5
SC_STMI1015	5.1	1.7	81.9	65.0	69.5	7%	1.7	2.4	2.8	3.0	1.7	2.5	2.9	3.1
SC_STMI1017	6.7	3.8	80.9	57.1	57.1	0%	2.1	3.1	3.6	3.8	2.1	3.1	3.6	3.8
SC_STMI1021	7.5	5.8	80.6	54.5	54.5	0%	2.3	3.4	4.0	4.2	2.3	3.4	4.0	4.2
SC_STMI1022	3.2	3.1	82.7	71.0	71.0	0%	1.1	1.6	1.9	2.0	1.1	1.6	1.9	2.0
SC_STMI1023	2.3	3.6	81.0	43.4	58.7	35%	0.6	1.0	1.1	1.2	0.7	1.0	1.2	1.3
SC_STMI107	10.9	3.0	79.0	60.5	60.5	0%	3.3	5.0	5.8	6.2	3.3	5.0	5.8	6.2
SC_STMI1110	6.0	3.9	80.1	60.9	61.7	1%	1.9	2.8	3.3	3.5	1.9	2.8	3.3	3.5
SC_STMI1114	8.1	2.1	80.0	93.4	93.4	0%	3.1	4.4	5.0	5.3	3.1	4.4	5.0	5.3
SC_STMI1123	2.1	2.4	81.2	50.9	83.1	63%	0.6	0.9	1.1	1.2	0.8	1.1	1.3	1.3
SC_STMI1160	2.8	3.6	83.6	59.0	66.5	13%	0.9	1.3	1.6	1.7	1.0	1.4	1.6	1.7
SC_STMI1164	1.1	2.6	79.2	59.9	70.0	17%	0.3	0.5	0.6	0.6	0.4	0.5	0.6	0.6
SC_STMI1165	2.9	4.8	79.1	67.5	69.5	3%	1.0	1.4	1.6	1.7	1.0	1.4	1.6	1.7
SC_STMI1174	7.5	3.2	79.9	28.5	78.2	174%	1.3	2.4	3.0	3.3	2.6	3.8	4.4	4.6
SC_STMI1212	3.7	3.4	80.2	59.0	60.4	2%	1.1	1.7	2.0	2.1	1.2	1.7	2.0	2.1
SC_STMI1217	4.3	4.9	79.7	61.9	61.9	0%	1.4	2.0	2.3	2.5	1.4	2.0	2.3	2.5
SC_STMI1219	5.4	3.3	83.4	58.4	60.0	3%	1.7	2.6	3.0	3.2	1.8	2.6	3.0	3.2
SC_STMI123	11.0	1.4	79.6	59.7	62.8	5%	3.2	4.9	5.8	6.1	3.3	5.0	5.9	6.2
SC_STMI1233	7.4	2.8	79.0	76.6	76.6	0%	2.6	3.7	4.3	4.5	2.6	3.7	4.3	4.5
SC_STMI124	4.0	2.3	79.1	71.2	71.2	0%	1.4	2.0	2.3	2.4	1.4	2.0	2.3	2.4
SC_STMI125	7.5	2.4	79.0	81.5	81.5	0%	2.7	3.8	4.4	4.7	2.7	3.8	4.4	4.7
SC_STMI128	1.7	2.0	78.2	60.7	67.8	12%	0.5	0.8	0.9	1.0	0.6	0.8	1.0	1.0
SC_STMI129	10.9	3.9	82.4	59.6	80.0	34%	3.3	5.0	5.9	6.2	3.9	5.6	6.4	6.8
SC_STMI1310	7.7	3.2	79.1	61.4	65.2	6%	2.4	3.6	4.2	4.4	2.5	3.6	4.2	4.5
SC_STMI137	5.9	2.9	79.3	57.7	68.9	19%	1.7	2.6	3.1	3.3	1.9	2.8	3.3	3.4
SC_STMI139	13.0	2.4	79.3	73.2	73.2	0%	4.3	6.3	7.3	7.7	4.3	6.3	7.3	7.7
SC_STMI143	11.2	2.2	79.0	37.8	67.8	79%	2.8	4.5	5.3	5.7	3.7	5.3	6.2	6.6
SC_STMJ092	7.2	4.6	80.0	48.8	50.0	2%	2.1	3.1	3.7	3.9	2.1	3.2	3.7	3.9
SC_STMJ1010	1.5	7.0	82.5	57.0	57.0	0%	0.5	0.7	0.8	0.9	0.5	0.7	0.8	0.9
SC_STMJ1011	7.3	4.9	80.5	50.9	50.9	0%	2.2	3.2	3.8	4.0	2.2	3.2	3.8	4.0
SC_STMJ102	14.3	3.5	81.6	54.9	56.0	2%	4.4	6.5	7.6	8.1	4.4	6.5	7.7	8.1

Table B-1. Hydrologic Input Data and Peak Flow Results

Subcatchment Name	Area (acre)	Average Slope (%)	Pervious Curve Number	Impervious Area (%)			Subcatchment Peak Flow (cfs)							
							Existing Land Use Scenario				Future Land Use Scenario			
				Existing Land Use	Future Land Use	Percent Increase	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm	2-yr, 24-hr Design Storm	10-yr, 24-hr Design Storm	25-yr, 24-hr Design Storm	50-yr, 24-hr Design Storm
SC_STMJ1022	7.1	4.2	84.0	50.3	50.3	0%	2.2	3.3	3.8	4.1	2.2	3.3	3.8	4.1
SC_STMJ103	5.0	2.3	83.4	51.1	51.1	0%	1.5	2.3	2.7	2.8	1.5	2.3	2.7	2.8
SC_STMJ104	8.5	3.1	81.6	48.0	49.7	4%	2.4	3.7	4.4	4.6	2.5	3.8	4.4	4.7
SC_STMJ106	3.7	3.4	83.8	46.8	50.0	7%	1.1	1.7	2.0	2.1	1.1	1.7	2.0	2.1
SC_STMJ107	5.9	3.6	82.9	44.3	49.2	11%	1.7	2.6	3.1	3.3	1.8	2.7	3.1	3.3
SC_STMJ1110	2.6	2.1	83.5	70.9	81.2	15%	0.9	1.3	1.5	1.6	1.0	1.4	1.6	1.7
SC_STMJ1111	4.6	1.0	79.8	61.4	80.2	31%	1.4	2.1	2.5	2.6	1.6	2.3	2.7	2.8
SC_STMJ1114	18.2	4.1	81.6	60.8	78.3	29%	5.6	8.4	9.9	10.4	6.4	9.2	10.7	11.2
SC_STMJ1121	11.2	5.4	79.0	19.6	46.5	137%	1.4	3.0	3.8	4.2	2.6	4.3	5.2	5.5
SC_STMJ1126	3.0	4.2	79.0	68.7	81.7	19%	1.0	1.4	1.7	1.8	1.1	1.5	1.8	1.8
SC_STMJ1134	7.4	2.1	79.0	44.2	80.0	81%	2.0	3.1	3.6	3.9	2.6	3.8	4.3	4.6
SC_STMJ1136	10.5	2.4	79.7	42.0	80.0	90%	2.7	4.3	5.1	5.4	3.7	5.3	6.1	6.5
SC_STMJ1138	8.1	3.7	79.3	38.2	80.0	109%	1.8	3.1	3.7	4.0	2.9	4.1	4.7	5.0
SC_STMJ1141	7.8	4.9	83.9	23.0	75.5	228%	1.6	2.8	3.4	3.7	2.7	3.9	4.6	4.8
SC_STMJ115	2.8	3.3	79.4	57.3	70.0	22%	0.8	1.3	1.5	1.6	0.9	1.3	1.6	1.7
SC_STMJ121	4.0	3.5	84.0	56.3	62.5	11%	1.3	1.9	2.2	2.3	1.3	1.9	2.2	2.4
SC_STMJ1211	6.3	1.8	82.3	29.9	77.8	160%	1.3	2.2	2.7	2.9	2.2	3.2	3.7	3.9
SC_STMJ1213	4.5	4.4	84.0	57.1	80.0	40%	1.5	2.1	2.5	2.7	1.6	2.3	2.7	2.8
SC_STMJ1217	4.2	5.2	84.0	60.6	80.0	32%	1.4	2.0	2.3	2.5	1.5	2.2	2.5	2.6
SC_STMJ1218	6.6	4.0	79.6	46.5	72.3	55%	1.5	2.5	3.0	3.2	2.1	3.2	3.7	3.9
SC_STMJ122	5.3	10.5	81.4	79.1	79.1	0%	1.9	2.7	3.1	3.3	1.9	2.7	3.1	3.3
SC_STMJ1226	8.2	7.8	80.4	33.9	51.6	52%	2.1	3.3	3.9	4.2	2.4	3.6	4.3	4.5
SC_STMJ123	9.0	2.4	84.0	48.5	75.3	55%	2.6	4.0	4.7	5.0	3.2	4.6	5.3	5.6
SC_STMJ1230	3.4	4.7	79.0	49.1	50.0	2%	1.0	1.5	1.7	1.8	1.0	1.5	1.7	1.8
SC_STMJ1238	8.2	1.2	83.6	25.0	80.0	220%	1.6	2.9	3.5	3.8	2.9	4.2	4.9	5.1
SC_STMJ125	1.7	4.6	84.0	42.6	66.2	55%	0.5	0.7	0.9	0.9	0.6	0.8	0.9	1.0
SC_STMJ126	4.9	4.0	84.0	62.3	62.3	0%	1.6	2.3	2.7	2.9	1.6	2.3	2.7	2.9
SC_STMK1112	9.3	7.8	74.1	26.7	36.7	37%	1.8	3.2	3.8	4.1	2.1	3.4	4.1	4.4
SC_STMK1120	7.3	2.2	77.5	40.4	49.6	23%	1.7	2.8	3.4	3.6	1.9	3.0	3.6	3.8
SC_STMK1122	24.3	17.7	72.5	18.8	21.0	12%	3.0	6.6	8.4	9.1	3.1	6.8	8.6	9.3
SC_STMK1211	8.2	7.0	78.0	46.7	50.0	7%	2.3	3.4	4.1	4.3	2.3	3.5	4.1	4.4
SC_STMK1212	4.0	3.4	79.0	48.8	50.0	2%	1.1	1.7	2.0	2.1	1.1	1.7	2.0	2.1
SC_STMK1213	2.3	6.1	70.3	51.8	51.8	0%	0.6	0.9	1.1	1.2	0.6	0.9	1.1	1.2
SC_STMK1216	1.4	12.9	74.7	63.2	63.2	0%	0.5	0.7	0.8	0.8	0.5	0.7	0.8	0.8
SC_STMK1218	3.2	15.3	58.3	27.0	27.0	0%	0.3	0.7	1.0	1.0	0.3	0.7	1.0	1.0
SC_STMK122	4.5	4.6	79.0	56.3	56.3	0%	1.4	2.0	2.4	2.5	1.4	2.0	2.4	2.5
SC_STMK1222	2.6	14.7	59.7	46.6	50.0	7%	0.5	0.9	1.1	1.2	0.5	1.0	1.1	1.2
SC_STMK1223	6.6	8.0	64.9	42.7	44.2	4%	1.2	2.3	2.7	2.9	1.3	2.3	2.8	3.0
SC_STMK123	2.7	21.7	74.5	38.9	38.9	0%	0.7	1.1	1.2	1.3	0.7	1.1	1.2	1.3
SC_STMK1232	6.8	20.6	70.8	44.5	44.5	0%	1.6	2.6	3.1	3.3	1.6	2.6	3.1	3.3
SC_STMK1233	2.8	8.9	75.7	47.8	50.0	5%	0.8	1.1	1.4	1.4	0.8	1.2	1.4	1.5
SC_STMK1235	8.7	7.6	78.1	27.0	50.0	85%	1.6	2.9	3.6	3.8	2.3	3.6	4.3	4.5
SC_STMK125	1.7	5.3	79.0	55.4	55.4	0%	0.5	0.8	0.9	0.9	0.5	0.8	0.9	0.9
SC_STML1131	13.9	4.0	79.0	88.1	88.1	0%	5.2	7.3	8.4	8.9	5.2	7.3	8.4	8.9
SC_STML1232	10.1	0.5	79.0	78.5	78.5	0%	3.5	5.1	5.9	6.2	3.5	5.1	5.9	6.2

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
CHEHALEM CREEK																	
C2	J1	STMG0911	163	12'' DIA	0.7%	203.00	201.80	210.7	208.1	203.5	202.9	203.6	203.0	3.1	1.4	1.9	--
C3	STMF126	J5554	59	12'' DIA	2.3%	166.02	164.69	170.4	170.5	166.7	165.2	166.7	165.2	5.4	3.9	3.9	--
C5	J9	STMF126	119	12'' DIA	1.3%	167.60	166.02	171.8	170.4	168.0	166.7	168.0	166.7	4.2	1.2	1.2	--
C6	J4162	STMF0913	134	30'' DIA	6.6%	199.00	190.20	202.0	203.4	199.7	191.6	199.7	191.6	105.3	15.8	16.1	--
CCT1-01	J-CCT1-02	OF_J-CCT1-01	913	Irregular Channel	2.6%	100.00	76.00	150.0	90.0	101.6	77.6	101.7	77.7		64.3	71.1	--
CCT1-02	J-CCT1-03	J-CCT1-02	594	Irregular Channel	2.0%	112.00	100.00	162.0	150.0	113.3	101.6	113.4	101.7		54.7	58.0	--
CCT1-03	J-CCT1-04	J-CCT1-03	335	Irregular Channel	2.7%	121.00	112.00	160.0	162.0	122.6	113.3	122.6	113.4		52.2	54.6	--
CCT1-04	J-CCT1-06	J-CCT1-05	688	Irregular Channel	1.1%	129.31	121.50	139.3	123.4	130.8	128.1	130.8	128.4		46.4	47.1	--
CCT1-05	J-CCT1-07	J-CCT1-06	61	Irregular Channel	1.1%	130.00	129.31	132.0	139.3	131.2	130.8	131.3	130.8		34.9	35.3	--
CCT2-01	J-CCT2-02	OF_J-CCT2-01	67	Irregular Channel	4.5%	100.00	97.00	109.0	109.0	101.0	100.0	101.0	100.0		48.7	51.1	--
CCT2-02	J-CCT2-03	J-CCT2-02	539	Irregular Channel	1.3%	107.00	100.00	150.0	109.0	109.1	101.0	109.1	101.0		40.3	42.0	--
CCT2-03	J-CCT2-04	J-CCT2-03	176	Irregular Channel	9.1%	123.00	107.00	173.0	150.0	124.1	109.1	124.1	109.1		37.4	38.8	--
CCT2-04	J-CCT2-05	J-CCT2-04	694	Irregular Channel	1.2%	131.00	123.00	156.0	173.0	132.8	124.1	132.8	124.1		33.8	35.1	--
CCT2-05	J-CCT2-06	J-CCT2-05	167	Irregular Channel	1.5%	133.50	131.00	158.5	156.0	134.7	132.8	134.7	132.8		31.1	31.7	--
CCT2-06	STMF135	J-CCT2-06	477	Irregular Channel	2.4%	145.00	133.50	161.6	158.5	146.1	134.7	146.1	134.7		23.4	23.8	--
CCT3-01	J-CCT3-02	OF_J-CCT3-01	1161	Irregular Channel	1.1%	112.00	99.00	152.0	140.0	115.5	101.9	115.6	102.0		210.7	231.6	--
CCT3-02	J-CCT3-03	J-CCT3-02	1460	Irregular Channel	0.5%	120.00	112.00	160.0	152.0	122.6	115.5	122.7	115.6		181.5	202.0	--
CCT3-03	J-CCT3-04	J-CCT3-03	644	Irregular Channel	1.2%	128.00	120.00	148.0	160.0	130.1	122.6	130.2	122.7		173.0	192.8	--
CCT3-04	J-CCT3-06	J-CCT3-05	319	Irregular Channel	2.5%	138.00	130.00	148.0	150.0	139.9	133.6	140.0	133.8		85.5	97.5	--
CCT3-05	J-CCT3-07	J-CCT3-06	571	Irregular Channel	1.2%	145.00	138.00	155.0	148.0	147.4	139.9	147.5	140.0		70.5	81.7	--
CCT3-06	J-CCT3-08	J-CCT3-07	149	Irregular Channel	2.0%	148.00	145.00	158.0	155.0	150.0	147.4	150.1	147.5		69.5	80.7	--
CCT3-07	J-CCT3-09	J-CCT3-08	303	Irregular Channel	2.6%	156.00	148.00	166.0	158.0	157.9	150.0	158.0	150.1		68.4	79.7	--
CCT3-08	J-CCT3-10	J-CCT3-09	215	Irregular Channel	1.9%	160.00	156.00	170.0	166.0	162.0	157.9	162.2	158.0		66.8	78.0	--
CCT3-09	J-CCT3-13	J-CCT3-12	393	Irregular Channel	1.4%	168.45	162.90	171.5	167.4	170.1	165.3	170.2	165.6		56.7	62.8	--
CCT3-10	J-CCT3-14	J-CCT3-13	188	Irregular Channel	1.4%	171.10	168.45	176.5	171.5	172.7	170.1	172.8	170.2		55.6	61.5	--
CCT3T1-01	STMF1224	J-CCT3-02	370	Irregular Channel	4.6%	129.10	112.00	152.6	152.0	130.5	115.5	130.6	115.6		30.8	31.2	--
CCT3T2-01	J3786	J-CCT3-05	752	Irregular Channel	1.8%	143.50	130.00	163.5	150.0	145.4	133.6	145.4	133.8		67.6	72.7	--
CCT3T3-01	J5386	J-CCT3-06	411	Irregular Channel	2.9%	150.00	138.00	170.0	148.0	150.8	139.9	150.8	140.0		13.7	14.2	--
HWY240_1	J-CCT3-05	J-CCT3-04	195	Irregular Channel	1.0%	130.00	128.00	150.0	148.0	133.6	130.1	133.8	130.2		158.5	177.3	--
STGM1012	STMF088	STMF089	181	15'' DIA	2.3%	204.24	200.13	209.7	205.3	205.0	200.9	205.0	200.9	10.1	6.3	6.4	--
STGM1017	STMG1029	STMG1028	201	36'' DIA	2.9%	190.30	184.50	194.4	194.6	195.6	195.5	199.2	199.0	115.6	19.0	22.5	Existing 10-yr
STGM1021	STMG078	STMG0851	129	18'' DIA	3.3%	242.40	238.10	247.2	242.8	243.4	242.9	243.6	243.2	19.9	7.2	7.4	--
STGM1039	STMG1245	STMG128	279	12'' DIA	0.5%	166.00	164.50	174.1	172.6	204.1	200.8	204.1	200.8	2.6	5.6	5.6	Existing 10-yr
STGM104	STMG0766	STMG0750	204	12'' DIA	8.1%	300.47	284.09	305.8	290.0	300.7	284.6	300.7	284.6	10.2	1.1	1.2	--
STGM1067	STMG0712	STMG0732	159	12'' DIA	3.2%	256.00	250.90	261.6	255.1	256.5	251.4	256.5	251.4	6.6	3.2	3.2	--
STGM1085	STMG1317	STMG1316	292	12'' DIA	2.8%	167.41	162.00	171.9	169.4	197.7	195.7	197.7	195.7	6.0	4.4	4.4	Existing 10-yr
STGM1091	STMF0845	STMF0844	260	12'' DIA	1.9%	197.68	192.85	201.8	196.7	198.2	196.7	198.2	196.7	5.0	2.5	2.5	--
STGM1093	STMG1310	STMG1312	262	15'' DIA	0.5%	164.50	163.10	169.9	169.4	191.9	190.0	191.9	190.0	4.7	7.1	7.1	Existing 10-yr
STGM1136	J4060	OF_J5408	313	12'' DIA	0.8%	153.98	151.48	163.0	158.3	154.9	152.3	154.9	152.3	3.2	3.3	3.4	--
STGM1139	STMF0832	STMF0831	225	12'' DIA	1.4%	203.44	200.29	210.0	206.6	204.1	201.6	204.1	201.6	4.4	3.0	3.0	--
STGM1148	STMG0718	STMG0715	113	12'' DIA	2.4%	256.68	254.03	270.1	260.1	260.0	254.8	260.2	254.8	5.7	6.7	6.7	--
STGM1156	STMG1413	STMG1414	317	18'' DIA	0.3%	162.00	161.00	170.3	168.8	163.0	161.4	163.0	161.4	5.9	4.6	4.6	--
STGM118	J3990	J-CCT3-16	123	1' H, 1'BW, 1 SS Channel	6.3%	182.00	174.28	187.0	179.1	182.3	175.5	182.3	175.5	12.1	1.2	1.6	--
STGM1182	STMF107	J4040	266	15'' DIA	1.8%	177.24	172.53	182.2	177.5	183.0	173.5	183.6	173.6	8.6	12.1	12.5	Existing 10-yr
STGM1192	STMF1011	STMF1012	29	33'' DIA	4.8%	150.89	149.35	166.6	166.1	152.2	150.7	152.3	150.8	116.2	54.6	57.9	--
STGM1212	J3692	J3694	60	18'' DIA	0.8%	185.00	184.50	191.9	187.4	187.6	186.5	188.3	186.6	9.6	14.4	15.3	--
STGM1223	STMG103	STMG101	152	12'' DIA	3.8%	194.51	188.80	205.6	200.0	195.2	189.9	195.2	189.9	7.0	5.7	5.9	--
STGM1234	J4400	J3514	87	12'' DIA	3.1%	227.50	224.80	230.9	227.3	233.0	228.3	233.2	228.5	6.5	9.1	9.1	Existing 10-yr
STGM1242	J5474	J3708	207	Irregular Channel	1.0%	187.00	185.00	191.8	190.0	188.5	188.3	188.8	188.7		33.6	38.1	--
STGM1249	STIF1138	J-CCT3-04	352	12'' DIA	0.9%	168.00	128.00	171.8	148.0	168.7	130.1	168.8	130.2	3.3	3.0	3.1	--
STGM1261	STMG0772	J3780	34	15'' DIA	3.5%	244.30	243.10	247.5	246.5	253.4	248.1	255.3	249.2	12.2	27.9	30.4	Existing 10-yr
STGM1273	J-CCT3-11	J-CCT3-10	67	42'' DIA	0.6%	160.41	160.00	169.0	170.0	163.2	162.0	163.6	162.2	42.5	66.8	78.0	--
STGM1276	STMF0814	STMF0815	163	12'' DIA	0.3%	205.00	204.50	211.0	212.1	205.5	204.9	205.5	204.9	2.0	1.0	1.0	--
STGM1303	STMF083	STMF086	437	24'' DIA	1.6%	218.19	211.36	225.5	217.3	219.1	212.4	219.1	212.4	28.6	12.6	12.7	--
STGM1309	STMG0811	STMG081	426	12'' DIA	1.6%	210.91	204.25	215.9	210.0	216.2	216.0	216.8	216.6	4.4	2.8	2.8	Existing 10-yr
STGM1325	STMG077	STMG0831	274	18'' DIA	1.1%	241.00	238.07	246.6	243.1	242.2	243.1	242.3	243.1	11.3	10.1	10.2	--
STGM1326	STMG0935	STMG0936	75	24'' DIA	1.5%	211.30	210.16	221.5	221.0	217.5	217.0	222.7	221.9	29.3	20.8	25.2	Future 10-yr
STGM1327	STIF132	STIF131	60	15'' DIA	0.2%	151.50	151.40	157.4	157.4	152.2	151.7	152.2	151.7	2.6	3.0	3.3	--
STGM1333	STMG135	STMG134	261	12'' DIA	0.3%	159.50	158.70	170.2	169.4	193.9	192.6	194.0	192.6	2.0	3.9	3.9	Existing 10-yr
STGM1335	J3694	J4318	354	Irregular Channel	1.1%	184.50	180.00	187.4	183.0	186.5	182.1	186.6	183.0		46.8	52.4	--
STGM1339	STMG1326	J4142	231	12'' DIA	3.5%	158.10	150.00	165.6	155.7	163.6	150.6	164.3	150.6	6.7	7.8	8.0	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM1340	J4946	J4948	19	18'' DIA	0.5%	171.50	171.40	173.5	173.8	172.8	172.0	172.8	172.0	7.6	10.0	10.1	--
STGM1342	J3780	STIG0710	192	Irregular Channel	2.0%	243.10	239.30	246.5	243.0	248.1	247.6	249.2	248.7		29.3	30.2	Existing 10-yr
STGM1356	STMG0859	STMG0858	97	15'' DIA	0.9%	245.36	244.49	250.6	250.3	246.5	245.6	248.5	247.4	6.4	7.1	7.1	--
STGM1370	STMG0744	STMG0742	156	12'' DIA	3.6%	262.97	257.32	268.2	262.5	263.3	262.5	263.4	262.5	7.1	1.9	2.1	--
STGM1372	STMG0860	STMG0859	218	15'' DIA	2.3%	250.40	245.36	256.1	250.6	251.2	246.5	251.2	248.5	10.2	7.1	7.1	--
STGM1380	STMG0850	STMG0829	185	36'' DIA	0.7%	229.13	227.89	237.3	235.1	238.1	237.4	238.3	237.7	54.6	40.9	41.1	Existing 10-yr
STGM1384	STIG0778	STMG0751	174	12'' DIA	2.2%	290.53	286.67	297.0	289.9	290.9	287.0	290.9	287.0	5.5	1.3	1.3	--
STGM140	STMG1036	STIG09106	446	21'' DIA	1.1%	201.00	196.30	204.9	198.4	201.8	197.1	202.0	199.4	17.0	6.8	10.0	--
STGM1417	J3700	J-CCT1-03	114	Irregular Channel	19.7%	140.00	112.00	152.0	162.0	140.4	113.3	140.4	113.4		3.6	3.6	--
STGM1431	J4938	STIF109	413	24'' DIA	0.7%	184.00	181.10	195.8	190.6	195.4	191.8	197.7	194.2	19.0	18.3	21.1	Future 10-yr
STGM1435	STMG0729	STMG075	323	24'' DIA	0.8%	232.43	229.78	242.9	234.3	234.9	231.3	235.4	231.3	20.6	23.2	24.4	--
STGM1455	STMG0831	STMG0850	270	18'' DIA	3.3%	238.07	229.13	243.1	237.3	243.1	238.1	243.1	238.3	19.8	10.1	10.2	--
STGM1483	STMG094	STMG0913	231	12'' DIA	0.7%	204.63	203.01	209.1	207.9	210.7	208.2	210.9	208.4	3.0	3.9	4.0	Existing 10-yr
STGM1485	STMF0910	STMF103	335	12'' DIA	1.5%	186.00	181.00	191.0	190.5	192.8	190.3	194.6	192.3	4.4	3.5	3.2	Existing 10-yr
STGM149	STMF0716	STMF0713	227	21'' DIA	1.5%	207.75	204.26	213.2	207.9	208.7	205.2	208.7	205.2	19.7	11.4	11.4	--
STGM1492	STMF089	STMF0824	60	18'' DIA	1.5%	200.13	199.23	205.3	204.5	200.9	200.0	200.9	200.0	13.5	6.3	6.4	--
STGM1494	STMF094	STMF093	110	36'' DIA	0.8%	189.97	189.10	200.2	198.1	191.1	190.3	191.2	190.3	60.3	19.0	19.2	--
STGM1500	STIG0890	STMG0845	14	18'' DIA	0.2%	219.93	219.90	226.2	225.8	227.4	227.3	227.6	227.5	4.9	15.6	15.5	Existing 10-yr
STGM1524	STMF0932	STMF091	155	36'' DIA	0.7%	185.81	184.65	193.0	190.4	187.3	185.7	187.3	185.8	57.9	27.2	27.9	--
STGM1532	J3664	J3666	375	Irregular Channel	0.1%	200.30	200.00	205.2	203.9	216.0	216.0	216.5	216.5		38.2	38.2	Existing 10-yr
STGM1534	STMF078	STMG0718	121	12'' DIA	1.8%	258.86	256.68	262.9	270.1	262.9	260.0	262.9	260.2	5.0	6.7	6.7	--
STGM1540	STMF0825	STMF0826	490	18'' DIA	1.3%	198.00	191.54	202.9	199.3	198.8	195.2	198.8	195.6	12.4	6.3	6.4	--
STGM1544	STMG0835	STMG0836	164	33'' DIA	1.4%	212.96	210.60	218.4	215.4	214.4	212.3	214.4	212.3	63.0	33.4	34.4	--
STGM1548	STMG084	STMG083	161	15'' DIA	0.6%	209.23	208.26	215.2	214.8	217.9	217.9	218.3	218.3	5.0	1.7	1.7	Existing 10-yr
STGM156	STMG147	STIG1416	8	12'' DIA	171.4%	128.19	121.28	143.8	144.1	128.4	124.8	128.5	125.0	44.3	4.4	7.0	--
STGM1563	STMG128	STMG1316	719	18'' DIA	0.3%	164.50	162.00	172.6	169.4	200.8	195.7	200.8	195.7	6.2	12.1	12.1	Existing 10-yr
STGM1576	STMF0843	STMF0842	196	12'' DIA	0.6%	191.98	190.80	195.5	196.4	195.5	193.3	195.5	193.4	2.9	2.5	2.5	--
STGM1601	STMF1217	STMF1218	228	18'' DIA	2.9%	175.00	168.49	183.8	176.9	175.6	169.1	175.6	169.1	17.8	6.2	6.2	--
STGM1602	STMG071	STMG072	247	18'' DIA	1.3%	226.07	222.75	230.4	225.9	227.0	224.0	227.0	224.0	12.2	8.8	8.9	--
STGM1604	STMF074	STMF0810	478	36'' DIA	0.5%	199.28	196.84	202.6	201.4	201.5	198.6	201.7	198.8	47.8	45.0	48.8	--
STGM1606	STMG1412	STMG136	220	18'' DIA	1.7%	158.80	155.05	168.7	163.8	160.0	155.7	160.0	155.7	13.7	12.1	12.2	--
STGM1615	STMF1227	STMF1226	53	36'' DIA	1.2%	158.04	157.40	166.0	165.5	159.3	158.7	159.3	158.7	74.2	26.7	26.7	--
STGM163	J4948	OF_J4952	68	Irregular Channel	2.8%	171.40	169.50	173.8	171.5	172.0	170.0	172.0	170.0		12.0	12.0	--
STGM1631	STMF0826	STMF0811	108	36'' DIA	0.2%	191.54	191.30	199.3	199.9	195.2	194.5	195.6	194.7	31.5	56.0	59.8	--
STGM1638	J4526	STMG0864	43	12'' DIA	7.4%	229.40	226.19	230.9	231.2	235.0	234.6	235.2	234.9	10.0	3.8	3.8	Existing 10-yr
STGM1641	J4120	J3728	173	Irregular Channel	2.0%	199.00	195.50	203.0	202.3	202.1	202.0	202.2	202.2		51.4	52.3	--
STGM1645	J4634	J3932	39	12'' DIA	6.7%	162.60	160.00	166.5	165.0	163.1	160.7	163.2	160.7	9.6	5.4	6.2	--
STGM1656	STMG1321	STMG1319	250	10'' DIA	0.5%	165.57	164.32	171.9	169.5	189.2	181.3	190.3	182.5	1.6	4.7	4.6	Existing 10-yr
STGM166	STMG0845	STMG0846	88	24'' DIA	0.5%	219.90	219.50	225.8	228.6	227.3	224.7	227.5	224.9	15.2	41.2	41.1	Existing 10-yr
STGM1663	STMF0926	J-CCT3-18	23	36'' DIA	3.5%	180.78	180.00	185.8	185.0	181.9	181.2	181.9	181.2	125.0	33.9	34.9	--
STGM1672	STMG0727	STMG0729	114	27'' DIA	2.0%	234.70	232.43	238.6	242.9	235.9	234.9	236.1	235.4	43.8	23.0	24.4	--
STGM1679	STIF137	J4500	273	12'' DIA	1.5%	150.10	146.00	158.8	152.1	150.7	146.3	150.7	146.3	4.4	2.2	2.4	--
STGM1702	STMF0831	STMF0830	276	12'' DIA	0.4%	200.29	199.12	206.6	203.4	201.6	200.0	201.6	200.0	2.4	3.0	3.0	--
STGM171	STMG102	STMG103	310	12'' DIA	1.7%	199.76	194.51	210.1	205.6	210.1	195.2	210.1	195.2	4.6	5.7	5.9	--
STGM1718	STIF0876	STIF0875	154	12'' DIA	0.7%	191.96	190.90	195.5	194.3	192.7	191.3	192.7	191.3	3.1	2.6	2.6	--
STGM1727	STMF0821	STMF0813	19	24'' DIA	7.4%	205.66	204.29	212.5	212.5	206.5	205.9	206.5	205.9	61.2	16.5	16.7	--
STGM173	STMG0916	STMG0917	154	12'' DIA	0.9%	191.69	190.30	198.8	197.6	192.4	190.9	192.4	190.9	3.4	2.7	2.8	--
STGM1740	STMG143	STMG145	183	12'' DIA	0.4%	160.47	159.65	167.0	166.4	161.6	160.4	161.7	160.4	2.4	2.8	3.0	--
STGM1741	STMF0824	STMF0825	108	18'' DIA	1.1%	199.23	198.00	204.5	202.9	200.0	198.8	200.0	198.8	11.7	6.3	6.4	--
STGM1769	STMG133	STMG132	300	18'' DIA	0.1%	157.92	157.50	167.3	165.5	191.3	180.7	191.3	180.7	3.9	20.8	20.8	Existing 10-yr
STGM1778	STMG0731	STMG0730	134	12'' DIA	4.2%	268.21	262.62	273.7	266.8	268.5	263.3	268.5	263.3	7.7	1.5	1.5	--
STGM1799	STMG097	STMG0910	200	24'' DIA	0.9%	204.55	202.75	212.8	215.7	210.2	204.3	212.4	204.4	11.6	20.8	24.6	--
STGM18	J4040	STMF102	127	18'' DIA	2.0%	172.53	169.96	177.5	175.0	173.5	171.4	173.6	171.4	14.9	11.9	12.3	--
STGM1815	STMG085	STMG084	217	15'' DIA	0.8%	211.01	209.23	216.5	215.2	218.0	217.9	218.3	218.3	5.9	1.6	1.7	Existing 10-yr
STGM1828	STMG0714	STMG0713	261	12'' DIA	5.9%	295.85	280.50	300.4	284.9	296.3	280.8	296.3	280.8	9.1	3.2	3.2	--
STGM1830	STIF1290	STMF126	13	8'' DIA	12.0%	167.61	166.02	170.7	170.4	168.0	166.7	168.0	166.7	4.2	2.9	2.9	--
STGM1831	J4058	J4060	128	12'' DIA	0.8%	155.00	153.98	162.3	163.0	155.9	154.9	155.9	154.9	3.2	3.3	3.4	--
STGM1834	J5472	J5474	63	33'' DIA	0.8%	187.50	187.00	192.4	191.8	189.2	188.5	189.4	188.8	46.7	33.6	38.1	--
STGM1838	STMG0717	J3540	151	12'' DIA	6.3%	249.02	239.50	252.1	242.8	249.8	240.4	249.8	240.4	9.0	8.8	8.9	--
STGM1854	J4298	J3514	252	Irregular Channel	0.0%	224.90	224.80	227.9	227.3	228.3	228.3	228.5	228.5		5.4	5.8	Existing 10-yr
STGM1858	STMF1022	J-CCT3-08	145	15'' DIA	5.7%	160.25	148.00	171.4	158.0	160.5	150.0	160.5	150.1	16.3	1.1	1.1	--
STGM186	STMG0813	STMG0812	145	33'' DIA	2.4%	204.50	201.10	210.7	210.0	217.1	216.1	217.4	216.7	43.9	48.7	48.6	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM1861	STMF097	STMF0926	435	15'' DIA	1.4%	190.32	180.78	196.5	185.8	191.0	181.9	191.0	181.9	8.0	4.0	4.3	--
STGM1868	STMG0742	STMG0768	300	12'' DIA	2.6%	257.32	249.66	262.5	253.5	262.5	259.4	262.5	260.9	6.0	1.9	2.1	--
STGM1872	STMG1232	STMG1218	543	12'' DIA	0.7%	165.59	161.72	172.2	168.3	175.2	173.7	175.2	173.7	3.0	2.8	2.8	Existing 10-yr
STGM1876	J7	J5554	294	12'' DIA	2.6%	172.43	164.69	175.3	170.5	175.4	165.2	175.4	165.2	5.8	11.9	11.9	Existing 10-yr
STGM1879	STMG1218	STMF135	635	18'' DIA	2.6%	161.72	145.00	168.3	161.6	173.7	146.1	173.7	146.1	17.0	21.8	21.8	Existing 10-yr
STGM1882	STIG1416	J-CCT1-04	42	24'' DIA	0.7%	121.28	121.00	144.1	160.0	124.8	122.6	125.0	122.6	18.5	50.1	52.1	--
STGM1885	STMF0812	J3760	35	36'' DIA	10.8%	189.70	185.90	195.7	192.5	190.9	189.7	191.0	189.8	216.7	58.5	63.6	--
STGM1895	STMG0864	J4400	28	12'' DIA	-4.6%	226.19	227.50	231.2	230.9	234.6	233.0	234.9	233.2	8.0	9.2	9.3	Existing 10-yr
STGM1902	STMF103	J4362	216	18'' DIA	0.8%	181.00	179.30	190.5	185.4	190.3	180.3	192.3	180.4	9.3	21.3	23.6	Future 10-yr
STGM1922	STMG0724	STMG076	138	18'' DIA	1.1%	228.95	227.40	233.0	231.5	229.6	227.7	229.6	227.7	11.0	3.5	3.6	--
STGM1942	STMF0713	STMF076	281	27'' DIA	1.1%	204.26	201.20	207.9	205.0	205.2	202.2	205.2	202.2	32.6	11.4	11.4	--
STGM1952	STMG075	STMG074	129	24'' DIA	1.3%	229.78	228.10	234.3	233.7	231.3	229.5	231.3	229.5	25.9	23.0	24.4	--
STGM1959	J5064	J3530	53	18'' DIA	1.0%	217.53	217.00	219.0	219.0	218.4	217.5	218.7	217.7	10.4	6.8	10.1	--
STGM196	STIF0867	STIF0876	176	12'' DIA	0.6%	193.06	191.96	196.9	195.5	193.8	192.7	193.8	192.7	2.9	2.6	2.6	--
STGM1964	J4142	J-CCT2-06	266	Irregular Channel	6.2%	150.00	133.50	155.7	158.5	150.6	134.7	150.6	134.7		7.8	8.0	--
STGM1971	STMG138	STMG1411	284	12'' DIA	1.5%	159.96	155.62	168.3	163.9	160.8	156.1	160.8	156.1	4.4	3.9	4.1	--
STGM1972	STMF0929	STMF097	35	12'' DIA	6.0%	192.41	190.32	196.7	196.5	192.7	191.0	192.7	191.0	8.9	1.3	1.5	--
STGM1993	STMF073	STMF071	102	18'' DIA	1.2%	221.91	220.65	224.4	225.8	222.9	222.3	223.0	222.3	11.6	8.8	8.9	--
STGM200	J4770	STIG1016	90	18'' DIA	0.4%	185.50	185.10	191.7	190.8	188.3	187.8	190.5	188.4	7.0	6.9	7.5	--
STGM2013	STMG0852	STMG0830	242	27'' DIA	1.0%	234.17	231.75	239.1	238.0	241.6	240.3	241.8	240.5	32.0	24.1	24.2	Existing 10-yr
STGM2016	STMF0815	STMF0816	263	12'' DIA	0.5%	204.50	203.09	212.1	208.7	204.9	203.6	204.9	203.6	2.7	1.0	1.0	--
STGM2021-A	J4898	J5576	466	Irregular Channel	1.0%	172.38	167.50	180.5	172.0	174.3	169.1	174.3	169.1		47.8	50.9	--
STGM2021-B	J5576	J5034	464	Irregular Channel	2.6%	167.50	154.93	172.0	166.7	169.1	157.5	169.1	157.9		54.7	58.1	--
STGM2046	J4632	J4634	252	Irregular Channel	0.4%	163.50	162.60	166.2	166.5	164.3	163.1	164.4	163.2		5.4	6.2	--
STGM2055	STMG146	J5354	65	15'' DIA	6.1%	157.00	153.00	163.5	163.0	157.4	153.4	157.4	153.5	15.9	4.0	4.3	--
STGM2057	STMG1322	STMG1323	59	18'' DIA	0.2%	157.40	157.30	165.5	165.4	178.0	175.9	178.0	175.9	4.3	19.7	19.7	Existing 10-yr
STGM2064	STMG0818	J4298	254	18'' DIA	0.2%	225.36	224.90	228.6	227.9	228.7	228.3	228.9	228.5	4.5	5.4	5.8	Existing 10-yr
STGM2078	STMG074	STMG073	160	27'' DIA	1.2%	228.10	226.20	233.7	231.3	229.5	227.6	229.5	227.6	33.9	23.0	24.4	--
STGM2082	STMG0833	STMG0832	259	18'' DIA	2.5%	247.00	240.50	252.5	245.3	247.9	245.3	247.9	245.3	17.5	10.3	10.5	--
STGM2095	J4818	J5398	137	18'' DIA	0.7%	176.00	175.00	188.5	183.8	178.9	175.7	179.1	175.7	9.0	12.0	12.0	--
STGM2101	STMG096	STMG0914	79	12'' DIA	2.1%	202.94	201.30	210.5	208.5	216.0	216.0	216.6	216.6	5.1	2.9	2.9	Existing 10-yr
STGM2108	STIG1024	STIG1031	130	12'' DIA	0.0%	187.02	187.00	189.4	190.4	194.7	192.1	196.6	193.8	0.4	5.1	5.4	Existing 10-yr
STGM2135	STMG0767	STMG0747	146	15'' DIA	3.0%	265.52	261.20	270.7	265.5	266.2	261.8	266.2	261.8	11.6	6.0	6.2	--
STGM2147	J4362	J-CCT3-14	213	Irregular Channel	3.9%	179.30	171.10	185.4	176.5	180.3	172.7	180.4	172.8		21.3	23.5	--
STGM2160	J3708	J3694	410	33'' DIA	0.1%	185.00	184.50	190.0	187.4	188.3	186.5	188.7	186.6	18.4	33.6	37.8	--
STGM2165	STMF0915	STMF0916	66	15'' DIA	0.7%	192.18	191.75	205.6	207.3	192.9	192.3	192.9	192.3	5.4	3.3	3.3	--
STGM2167	STMF0829	STMF0827	26	15'' DIA	1.2%	198.35	198.03	201.9	201.5	199.1	198.5	199.1	198.6	7.4	4.8	4.8	--
STGM2210	J3530	STMG1036	314	18'' DIA	5.1%	217.00	201.00	219.0	204.9	217.5	201.8	217.7	202.0	25.1	6.8	10.0	--
STGM2213	STMG0853	STMG0864	213	18'' DIA	-0.8%	224.49	226.19	229.1	231.2	235.2	234.6	235.5	234.9	9.8	5.8	5.9	Existing 10-yr
STGM2219	STIF1135	STIF1138	58	12'' DIA	0.5%	168.60	168.00	173.0	171.8	169.5	168.7	169.5	168.8	2.6	3.0	3.1	--
STGM2237	STMF084	STMF083	223	21'' DIA	0.2%	218.62	218.19	225.3	225.5	220.9	219.1	221.0	219.1	7.0	12.6	12.7	--
STGM2269	STMG0865	STMG0852	21	18'' DIA	4.2%	235.06	234.17	239.5	239.1	241.7	241.6	241.9	241.8	22.2	7.0	7.1	Existing 10-yr
STGM2271	STMG0822	STMG089	262	27'' DIA	1.0%	224.48	221.73	229.2	226.5	226.0	223.4	226.0	223.4	31.9	24.9	26.2	--
STGM2277	STMF0911	STMF0910	191	12'' DIA	0.5%	186.90	186.00	194.2	191.0	194.4	192.8	195.9	194.6	2.4	3.4	3.3	Existing 10-yr
STGM2280	STMG1023	STMG1024	237	15'' DIA	0.6%	182.09	180.74	187.1	186.8	182.9	182.6	185.5	183.5	5.1	2.9	3.0	--
STGM2281	STMG095	STMG094	311	12'' DIA	-0.1%	204.18	204.63	209.3	209.1	214.3	210.7	214.6	210.9	1.4	4.0	4.1	Existing 10-yr
STGM2290	STMG0776	STMG0777	132	36'' DIA	2.2%	248.31	245.36	256.2	250.9	265.9	265.9	269.3	269.2	102.3	11.5	12.1	Existing 10-yr
STGM2311	STMG0851	STMG0852	262	24'' DIA	1.5%	238.10	234.17	242.8	239.1	242.9	241.6	243.2	241.8	29.0	17.5	17.7	Existing 10-yr
STGM2358	STMG0814	STMG087	290	12'' DIA	1.4%	218.02	213.97	221.3	217.3	218.8	217.5	218.8	217.8	4.2	2.7	2.7	--
STGM2371	STMF0816	J4120	160	15'' DIA	2.6%	203.09	199.00	208.7	203.0	203.6	202.1	203.6	202.2	10.8	3.9	3.9	--
STGM2383	STMF0924	J3838	131	18'' DIA	1.0%	183.64	182.30	193.3	191.2	184.8	183.1	184.8	183.1	11.1	10.0	10.2	--
STGM2390	J4888	J-CCT2-04	85	12'' DIA	25.4%	144.00	123.00	146.0	173.0	144.3	124.1	144.3	124.1	18.1	3.8	3.9	--
STGM2405	STMG0749	STMG0767	239	15'' DIA	4.5%	276.33	265.52	282.8	270.7	276.9	266.2	276.9	266.2	14.3	6.0	6.2	--
STGM2406	J5304	STMF116	225	12'' DIA	0.4%	174.00	173.10	182.4	179.5	194.4	190.1	194.5	190.2	2.3	5.4	5.5	Existing 10-yr
STGM2407	STMG089	STMG0820	199	33'' DIA	0.6%	221.73	220.62	226.5	225.4	223.4	221.7	223.4	221.7	39.3	26.3	27.6	--
STGM2430	STMG1219	STMG1218	82	18'' DIA	0.6%	162.20	161.72	169.2	168.3	176.5	173.7	176.5	173.7	8.0	20.4	20.4	Existing 10-yr
STGM2438	STMF0842	STMF0812	142	36'' DIA	0.8%	190.80	189.70	196.4	195.7	193.3	190.9	193.4	191.0	58.5	58.5	62.3	--
STGM244	STMF0811	STMF0842	161	36'' DIA	0.3%	191.30	190.80	199.9	196.4	194.5	193.3	194.7	193.4	37.1	56.0	59.8	--
STGM2443	J4482	J4898	168	24'' DIA	2.4%	176.38	172.38	180.8	180.5	181.8	174.3	182.9	174.3	34.9	51.2	55.2	Existing 10-yr
STGM245	J3516	STIG0894	33	Irregular Channel	3.3%	224.36	223.30	227.2	226.8	227.9	227.9	228.1	228.1		15.2	14.5	Existing 10-yr
STGM2457	STMG0827	STMG0845	271	24'' DIA	0.6%	221.54	219.90	231.5	225.8	232.8	227.3	233.1	227.5	17.4	33.1	33.2	Existing 10-yr
STGM2463	STMF0927	J3990	133	12'' DIA	0.5%	182.71	182.00	188.5	187.0	183.2	182.3	183.3	182.3	2.7	1.2	1.6	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM2468	STMG0847	J4526	120	12'' DIA	0.5%	229.97	229.40	233.3	230.9	236.1	235.0	236.3	235.2	2.6	4.0	4.0	Existing 10-yr
STGM2486	STMG098	STMG097	102	18'' DIA	0.8%	205.33	204.55	214.9	212.8	214.2	210.2	218.0	212.4	9.2	20.8	24.7	Future 10-yr
STGM2489	STMG0821	STMG0822	63	33'' DIA	0.5%	224.82	224.48	229.7	229.2	226.4	226.0	226.5	226.0	38.8	24.9	26.2	--
STGM2499	J3728	J3730	26	18'' DIA	2.7%	195.50	194.80	202.3	202.4	202.0	196.6	202.2	196.6	17.4	48.3	48.9	--
STGM2506	J2	STIG1022	135	12'' DIA	0.3%	188.89	188.47	193.9	191.4	204.1	201.1	207.4	203.9	2.0	6.2	6.7	Existing 10-yr
STGM252	STMG0710	STMG079	94	18'' DIA	2.7%	247.10	244.55	248.1	252.0	247.8	245.3	247.8	245.3	18.1	7.2	7.4	--
STGM2536	STMF117	J5422	122	18'' DIA	0.1%	167.22	167.05	170.0	168.8	168.5	167.7	168.5	167.7	3.9	7.6	7.6	--
STGM2549	STMG0720	STMG0711	152	12'' DIA	4.2%	256.47	250.10	261.2	254.9	257.3	250.9	257.3	251.0	7.6	7.2	7.4	--
STGM2556	STMF0810	STMF0826	392	36'' DIA	1.4%	196.84	191.54	201.4	199.3	198.6	195.2	198.8	195.6	77.6	49.7	53.5	--
STGM2591	STIG0777	STIG0778	30	10'' DIA	0.6%	290.71	290.53	296.5	297.0	291.2	290.9	291.2	290.9	1.8	1.2	1.3	--
STGM2595	STMG0747	STMG0771	18	15'' DIA	3.3%	261.20	260.62	265.5	265.4	261.8	261.3	261.8	261.3	12.3	6.0	6.2	--
STGM2596	STMG099	STMG1021	837	33'' DIA	1.1%	201.50	192.00	208.6	202.6	202.8	193.7	202.9	193.9	56.4	24.8	29.1	--
STGM2605	STMG121	STMG1226	321	12'' DIA	0.6%	167.00	165.13	172.7	171.9	208.7	184.6	208.6	184.5	2.7	10.6	10.6	Existing 10-yr
STGM2635	STIF1287	STIF129	206	12'' DIA	1.0%	171.84	169.71	174.6	172.8	211.2	209.8	211.2	209.8	3.6	4.6	4.6	Existing 10-yr
STGM2656	STMF0922	STMF0923	166	18'' DIA	0.9%	188.07	186.61	199.2	197.6	189.3	187.8	189.3	187.8	10.2	10.0	10.2	--
STGM2669	STMF0720	STMF0833	216	12'' DIA	0.8%	202.21	200.47	204.2	202.5	202.7	201.0	202.7	201.0	3.4	1.8	1.8	--
STGM2676	STMG1210	STMG1232	248	12'' DIA	0.6%	167.05	165.59	173.7	172.2	175.9	175.2	175.9	175.2	2.7	2.8	2.8	Existing 10-yr
STGM2681	STMG0722	STMG077	137	12'' DIA	1.1%	242.48	241.00	248.2	246.6	247.0	242.2	247.0	242.3	3.8	5.5	5.7	--
STGM2686	STMF113	STMF1012	137	33'' DIA	5.1%	160.38	149.35	168.7	166.1	161.0	150.7	161.0	150.8	125.6	11.3	12.5	--
STGM2687	STMG1227	STMG1219	279	18'' DIA	0.6%	163.82	162.20	170.6	169.2	182.7	176.5	182.6	176.5	8.0	16.3	16.3	Existing 10-yr
STGM2689b	J5554	STMF1220	53	24'' DIA	7.7%	164.69	160.62	170.5	172.3	165.2	161.5	165.2	161.5	64.5	9.7	9.7	--
STGM2690	STMG0725	STMG0724	66	12'' DIA	2.2%	230.43	228.95	233.8	233.0	231.0	229.6	231.0	229.6	5.4	3.5	3.6	--
STGM2693	STMF134	J4894	171	12'' DIA	1.5%	146.60	144.10	152.3	150.5	151.3	144.4	152.3	144.4	4.3	4.8	5.0	--
STGM2699	STMF0813	STIF0817	243	36'' DIA	1.7%	204.29	200.10	212.5	207.3	205.9	202.1	205.9	202.3	87.4	49.9	51.2	--
STGM2705	STIF1132	STIF1133	73	12'' DIA	0.7%	172.10	171.50	177.9	175.3	172.9	172.2	172.9	172.2	2.9	3.0	3.1	--
STGM2710	J5034	STMF1010	137	33'' DIA	0.8%	154.93	153.57	166.7	166.9	157.5	155.1	157.9	155.2	48.8	54.7	58.1	--
STGM2711	STMG0738	STMG0735	143	12'' DIA	1.1%	245.09	243.49	250.3	249.5	250.4	248.1	251.1	249.5	3.9	5.5	5.7	Existing 10-yr
STGM272	STMF0844	STMF0843	164	12'' DIA	0.5%	192.85	191.98	196.7	195.5	196.7	195.5	196.7	195.5	2.7	2.5	2.5	--
STGM2735	STMF1220	STMF1221	94	36'' DIA	1.5%	160.62	159.23	172.3	166.8	161.5	160.5	161.5	160.5	79.4	15.9	15.9	--
STGM2737	STMG1022	STMG1023	220	15'' DIA	0.6%	183.41	182.09	188.6	187.1	184.1	182.9	184.1	185.5	5.2	2.9	3.0	--
STGM275	STMF075	STMF074	155	36'' DIA	0.6%	200.16	199.28	203.5	202.6	201.5	201.5	201.7	201.7	50.3	11.4	11.4	--
STGM2759	STMG0832	STMG0851	250	21'' DIA	1.0%	240.50	238.10	245.3	242.8	245.3	242.9	245.3	243.2	15.6	10.3	10.4	--
STGM276	STMG0828	STMG0827	120	24'' DIA	0.8%	222.44	221.54	232.2	231.5	235.4	232.8	235.6	233.1	19.6	33.2	33.3	Existing 10-yr
STGM2761	STIF1262	OF_J3682	296	12'' DIA	19.3%	145.18	93.00	154.2	123.8	149.6	93.6	149.6	93.6	15.7	10.4	10.4	--
STGM2763	STMG081	STMG096	106	12'' DIA	1.2%	204.25	202.94	210.0	210.5	216.0	216.0	216.6	216.6	4.0	3.0	2.9	Existing 10-yr
STGM277	STMG0853	STMG0825	91	18'' DIA	1.7%	224.49	222.92	229.1	229.9	235.2	235.5	235.5	235.7	14.4	5.8	5.9	Existing 10-yr
STGM2776	STMG1316	STMG133	357	18'' DIA	1.1%	162.00	157.92	169.4	167.3	195.7	191.3	195.7	191.3	11.2	13.2	13.2	Existing 10-yr
STGM2786	J4402	STMF109	199	12'' DIA	0.6%	182.41	181.25	190.8	186.3	189.3	186.3	188.7	186.3	2.7	3.6	3.7	--
STGM2791	STMG0765	STMG0762	247	12'' DIA	0.5%	340.04	338.85	345.6	344.1	340.6	339.1	340.6	339.1	2.5	1.2	1.3	--
STGM2796	STMF0836	STMF0837	275	12'' DIA	1.8%	192.16	187.20	195.8	193.7	192.7	187.7	192.7	187.7	5.0	2.6	2.6	--
STGM2798	STMF0830	STMF0829	120	15'' DIA	0.6%	199.12	198.35	203.4	201.9	200.0	199.1	200.0	199.1	5.4	4.8	4.8	--
STGM2801	STMG0855	STMG0833	279	15'' DIA	2.2%	253.08	247.00	266.7	252.5	253.9	247.9	253.9	247.9	9.9	7.2	7.3	--
STGM2827	STMG136	J-CCT1-06	286	21'' DIA	8.8%	155.05	129.31	163.8	139.3	155.7	130.8	155.7	130.8	46.5	12.1	12.2	--
STGM2829	STMG079	STMG078	121	18'' DIA	1.8%	244.55	242.40	252.0	247.2	245.3	243.4	245.3	243.6	14.5	7.2	7.4	--
STGM2842	STMG0819	STMG086	457	33'' DIA	1.3%	218.34	212.42	223.2	217.4	221.6	219.0	221.9	219.3	60.0	44.7	44.7	--
STGM2845	STMF0823	STMF0822	328	12'' DIA	0.3%	204.32	203.22	210.5	208.7	207.0	204.0	206.7	204.0	2.2	2.9	2.9	--
STGM2847	STMF072	STMF084	183	18'' DIA	0.9%	220.30	218.62	226.0	225.3	222.2	220.9	222.2	221.0	10.0	8.8	8.9	--
STGM2848	STMG0810	STMG089	175	15'' DIA	1.4%	224.14	221.73	227.4	226.5	224.6	223.4	224.6	223.4	7.5	2.3	2.3	--
STGM2857	STMG0771	STMG0720	133	15'' DIA	3.1%	260.62	256.47	265.4	261.2	261.3	257.3	261.3	257.3	11.3	6.0	6.2	--
STGM2903	STIG1022	STIG1023	278	12'' DIA	0.5%	188.47	187.20	191.4	189.5	201.1	195.4	203.9	197.4	2.4	5.8	6.2	Existing 10-yr
STGM2904	STMG0711	STMG0710	76	12'' DIA	3.9%	250.10	247.10	254.9	248.1	250.9	247.8	251.0	247.8	7.4	7.2	7.4	--
STGM2909	J-CCT1-05	STIG1416	88	24'' DIA	0.3%	121.50	121.28	123.4	144.1	128.1	124.8	128.4	125.0	11.3	50.2	51.2	Existing 10-yr
STGM2941	STMH071	J4972	26	12'' DIA	6.1%	269.29	268.10	275.6	274.5	270.0	268.4	270.0	268.4	8.9	1.8	1.8	--
STGM2961	STMF0913	STMF094	89	36'' DIA	0.3%	190.20	189.97	203.4	200.2	191.6	191.1	191.6	191.2	34.0	17.3	17.5	--
STGM2969	J3896	J5174	65	33'' DIA	1.1%	188.70	188.00	196.0	193.5	190.4	189.9	190.5	190.0	55.1	33.6	38.1	--
STGM2972	STIF1324	J-CCT2-02	493	12'' DIA	8.1%	140.00	100.00	149.5	109.0	140.6	101.0	140.6	101.0	10.2	6.1	6.1	--
STGM2973	STIF1133	STIF1134	98	12'' DIA	1.0%	171.50	170.40	175.3	174.7	172.2	171.1	172.2	171.1	3.6	3.0	3.1	--
STGM298	STMG0715	STMG0717	113	12'' DIA	4.4%	254.03	249.02	260.1	252.1	254.8	249.8	254.8	249.8	7.8	6.7	6.7	--
STGM2982	J3688	STMF117	467	12'' DIA	1.2%	172.98	167.22	177.1	170.0	189.6	168.5	189.6	168.5	4.0	7.9	7.9	Existing 10-yr
STGM2988	STMG0924	J5064	1248	24'' DIA	0.0%	218.00	217.53	223.8	219.0	219.5	218.4	219.5	218.7	4.4	4.1	4.5	--
STGM2992	STMG0721	STMG0720	257	12'' DIA	3.0%	264.20	256.47	270.5	261.2	264.5	257.3	264.5	257.3	6.2	1.2	1.2	--
STGM2996	STMF0837	OF_J5574	42	15'' DIA	0.9%	187.20	186.80	193.7	194.0	187.7	187.3	187.7	187.3	6.6	2.6	2.6	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM2997	STMF0925	STMF0922	297	12'' DIA	0.7%	190.26	188.07	197.5	199.2	190.7	189.3	190.7	189.3	3.1	1.1	1.2	--
STGM2999	STMG144	STMG141	261	12'' DIA	1.2%	157.50	154.32	164.0	162.3	158.3	154.9	158.3	154.9	3.9	3.6	3.6	--
STGM3000	STMG0854	STMG0819	96	27'' DIA	1.0%	219.30	218.34	224.2	223.2	223.4	221.6	223.6	221.9	30.8	44.7	44.7	--
STGM3028	STIF0877	STIF0867	159	12'' DIA	0.8%	194.40	193.06	199.1	196.9	195.1	193.8	195.1	193.8	3.4	2.6	2.6	--
STGM3029	STIG1348	STIG1349	39	12'' DIA	2.1%	162.33	161.50	167.7	168.1	173.8	172.5	175.1	173.7	5.2	6.7	7.0	Existing 10-yr
STGM3038	STMF122	STMF121	303	12'' DIA	1.0%	154.00	151.00	156.6	153.0	154.7	151.3	154.7	151.3	3.5	2.8	2.8	--
STGM3044	STMF0840	STMF0839	249	12'' DIA	-1.1%	194.68	197.51	203.5	207.1	195.3	198.2	195.3	198.2	3.9	3.3	3.3	--
STGM3052	STMG1226	STMG1227	225	18'' DIA	0.6%	165.13	163.82	171.9	170.6	184.6	182.7	184.5	182.6	8.0	9.9	9.9	Existing 10-yr
STGM3091	STMF1222	STMF1223	295	36'' DIA	1.2%	148.10	144.70	164.3	158.2	149.5	145.3	149.5	145.3	72.1	26.7	26.7	--
STGM3105	J3540	STMG071	248	12'' DIA	5.4%	239.50	226.07	242.8	230.4	240.4	227.0	240.4	227.0	8.3	8.8	8.9	--
STGM3119	STMF105	STMF106	84	12'' DIA	2.1%	172.00	170.20	182.8	178.7	172.4	170.5	172.4	170.5	5.2	1.3	1.4	--
STGM3122	STMG0932	STMG0928	232	24'' DIA	1.6%	223.75	220.00	232.5	230.8	224.5	221.6	231.3	229.4	29.4	8.3	11.4	--
STGM3132	STMF1225	STMF1222	254	36'' DIA	3.5%	156.96	148.10	165.6	164.3	157.9	149.5	157.9	149.5	127.1	26.7	26.7	--
STGM3139	J5354	J-CCT1-05	243	Irregular Channel	13.1%	153.00	121.50	163.0	123.4	153.4	128.1	153.5	128.4		4.0	4.3	--
STGM3141	STMF1023	J-CCT3-07	109	12'' DIA	9.9%	160.80	145.00	169.1	155.0	161.0	147.4	161.0	147.5	12.4	1.0	1.0	--
STGM3150	STMG1021	J3896	685	33'' DIA	0.5%	192.00	188.70	202.6	196.0	193.7	190.4	193.9	190.5	36.9	26.3	30.7	--
STGM3164	J4972	STMH077	125	12'' DIA	4.6%	268.10	262.39	274.5	267.5	268.4	262.8	268.4	262.8	8.1	1.8	1.8	--
STGM3167	STMG1411	STMG1410	227	12'' DIA	8.1%	155.62	137.22	163.9	145.7	156.1	137.5	156.1	137.5	10.1	3.9	4.1	--
STGM3173	STMG0843	STMG0835	205	33'' DIA	0.5%	214.07	212.96	219.4	218.4	215.7	214.4	215.8	214.4	38.7	26.3	27.6	--
STGM3180	J5422	STMF1221	150	Irregular Channel	5.2%	167.05	159.23	168.8	166.8	167.7	160.5	167.7	160.5		7.6	7.6	--
STGM32	STMG0817	STMG0818	123	15'' DIA	0.6%	226.04	225.36	229.1	228.6	229.4	228.7	229.7	228.9	4.8	5.5	5.9	Existing 10-yr
STGM320	STMG0713	STMG0734	124	12'' DIA	14.7%	280.50	262.50	284.9	270.8	280.8	262.9	280.8	262.9	14.4	3.2	3.2	--
STGM3203	STMG0917	STMF0932	273	12'' DIA	1.6%	190.30	185.81	197.6	193.0	190.9	187.3	190.9	187.3	4.6	2.7	2.8	--
STGM3207	STMG0825	STMG0828	47	36'' DIA	1.0%	222.92	222.44	229.9	232.2	235.5	235.4	235.7	235.6	67.8	39.1	39.3	Existing 10-yr
STGM3214	STMG086	STMG083	252	33'' DIA	1.7%	212.42	208.26	217.4	214.8	219.0	217.9	219.3	218.3	67.8	44.4	44.4	Existing 10-yr
STGM3224	STMG141	J3700	203	12'' DIA	2.1%	154.32	140.00	162.3	152.0	154.9	140.4	154.9	140.4	5.2	3.6	3.6	--
STGM3236	STMG0913	STMF092	331	12'' DIA	1.1%	203.01	199.23	207.9	203.2	208.2	206.1	208.4	206.3	3.8	3.8	3.8	Existing 10-yr
STGM3252	J3498	STMG149	242	12'' DIA	0.8%	159.00	157.06	166.5	162.2	159.6	157.6	166.5	157.7	3.2	2.3	4.3	--
STGM3264	STMG0723	STMG0730	312	12'' DIA	0.5%	264.31	262.62	268.0	266.8	264.6	263.3	264.7	263.3	2.7	0.7	0.7	--
STGM3268	STMG0848	STMG0863	130	36'' DIA	0.8%	225.02	223.96	231.3	229.5	236.3	235.8	236.5	236.1	60.7	39.7	39.9	Existing 10-yr
STGM3276	STIF109	STMF103	51	18'' DIA	0.2%	181.10	181.00	190.6	190.5	191.8	190.3	194.2	192.3	4.6	18.3	20.8	Existing 10-yr
STGM3292	STMF0822	STMF0816	55	12'' DIA	0.2%	203.22	203.09	208.7	208.7	204.0	203.6	204.0	203.6	1.8	2.9	2.9	--
STGM3293	STMG0837	STMF085	132	33'' DIA	0.5%	208.00	207.36	215.0	212.4	210.0	208.7	210.0	208.8	36.7	33.4	34.4	--
STGM3314	STMG0846	STMG0854	67	27'' DIA	0.3%	219.50	219.30	228.6	224.2	224.7	223.4	224.9	223.6	16.9	44.7	44.7	--
STGM3315	STMF082	STMG0813	255	15'' DIA	1.2%	207.57	204.50	212.1	210.7	217.1	217.1	217.5	217.4	7.1	2.7	2.8	Existing 10-yr
STGM3319	STMG0858	STMG0857	120	15'' DIA	2.3%	244.49	241.70	250.3	247.5	245.6	244.6	247.4	246.0	10.2	7.1	7.2	--
STGM3330	STIF0875	STIF0874	140	12'' DIA	2.9%	190.90	186.57	194.3	194.6	191.3	187.3	191.3	187.3	6.3	2.6	2.6	--
STGM3334	STIF131	J-CCT2-03	197	15'' DIA	23.2%	151.40	107.00	157.4	150.0	151.7	109.1	151.7	109.1	29.7	3.0	3.3	--
STGM3369	STMG1323	STMG1324	360	21'' DIA	0.1%	157.30	157.00	165.4	166.0	175.9	166.0	175.9	166.0	4.6	31.4	31.4	Existing 10-yr
STGM3379	STIG1349	STMG1325	138	12'' DIA	0.5%	161.50	160.87	168.1	166.8	172.5	167.8	173.7	168.7	2.4	6.6	6.8	Existing 10-yr
STGM3386	STMG0910	STMG099	312	33'' DIA	0.4%	202.75	201.50	215.7	208.6	204.3	202.8	204.4	202.9	33.5	20.8	24.6	--
STGM339	STMF116	J3688	32	12'' DIA	0.4%	173.10	172.98	179.5	177.1	190.1	189.6	190.2	189.6	2.2	5.0	5.1	Existing 10-yr
STGM3399	STMF109	STMF107	303	18'' DIA	1.3%	181.25	177.24	186.3	182.2	186.3	183.0	186.3	183.6	11.8	7.9	8.3	--
STGM3402	STMG0768	STMG0770	161	12'' DIA	2.4%	249.66	245.78	253.5	251.1	259.4	255.8	260.9	256.9	5.8	6.2	6.4	Existing 10-yr
STGM3411	STMH072	STMH071	271	12'' DIA	8.5%	292.30	269.29	302.0	275.6	292.6	270.0	292.6	270.0	11.1	1.8	1.8	--
STGM3426	STMG0856	STMG0865	499	18'' DIA	0.9%	239.74	235.06	247.0	239.5	243.7	241.7	244.9	241.9	10.6	7.0	7.1	--
STGM3439	STMF101	STMF1014	93	18'' DIA	2.7%	154.80	152.30	170.5	171.4	155.8	153.3	155.8	153.3	17.2	13.1	13.7	--
STGM3444	STMG145	STMG146	267	15'' DIA	1.0%	159.65	157.00	166.4	163.5	160.4	157.4	160.4	157.4	6.4	4.0	4.3	--
STGM3465	J5366	J3664	51	27'' DIA	0.2%	200.41	200.30	205.4	205.2	216.1	216.0	216.7	216.5	14.4	45.4	44.1	Existing 10-yr
STGM348	STMG0844	STMG0835	82	12'' DIA	4.3%	216.50	212.96	220.3	218.4	217.3	214.4	217.3	214.4	7.4	7.1	7.1	--
STGM3489	J-CCT3-12	J-CCT3-11	107	42'' DIA	2.3%	162.90	160.41	167.4	169.0	165.3	163.2	165.6	163.6	83.7	65.4	76.6	--
STGM3497	STMG0732	STMG0833	127	12'' DIA	3.1%	250.90	247.00	255.1	252.5	251.4	247.9	251.4	247.9	6.4	3.2	3.2	--
STGM3518	J3646	STMF113	49	21'' DIA	2.4%	161.58	160.38	173.8	168.7	162.4	161.0	162.5	161.0	24.6	11.3	12.6	--
STGM3520_1	J5398	J7	526	Irregular Channel	0.5%	175.00	172.43	183.8	175.3	175.7	175.4	175.7	175.4		12.0	12.0	--
STGM3524	STMF071	STMF072	19	18'' DIA	1.9%	220.65	220.30	225.8	226.0	222.3	222.2	222.3	222.2	14.4	8.8	8.9	--
STGM3527	STMG1025	STMG1024	231	15'' DIA	0.6%	182.10	180.74	187.5	186.8	182.7	182.6	183.5	183.5	5.2	1.8	1.8	--
STGM3535	J3666	STIF092	23	12'' DIA	3.1%	200.00	199.28	203.9	202.8	216.0	211.9	216.5	212.3	6.3	24.7	24.8	Existing 10-yr
STGM3545	STMG088	STMG0816	191	12'' DIA	0.2%	236.00	235.61	238.8	238.1	243.9	239.3	245.7	240.4	1.6	5.7	6.1	Existing 10-yr
STGM3553	STMG0863	STMG0824	88	36'' DIA	0.8%	223.96	223.21	229.5	230.3	235.8	235.5	236.1	235.8	61.3	39.4	39.6	Existing 10-yr
STGM3561	STMH081	STMG0855	285	15'' DIA	0.4%	254.22	253.08	260.1	266.7	260.1	253.9	260.1	253.9	4.2	7.2	7.3	--
STGM3587	STIG0894	STIG0890	73	18'' DIA	4.6%	223.30	219.93	226.8	226.2	227.9	227.4	228.1	227.6	22.6	15.1	14.6	Existing 10-yr
STGM3596	STMG0839	STMG0840	194	12'' DIA	1.8%	230.00	226.50	237.2	230.2	235.6	230.1	236.1	230.2	5.0	7.2	7.2	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM3607	STMF0840	STMF0841	27	15'' DIA	1.4%	194.68	194.31	203.5	203.2	195.3	195.1	195.3	195.1	7.9	3.3	3.3	--
STGM3611	STMG149	STMG147	283	12'' DIA	10.2%	157.06	128.19	162.2	143.8	157.6	128.4	157.7	128.5	11.4	4.4	7.0	--
STGM3615	J5220	J4770	571	12'' DIA	0.4%	188.00	185.50	192.5	191.7	192.5	188.3	192.8	190.5	2.4	3.0	3.2	Future 10-yr
STGM3618	STMF1010	STMF1011	89	33'' DIA	2.7%	153.57	150.89	166.9	166.6	155.1	152.2	155.2	152.3	88.1	54.6	57.9	--
STGM3619	STMG0716	STMG0717	418	12'' DIA	3.0%	261.67	249.02	267.9	252.1	262.1	249.8	262.1	249.8	6.4	2.1	2.2	--
STGM3634	STMF106	J-CCT3-13	38	12'' DIA	3.2%	170.20	168.45	178.7	171.5	170.5	170.1	170.5	170.2	6.2	1.3	1.4	--
STGM3636	STMF121	OF_J3954	100	12'' DIA	19.3%	151.00	132.00	153.0	135.0	151.3	132.3	151.3	132.3	15.3	2.8	2.8	--
STGM3642	STMF0931	STMF0926	55	36'' DIA	0.3%	180.95	180.78	188.9	185.8	182.7	181.9	182.8	181.9	37.3	27.2	27.8	--
STGM3652	STMG0761	STMG0754	144	12'' DIA	11.2%	324.00	307.92	329.7	315.2	324.2	308.1	324.2	308.1	12.2	1.2	1.3	--
STGM3665	STMF0916	STMF0917	117	15'' DIA	2.1%	191.75	189.31	207.3	200.0	192.3	190.3	192.3	190.3	9.7	3.3	3.3	--
STGM3703	STMG0750	STMG0749	107	15'' DIA	7.3%	284.09	276.33	290.0	282.8	284.6	276.9	284.6	276.9	18.2	6.0	6.2	--
STGM3710	STIG1016	J3692	26	18'' DIA	0.4%	185.10	185.00	190.8	191.9	187.8	187.6	188.4	188.3	6.5	6.9	7.5	--
STGM3722	STMG0777	STMG0772	139	12'' DIA	0.8%	245.36	244.30	250.9	247.5	265.9	253.4	269.2	255.3	3.2	11.3	11.9	Existing 10-yr
STGM3724	STMF091	STMF0931	174	36'' DIA	2.1%	184.65	180.95	190.4	188.9	185.7	182.7	185.8	182.8	97.1	27.2	27.9	--
STGM3732	STMF0917	STMF0922	114	18'' DIA	1.1%	189.31	188.07	200.0	199.2	190.3	189.3	190.3	189.3	11.5	9.0	9.0	--
STGM3734	STMF093	STMF0932	419	36'' DIA	0.8%	189.10	185.81	198.1	193.0	190.3	187.3	190.3	187.3	58.6	21.1	21.3	--
STGM3741	STMF0930	STMF0928	184	12'' DIA	1.8%	198.17	194.94	203.4	200.0	198.5	195.4	198.5	195.4	4.9	1.3	1.5	--
STGM375	STIG1031	STMG1030	298	12'' DIA	1.3%	187.00	183.05	190.4	188.1	192.1	188.1	193.8	188.1	4.1	5.0	5.3	Existing 10-yr
STGM3766	STMG0733	STIH077	354	12'' DIA	0.9%	268.14	264.96	274.9	271.4	268.4	265.1	268.4	265.1	3.5	0.4	0.6	--
STGM3768	STMF102	STIF1030	43	18'' DIA	0.6%	169.96	169.70	175.0	174.7	171.4	170.5	171.4	170.5	8.2	11.9	12.3	--
STGM3769	STMG0834	STMG0843	128	33'' DIA	2.4%	217.11	214.07	223.7	219.4	218.2	215.7	218.2	215.8	82.2	26.3	27.6	--
STGM3778_a	J-CCT3-18	J-CCT3-16	440	Irregular Channel	1.3%	180.00	174.28	185.0	179.1	181.2	175.5	181.2	175.5		31.2	32.2	--
STGM3778_b	J-CCT3-16	J-CCT3-15	195	Irregular Channel	1.5%	174.28	171.40	179.1	176.3	175.5	173.5	175.5	173.7		32.3	33.7	--
STGM3780	STIF0817	J4120	231	Irregular Channel	0.5%	200.10	199.00	207.3	203.0	202.1	202.1	202.3	202.2		49.8	51.1	--
STGM3781	STIG0837	STIG0890	21	12'' DIA	9.7%	222.00	219.93	226.2	226.2	227.4	227.4	227.6	227.6	10.6	0.6	0.6	Existing 10-yr
STGM3785	STIG1075	J3896	525	12'' DIA	0.3%	190.14	188.70	198.9	196.0	204.5	190.4	205.0	190.5	1.9	6.2	6.3	Existing 10-yr
STGM3808	STMG1325	STMG1326	88	12'' DIA	3.2%	160.87	158.10	166.8	165.6	167.8	163.6	168.7	164.3	6.3	7.9	8.1	Existing 10-yr
STGM3835	STMG1034	J3692	17	18'' DIA	0.6%	185.10	185.00	191.3	191.9	187.8	187.6	188.3	188.3	8.0	7.6	7.8	--
STGM3838	STMG1215	STMG1210	87	12'' DIA	2.0%	168.80	167.05	175.4	173.7	176.2	175.9	176.2	175.9	5.1	2.6	2.6	Existing 10-yr
STGM3846	STMG1312	STMG1311	258	15'' DIA	0.3%	163.10	162.20	169.4	168.1	190.0	188.2	190.0	188.2	3.8	6.3	6.3	Existing 10-yr
STGM3861	STMG1324	J4572	112	18'' DIA	6.3%	157.00	150.00	166.0	163.6	166.0	151.1	166.0	151.1	26.3	31.3	31.3	--
STGM3871	STMH077	STMH073	122	12'' DIA	4.4%	262.39	257.00	267.5	261.5	262.8	259.7	262.8	260.1	7.9	2.2	2.3	--
STGM3883	STMG0919	STMF0911	104	12'' DIA	0.9%	187.81	186.90	195.8	194.2	195.8	194.4	196.7	195.9	3.3	3.4	3.4	Future 10-yr
STGM3886	STMG076	STMG073	9	27'' DIA	13.2%	227.40	226.20	231.5	231.3	227.7	227.6	227.7	227.6	117.7	3.5	3.6	--
STGM3894	STMG0937	STMG098	259	24'' DIA	1.3%	208.73	205.33	219.4	214.9	216.2	214.2	220.8	218.0	27.0	20.8	24.9	Future 10-yr
STGM3901	STMG0933	STMG0934	88	24'' DIA	1.5%	214.11	212.83	224.4	223.2	219.1	218.4	224.9	223.9	28.5	20.8	25.6	Future 10-yr
STGM3905	STMF1226	STMF1225	39	36'' DIA	1.1%	157.40	156.96	165.5	165.6	158.7	157.9	158.7	157.9	70.3	26.7	26.7	--
STGM3908	STMF1221	STMF1227	135	36'' DIA	0.9%	159.23	158.04	166.8	166.0	160.5	159.3	160.5	159.3	63.0	23.3	23.3	--
STGM3911	STMG0762	STMG0761	196	12'' DIA	7.6%	338.85	324.00	344.1	329.7	339.1	324.2	339.1	324.2	10.2	1.2	1.3	--
STGM3920	STMG1027	STMG1029	247	33'' DIA	1.8%	195.00	190.30	198.2	194.4	195.6	195.6	199.3	199.2	68.1	6.8	10.2	Future 10-yr
STGM3930	STMF1223	STMF1224	73	36'' DIA	21.9%	144.70	129.10	158.2	152.6	145.3	130.5	145.3	130.6	308.0	30.8	31.2	--
STGM3936	STMG132	STMG1322	78	18'' DIA	0.1%	157.50	157.40	165.5	165.5	180.7	178.0	180.7	178.0	3.8	19.7	19.7	Existing 10-yr
STGM3945	STMF1219	STMF1220	92	33'' DIA	2.5%	162.89	160.62	172.6	172.3	163.4	161.5	163.4	161.5	88.9	6.2	6.2	--
STGM3974	STMF087	STMF0821	322	24'' DIA	1.4%	210.00	205.66	215.1	212.5	211.2	206.5	211.2	206.5	26.3	16.5	16.7	--
STGM4013	STMG1315	STMG1323	65	15'' DIA	3.1%	162.00	157.30	166.1	165.4	177.3	175.9	177.3	175.9	11.3	9.9	9.9	Existing 10-yr
STGM4016	STMG101	STMG104	246	18'' DIA	0.4%	188.80	187.90	200.0	200.8	189.9	188.8	189.9	188.9	6.3	5.7	5.9	--
STGM402	STMF081	STMF082	340	12'' DIA	1.4%	212.38	207.57	217.1	212.1	217.4	217.1	217.7	217.5	4.2	2.7	2.7	Existing 10-yr
STGM4043	J3932	J-CCT1-02	815	Irregular Channel	2.5%	160.00	100.00	165.0	150.0	160.7	101.6	160.7	101.7		5.4	6.2	--
STGM4047	STMG0815	STMG0817	311	15'' DIA	1.8%	231.50	226.04	235.5	229.1	232.3	229.4	232.4	229.7	8.5	5.5	5.9	--
STGM4059	STMF0838	STMF0839	252	12'' DIA	2.4%	203.44	197.51	213.2	207.1	204.0	198.2	204.0	198.2	5.7	3.3	3.3	--
STGM406	STIF0874	OF_J4224	31	12'' DIA	0.6%	186.57	186.40	194.6	194.0	187.3	187.1	187.3	187.1	2.7	2.6	2.6	--
STGM4119	STMG0739	STMG0738	113	12'' DIA	0.2%	245.30	245.09	250.5	250.3	252.9	250.4	253.8	251.1	1.6	5.5	5.8	Existing 10-yr
STGM4127	STMG0775	STMG0776	287	12'' DIA	3.7%	259.00	248.31	264.7	256.2	293.0	265.9	299.5	269.3	7.2	12.6	13.5	Existing 10-yr
STGM4138	STMG0930	STMG0916	166	12'' DIA	2.3%	195.50	191.69	203.4	198.8	196.0	192.4	196.0	192.4	5.4	2.7	2.8	--
STGM414	STMF0914	STMF0915	30	15'' DIA	1.4%	192.61	192.18	205.4	205.6	193.2	192.9	193.2	192.9	8.1	3.3	3.3	--
STGM4140	STMF076	STMF075	208	36'' DIA	0.5%	201.20	200.16	205.0	203.5	202.2	201.5	202.2	201.7	47.5	11.4	11.4	--
STGM4141	STMH076	STMH081	129	12'' DIA	1.0%	255.50	254.22	259.7	260.1	259.7	260.1	259.7	260.1	3.7	2.2	2.3	--
STGM4149	STMF092	J4162	88	15'' DIA	0.3%	199.23	199.00	203.2	202.0	206.1	199.7	206.3	199.7	3.3	15.8	16.1	Existing 10-yr
STGM415	STMF0918	STMF0919	170	12'' DIA	1.0%	200.20	198.53	208.1	209.2	200.9	199.0	200.9	199.0	3.7	3.0	3.0	--
STGM4158	J4708	J4216	332	Irregular Channel	11.1%	146.50	110.00	152.6	114.3	146.6	110.3	146.6	110.4		1.2	1.3	--
STGM4160	STMG0914	J3664	67	12'' DIA	0.4%	201.30	200.30	208.5	205.2	216.0	216.0	216.6	216.5	2.4	2.9	2.9	Existing 10-yr
STGM4167	J-CCT3-15	J-CCT3-14	31	24'' DIA	1.0%	171.40	171.10	176.3	176.5	173.5	172.7	173.7	172.8	22.3	35.0	38.5	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM4170	STMG0751	STMG0750	133	12'' DIA	1.9%	286.67	284.09	289.9	290.0	287.0	284.6	287.0	284.6	5.1	1.2	1.3	--
STGM4172	J4216	OF_J4218	232	Irregular Channel	8.6%	110.00	90.00	114.3	94.0	110.3	90.4	110.4	90.4		7.2	7.6	--
STGM4177	STMF0841	STMF0914	315	15'' DIA	0.5%	194.31	192.61	203.2	205.4	195.1	193.2	195.1	193.2	4.9	3.3	3.3	--
STGM4199	STMG1028	J4938	35	18'' DIA	1.4%	184.50	184.00	194.6	195.8	195.5	195.4	199.0	197.7	12.6	18.5	21.4	Existing 10-yr
STGM420	STMG082	STMG0813	97	36'' DIA	1.6%	206.02	204.50	211.3	210.7	217.3	217.1	217.7	217.4	84.2	46.6	46.5	Existing 10-yr
STGM4201	STMG0824	STMG0825	24	36'' DIA	1.2%	223.21	222.92	230.3	229.9	235.5	235.5	235.8	235.7	73.7	39.2	39.4	Existing 10-yr
STGM4204	STMG0857	STMG0856	84	15'' DIA	2.3%	241.70	239.74	247.5	247.0	244.6	243.7	246.0	244.9	10.2	7.0	7.1	--
STGM4212	STIH077	STMH077	56	12'' DIA	4.6%	264.96	262.39	271.4	267.5	265.1	262.8	265.1	262.8	8.4	0.4	0.6	--
STGM4215	STMG0812	J5040	26	33'' DIA	0.4%	201.10	201.00	210.0	207.7	216.1	216.1	216.7	216.7	17.8	48.3	48.3	Existing 10-yr
STGM4226	STIF1030	STMF101	278	18'' DIA	5.4%	169.70	154.80	174.7	170.5	170.5	155.8	170.5	155.8	24.1	13.7	14.0	--
STGM4234	J4500	OF_J5512	337	Irregular Channel	19.2%	146.00	82.50	152.1	84.0	146.3	82.8	146.3	82.8		3.4	3.7	--
STGM4268	STMG0911	STMG099	50	12'' DIA	0.6%	201.80	201.50	208.1	208.6	202.9	202.8	203.0	202.9	2.8	1.4	1.9	--
STGM427	STMH073	STMH076	169	12'' DIA	0.9%	257.00	255.50	261.5	259.7	259.7	259.7	260.1	259.7	3.5	2.2	2.3	--
STGM4276	STMF131	J4708	122	12'' DIA	0.3%	146.92	146.50	155.4	152.6	147.5	146.6	147.5	146.6	2.1	1.2	1.3	--
STGM4284	J3730	J3760	636	Irregular Channel	1.4%	194.80	185.90	202.4	192.5	196.6	189.7	196.6	189.8		48.3	48.9	--
STGM4289	STMG0769	STMG0768	152	12'' DIA	3.0%	254.21	249.66	259.5	253.5	259.6	259.4	261.0	260.9	6.3	1.3	1.4	Existing 10-yr
STGM4293	J4318	J4482	186	Irregular Channel	2.0%	180.00	176.38	183.0	180.8	182.1	181.8	183.0	182.9		51.3	57.5	Future 10-yr
STGM43	J3760	OF_J4000	50	36'' DIA	0.8%	185.90	185.50	192.5	188.5	189.7	188.5	189.8	188.5	59.7	105.8	110.1	--
STGM4305	STIG07112	STMG0772	358	15'' DIA	3.1%	255.04	244.30	258.7	247.5	270.9	253.4	278.5	255.3	11.3	15.6	17.8	Existing 10-yr
STGM4306	STMF0928	STMF0929	312	12'' DIA	0.8%	194.94	192.41	200.0	196.7	195.4	192.7	195.4	192.7	3.3	1.3	1.5	--
STGM4320	STMG104	STMG1034	690	21'' DIA	0.4%	187.90	185.10	200.8	191.3	188.8	187.8	188.9	188.3	10.1	5.7	5.9	--
STGM4322	STMG0730	STMG0716	157	12'' DIA	0.6%	262.62	261.67	266.8	267.9	263.3	262.1	263.3	262.1	2.9	2.1	2.2	--
STGM4418	STMG0774	STMG0775	245	12'' DIA	1.0%	261.43	259.00	268.4	264.7	311.4	293.0	320.2	299.5	3.7	12.4	13.5	Existing 10-yr
STGM442	STMG0820	STMG0834	133	33'' DIA	2.7%	220.62	217.11	225.4	223.7	221.7	218.2	221.7	218.2	84.9	26.3	27.6	--
STGM443	STIG0710	STMG0727	231	18'' DIA	2.0%	239.30	234.70	243.0	238.6	247.6	235.9	248.7	236.1	14.9	32.5	28.1	Existing 10-yr
STGM4468	J4882	STMF118	25	18'' DIA	1.2%	175.58	175.28	185.8	186.4	176.5	176.0	176.5	176.0	11.9	8.8	8.8	--
STGM447	STMF0827	STMF0810	22	18'' DIA	5.4%	198.03	196.84	201.5	201.4	198.5	198.6	198.6	198.8	25.2	4.8	4.8	--
STGM4474	STIF129	STIF1210	139	6'' DIA	0.6%	169.71	168.92	172.8	171.3	209.8	172.2	209.8	172.2	0.4	3.7	3.7	Existing 10-yr
STGM4476	STIF1210	J8	39	12'' DIA	-0.2%	168.92	169.00	171.3	171.4	172.2	172.0	172.2	172.0	1.7	2.9	2.9	Existing 10-yr
STGM464	STMG083	STMG082	143	33'' DIA	1.6%	208.26	206.02	214.8	211.3	217.9	217.3	218.3	217.7	66.1	45.4	45.3	Existing 10-yr
STGM485	STIF1329	STMF134	504	12'' DIA	1.5%	154.00	146.60	163.2	152.3	163.2	151.3	163.2	152.3	4.3	4.8	5.0	--
STGM486	STMG0849	STMG0848	49	36'' DIA	0.8%	225.39	225.02	231.0	231.3	236.4	236.3	236.7	236.5	58.3	40.0	40.2	Existing 10-yr
STGM498	STMG0770	STMG0739	134	12'' DIA	0.4%	245.78	245.30	251.1	250.5	255.8	252.9	256.9	253.8	2.2	5.8	6.0	Existing 10-yr
STGM5	STMG0755	STMG0766	249	12'' DIA	6.0%	315.40	300.47	318.8	305.8	315.6	300.7	315.7	300.7	9.3	1.1	1.2	--
STGM516	STMG1311	STMG1315	511	15'' DIA	0.0%	162.20	162.00	168.1	166.1	188.2	177.3	188.2	177.3	1.3	11.2	11.2	Existing 10-yr
STGM52	STMG1319	STIG1348	243	10'' DIA	0.8%	164.32	162.33	169.5	167.7	181.3	173.8	182.5	175.1	2.0	4.0	3.9	Existing 10-yr
STGM533	STMG0816	STMG0815	279	12'' DIA	1.5%	235.61	231.50	238.1	235.5	239.3	232.3	240.4	232.4	4.3	5.6	6.0	Existing 10-yr
STGM539	STMF085	STMF0813	222	36'' DIA	1.4%	207.36	204.29	212.4	212.5	208.7	205.9	208.8	205.9	77.9	34.9	36.1	--
STGM541	STMF086	STMF087	128	24'' DIA	1.1%	211.36	210.00	217.3	215.1	212.4	211.2	212.4	211.2	23.3	12.6	12.7	--
STGM543	STMG0841	STMG0844	138	12'' DIA	2.8%	220.30	216.50	223.9	220.3	223.9	217.3	223.9	217.3	6.2	7.1	7.1	--
STGM555	STIF1134	STIF1135	158	12'' DIA	1.1%	170.40	168.60	174.7	173.0	171.1	169.5	171.1	169.5	3.7	3.0	3.1	--
STGM567	STMF1014	J5386	133	24'' DIA	1.7%	152.30	150.00	171.4	170.0	153.3	150.8	153.3	150.8	29.8	13.7	14.2	--
STGM575	STMG087	STMF081	116	12'' DIA	1.4%	213.97	212.38	217.3	217.1	217.5	217.4	217.8	217.7	4.2	2.7	2.7	Existing 10-yr
STGM583	STMG1112	J4882	512	18'' DIA	1.2%	181.88	175.58	189.4	185.8	182.8	176.5	182.8	176.5	12.0	8.8	8.8	--
STGM592	STMF0919	STMF0921	205	12'' DIA	3.8%	198.53	190.78	209.2	201.7	199.0	193.1	199.0	192.9	7.1	3.0	3.0	--
STGM602	STIG108	J5576	98	12'' DIA	0.8%	168.30	167.50	174.5	172.0	169.1	169.1	169.2	169.1	3.3	0.9	0.9	--
STGM609	STMG1030	STMF109	410	15'' DIA	0.4%	183.05	181.25	188.1	186.3	188.1	186.3	188.1	186.3	4.3	5.3	5.6	--
STGM612	STMF0835	STMF0836	338	12'' DIA	1.1%	195.93	192.16	201.8	195.8	196.5	192.7	196.5	192.7	3.9	2.6	2.6	--
STGM618	STMG1024	J4318	120	15'' DIA	0.6%	180.74	180.00	186.8	183.0	182.6	182.1	183.5	183.0	5.3	4.6	4.8	--
STGM633	STMG0830	STMG0850	255	27'' DIA	1.0%	231.75	229.13	238.0	237.3	240.3	238.1	240.5	238.3	32.7	31.4	31.5	Existing 10-yr
STGM65	STMG0836	STMG0837	297	33'' DIA	0.9%	210.60	208.00	215.4	215.0	212.3	210.0	212.3	210.0	49.9	33.4	34.4	--
STGM66	STMG0934	STMG0935	107	24'' DIA	1.4%	212.83	211.30	223.2	221.5	218.4	217.5	223.9	222.7	28.1	20.8	25.3	Future 10-yr
STGM685	STMG1320	STMG1321	264	10'' DIA	0.3%	166.40	165.57	173.9	171.9	198.8	189.2	199.6	190.3	1.2	5.4	5.4	Existing 10-yr
STGM694	J8	STIF1290	64	8'' DIA	2.2%	169.00	167.61	171.4	170.7	172.0	168.0	172.0	168.0	1.9	2.9	2.9	Existing 10-yr
STGM70	STMG0840	STMG0841	155	12'' DIA	4.0%	226.50	220.30	230.2	223.9	230.1	223.9	230.2	223.9	7.4	7.2	7.2	--
STGM725	STMG0829	STMG0849	291	36'' DIA	0.9%	227.89	225.39	235.1	231.0	237.4	236.4	237.7	236.7	61.5	40.4	40.6	Existing 10-yr
STGM738	STMF118	J3646	477	18'' DIA	2.9%	175.28	161.58	186.4	173.8	176.0	162.4	176.0	162.5	17.9	8.8	8.8	--
STGM741	STMG142	STMG145	48	12'' DIA	0.8%	160.03	159.65	166.8	166.4	160.5	160.4	160.5	160.4	3.2	1.1	1.3	--
STGM742	STMG072	STMF073	114	18'' DIA	0.7%	222.75	221.91	225.9	224.4	224.0	222.9	224.0	223.0	8.8	8.8	8.9	--
STGM751	J5040	J5366	153	Irregular Channel	0.4%	201.00	200.41	207.7	205.4	216.1	216.1	216.7	216.7		48.2	48.1	Existing 10-yr
STGM753	STMG1414	STMG1412	21	18'' DIA	10.6%	161.00	158.80	168.8	168.7	161.4	160.0	161.4	160.0	35.2	4.6	4.6	--
STGM755	STMG0735	STMG0722	107	12'' DIA	0.9%	243.49	242.48	249.5	248.2	248.1	247.0	249.5	247.0	3.6	5.5	5.7	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM779	STIG09106	STMG1027	27	21'' DIA	1.1%	196.30	195.00	198.4	198.2	197.1	195.6	199.4	199.3	17.4	6.8	10.0	Future 10-yr
STGM78	STMG073	STMG0821	140	33'' DIA	1.0%	226.20	224.82	231.3	229.7	227.6	226.4	227.6	226.5	52.9	24.9	26.2	--
STGM8	STMF1012	J3786	98	33'' DIA	6.0%	149.35	143.50	166.1	163.5	150.7	145.4	150.8	145.4	130.3	65.1	69.8	--
STGM800	STIF092	STMF092	34	12'' DIA	0.1%	199.28	199.23	202.8	203.2	211.9	206.1	212.3	206.3	1.4	14.9	15.2	Existing 10-yr
STGM831	STMF0921	STMF0917	94	12'' DIA	1.6%	190.78	189.31	201.7	200.0	193.1	190.3	192.9	190.3	4.6	5.6	5.6	--
STGM833	STMF1218	STMF1219	230	24'' DIA	2.4%	168.49	162.89	176.9	172.6	169.1	163.4	169.1	163.4	34.6	6.2	6.2	--
STGM865	STMF0923	STMF0924	336	18'' DIA	0.9%	186.61	183.64	197.6	193.3	187.8	184.8	187.8	184.8	10.3	10.0	10.2	--
STGM868	STMG0734	STMG0712	133	12'' DIA	4.9%	262.50	256.00	270.8	261.6	262.9	256.5	262.9	256.5	8.1	3.2	3.2	--
STGM870	STMF1013	STMF1014	181	12'' DIA	4.2%	159.85	152.30	174.7	171.4	160.1	153.3	160.1	153.3	7.5	0.9	0.9	--
STGM890	STMG0842	STMG0839	126	12'' DIA	0.7%	230.83	230.00	235.9	237.2	239.4	235.6	239.7	236.1	3.0	7.2	7.2	Existing 10-yr
STGM893	J4894	J4216	517	Irregular Channel	6.6%	144.10	110.00	150.5	114.3	144.4	110.3	144.4	110.4		4.8	5.0	--
STGM915	J5174	J5472	57	Irregular Channel	0.9%	188.00	187.50	193.5	192.4	189.9	189.2	190.0	189.4		33.6	38.1	--
STGM916	STMG1410	STIG1416	58	12'' DIA	28.8%	137.22	121.28	145.7	144.1	137.5	124.8	137.5	125.0	18.8	3.9	4.1	--
STGM929	STIG1072	STIG1075	282	12'' DIA	1.0%	193.00	190.14	199.2	198.9	208.2	204.5	208.9	205.0	3.6	4.5	4.6	Existing 10-yr
STGM938	J4572	J-CCT1-07	510	Irregular Channel	3.9%	150.00	130.00	163.6	132.0	151.1	131.2	151.1	131.3		31.3	31.3	--
STGM939	STMG134	STMG133	270	12'' DIA	0.3%	158.70	157.92	169.4	167.3	192.6	191.3	192.6	191.3	1.9	3.1	3.1	Existing 10-yr
STGM958	STIG1023	STIG1024	33	12'' DIA	0.5%	187.20	187.02	189.5	189.4	195.4	194.7	197.4	196.6	2.6	5.3	5.7	Existing 10-yr
STGM959	STMG0928	STMG0933	364	24'' DIA	1.6%	220.00	214.11	230.8	224.4	221.6	219.1	229.4	224.9	30.1	21.0	25.6	--
STGM961	STMG0754	STIG0777	155	12'' DIA	11.2%	307.92	290.71	315.2	296.5	308.1	291.2	308.1	291.2	12.2	1.2	1.3	--
STGM963	J3838	J4946	603	Irregular Channel	1.8%	182.30	171.50	191.2	173.5	183.1	172.8	183.1	172.8		10.0	10.1	--
STGM970	STMG0936	STMG0937	97	24'' DIA	1.5%	210.16	208.73	221.0	219.4	217.0	216.2	221.9	220.8	28.5	20.8	25.0	Future 10-yr
STGM975	STMF0833	STMF0830	226	12'' DIA	0.6%	200.47	199.12	202.5	203.4	201.0	200.0	201.0	200.0	2.9	1.8	1.8	--
STGM987	J3514	J3516	46	18'' DIA	1.0%	224.80	224.36	227.3	227.2	228.3	227.9	228.5	228.1	10.3	11.6	11.8	Existing 10-yr
HESS CREEK																	
C1	STMG1213	J-HC-16	349	12'' DIA	12.0%	167.50	126.00	174.0	147.0	167.9	129.1	167.9	129.3	12.2	4.8	4.8	--
C9	J4872	STII11281	413	36'' DIA	0.5%	204.00	201.50	212.1	211.5	205.4	203.0	205.5	203.1	48.4	22.8	23.4	--
HC-02	J-HC-05	J-HC-04	219	Irregular Channel	0.5%	101.00	100.00	160.0	145.0	105.6	105.6	106.6	106.6		476.7	590.1	--
HC-03	J-HC-06	J-HC-05	1465	Irregular Channel	0.3%	105.00	101.00	145.0	160.0	111.0	105.6	110.9	106.6		436.5	541.0	--
HC-04	J-HC-07	J-HC-06	624	Irregular Channel	0.0%	105.30	105.00	140.0	145.0	111.0	111.0	110.9	110.9		382.9	471.7	--
HC-05	J-HC-08	J-HC-07	44	Irregular Channel	0.2%	105.40	105.30	140.0	140.0	111.0	111.0	110.9	110.9		379.5	466.1	--
HC-06	J-HC-09	J-HC-08	394	Irregular Channel	0.9%	109.00	105.40	145.0	140.0	111.3	111.0	111.4	110.9		379.6	466.4	--
HC-07	J-HC-10	J-HC-09	805	Irregular Channel	0.3%	111.50	109.00	155.0	145.0	114.5	111.3	114.6	111.4		376.5	462.1	--
HC-08	J-HC-11	J-HC-10	373	Irregular Channel	0.3%	112.50	111.50	119.0	155.0	115.2	114.5	115.4	114.6		371.5	455.7	--
HC-09	J-HC-12	J-HC-11	640	Irregular Channel	0.5%	115.43	112.50	140.0	119.0	120.1	115.2	120.3	115.4		365.0	448.4	--
HC-10	J-HC-13	J-HC-12	342	Irregular Channel	0.5%	117.00	115.43	140.0	140.0	121.5	120.1	121.7	120.3		362.8	445.5	--
HC-11	J-HC-14	J-HC-13	998	Irregular Channel	0.4%	120.50	117.00	150.0	140.0	125.2	121.5	125.5	121.7		355.8	437.9	--
HC-12	J-HC-15	J-HC-14	941	Irregular Channel	0.5%	125.00	120.50	140.0	150.0	127.7	125.2	128.0	125.5		343.1	424.1	--
HC-13	J-HC-16	J-HC-15	339	Irregular Channel	0.3%	126.00	125.00	147.0	140.0	129.1	127.7	129.3	128.0		343.0	430.4	--
HC-14	J-HC-17	J-HC-16	331	Irregular Channel	0.3%	127.00	126.00	160.0	147.0	130.0	129.1	130.4	129.3		362.6	473.1	--
HC-15	J-HC-19	J-HC-18	293	Irregular Channel	0.3%	129.00	128.00	155.0	154.7	134.0	133.2	134.4	133.7		314.1	391.0	--
HC-16	J-HC-20	J-HC-19	752	Irregular Channel	0.6%	133.80	129.00	143.8	155.0	138.5	134.0	139.0	134.4		307.9	384.4	--
HC-17	J-HC-21	J-HC-20	348	Irregular Channel	0.6%	136.00	133.80	146.0	143.8	140.7	138.5	141.2	139.0		303.8	380.0	--
HC-18	J-HC-22	J-HC-21	569	Irregular Channel	0.2%	137.00	136.00	147.0	146.0	143.0	140.7	143.6	141.2		301.6	377.6	--
HC-19	J-HC-23	J-HC-22	155	Irregular Channel	0.5%	137.76	137.00	147.8	147.0	143.2	143.0	143.7	143.6		296.1	372.0	--
HC-20	J-HC-24	J-HC-23	255	Irregular Channel	0.5%	139.00	137.76	149.0	147.8	143.6	143.2	144.2	143.7		295.0	370.9	--
HC-21	J-HC-25	J-HC-24	236	Irregular Channel	0.1%	139.30	139.00	160.0	149.0	143.8	143.6	144.3	144.2		280.9	355.2	--
HC-22	J-HC-27	J-HC-26	1573	Irregular Channel	0.7%	151.50	140.40	170.0	146.1	154.9	144.8	155.1	145.5		280.4	354.8	--
HC-23	J-HC-28	J-HC-27	179	Irregular Channel	0.2%	151.80	151.50	170.0	170.0	155.9	154.9	156.2	155.1		247.9	317.1	--
HC-24	J-HC-30	J-HC-29	1069	Irregular Channel	0.8%	162.00	153.50	180.0	160.0	166.7	156.5	166.8	156.9		232.4	299.8	--
HC-25	J-HC-31	J-HC-30	181	Irregular Channel	1.4%	164.50	162.00	180.0	180.0	168.1	166.7	168.4	166.8		232.6	299.2	--
HC-26	J-HC-32	J-HC-31	822	Irregular Channel	0.3%	167.00	164.50	180.0	180.0	168.9	168.1	169.1	168.4		209.0	270.5	--
HC-27	J-HC-33	J-HC-32	583	Irregular Channel	0.3%	169.00	167.00	195.0	180.0	170.5	168.9	170.7	169.1		200.3	260.3	--
HC-28	J-HC-34	J-HC-33	755	Irregular Channel	1.1%	177.00	169.00	190.0	195.0	180.8	170.5	181.0	170.7		195.5	253.5	--
HC-29	J-HC-36	J-HC-35	356	Irregular Channel	0.5%	180.50	178.70	187.0	185.2	184.1	181.7	184.3	182.1		187.0	241.4	--
HC-30	J-HC-37	J-HC-36	1760	Irregular Channel	0.9%	196.00	180.50	220.0	187.0	199.0	184.1	199.3	184.3		175.5	228.4	--
HC-31	J-HC-38	J-HC-37	691	Irregular Channel	1.1%	203.50	196.00	230.0	220.0	207.1	199.0	207.4	199.3		164.7	210.7	--
HC-32	J-HC-39	J-HC-38	785	Irregular Channel	3.3%	229.60	203.50	245.0	230.0	231.5	207.1	231.6	207.4		76.2	86.1	--
HC-33	J-HC-40	J-HC-39	1818	Irregular Channel	3.5%	294.00	229.60	330.0	245.0	295.8	231.5	295.9	231.6		71.8	78.1	--
HCT1-01	J4974	OF_J-HC-01	946	Irregular Channel	6.9%	156.40	91.70	163.4	155.0	156.7	91.9	156.7	92.0		8.4	14.5	--
HCT2-01	J-HCT2-01	J-HC-05	680	Irregular Channel	0.9%	107.00	101.00	165.0	160.0	108.5	105.6	108.7	106.6		47.2	63.3	--
HCT2-02	J-HCT2-02	J-HCT2-01	688	Irregular Channel	1.9%	120.00	107.00	160.0	165.0	121.2	108.5	121.3	108.7		39.2	49.0	--
HCT2-03	J-HCT2-03	J-HCT2-02	834	Irregular Channel	2.5%	141.00	120.00	160.0	160.0	142.1	121.2	142.2	121.3		35.1	41.7	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
HCT3-01	J-HCT3-01	J-HC-06	1106	Irregular Channel	2.5%	132.64	105.00	165.0	145.0	133.9	111.0	133.9	110.9		80.2	84.9	--
HCT3-02	J-HCT3-02	J-HCT3-01	567	Irregular Channel	2.5%	146.80	132.64	155.0	165.0	147.7	133.9	147.7	133.9		78.2	82.5	--
HCT3-03	J-HCT3-03	J-HCT3-02	570	Irregular Channel	1.4%	155.00	146.80	165.0	155.0	155.7	147.7	155.7	147.7		71.8	73.8	--
HCT3-04	J-HCT3-04	J-HCT3-03	376	Irregular Channel	1.4%	160.40	155.00	165.0	165.0	163.6	155.7	163.6	155.7		65.7	66.9	--
HCT3-05	J-HCT3-05	J-HCT3-04	128	Irregular Channel	1.5%	162.30	160.40	170.0	165.0	165.1	163.6	165.1	163.6		63.7	64.8	--
HCT3-06	J-HCT3-06	J-HCT3-05	146	Irregular Channel	1.4%	164.40	162.30	170.0	170.0	167.2	165.1	167.2	165.1		63.0	64.1	--
HCT3-07	J-HCT3-08	J-HCT3-07	271	Irregular Channel	2.1%	170.20	164.60	175.0	173.0	171.6	167.6	171.7	167.6		60.6	61.5	--
HCT4_01	J-HCT4-01	J-HC-27	359	Irregular Channel	3.2%	163.00	151.50	185.0	170.0	164.4	154.9	164.4	155.1		40.3	40.9	--
HCT4-02	J-HCT4-02	J-HCT4-01	204	Irregular Channel	1.7%	166.40	163.00	188.4	185.0	167.5	164.4	167.5	164.4		35.4	35.9	--
HCT4-03	J-HCT4-03	J-HCT4-02	93	Irregular Channel	1.7%	168.00	166.40	190.0	188.4	169.6	167.5	169.6	167.5		33.8	34.3	--
HCT4-04	J-HCT4-04	J-HCT4-03	310	Irregular Channel	2.5%	175.60	168.00	195.0	190.0	177.0	169.6	177.0	169.6		32.1	32.6	--
HCT4-05	J-HCT4-06	J-HCT4-05	263	Irregular Channel	3.2%	185.00	176.50	195.0	188.8	186.3	177.7	186.4	177.7		31.1	31.5	--
HCT5-01	STMH1026	J-HC-31	480	Irregular Channel	1.6%	172.00	164.50	187.5	180.0	173.2	168.1	173.2	168.4		28.7	29.3	--
HCT6-01	J4956	J-HC-38	1558	Irregular Channel	2.3%	240.00	203.50	254.2	230.0	241.6	207.1	241.8	207.4		84.7	118.2	--
STGM1000	STMH1312	J-HCT3-01	120	12'' DIA	12.6%	147.62	132.64	162.4	165.0	147.9	133.9	147.9	133.9	12.9	2.2	2.7	--
STGM1002	STMH108	J-HCT4-03	61	12'' DIA	33.0%	187.00	168.00	196.1	190.0	187.2	169.6	187.2	169.6	20.9	1.7	1.7	--
STGM1018	STMH1223	STMH1230	108	12'' DIA	0.2%	172.94	172.72	177.0	176.7	184.0	183.3	184.2	183.4	1.7	3.9	3.9	Existing 10-yr
STGM1044	J4068	J4066	42	12'' DIA	0.2%	186.10	186.00	192.4	192.0	192.8	192.7	192.9	192.8	1.8	3.3	3.3	Existing 10-yr
STGM1060	STMH1245	J-HCT3-04	157	15'' DIA	3.6%	166.12	160.40	172.5	165.0	166.5	163.6	166.5	163.6	12.8	2.0	2.0	--
STGM1068	STMH1133	J5510	46	18'' DIA	1.7%	181.30	180.53	188.4	188.5	181.9	181.2	181.9	181.2	13.7	4.9	5.1	--
STGM107	STMG112	STMG117	297	12'' DIA	0.2%	185.51	185.00	194.4	192.3	192.2	186.1	192.3	186.1	1.5	5.1	5.1	--
STGM1114	STMH1252	J-HCT3-05	39	12'' DIA	3.9%	163.82	162.30	169.6	170.0	165.2	165.1	165.2	165.1	7.5	0.7	0.7	--
STGM1142	J3762	J4234	25	18'' DIA	0.8%	187.40	187.20	195.6	195.7	188.4	188.1	188.4	188.1	9.5	7.5	7.5	--
STGM1150	STMH091	STMH106	385	15'' DIA	0.6%	199.87	197.65	209.1	208.4	200.6	198.2	200.6	198.2	4.9	3.1	3.1	--
STGM1173	STMI1311	J4160	152	24'' DIA	4.6%	154.39	147.33	162.6	154.4	154.8	148.2	154.9	148.3	48.6	3.9	8.2	--
STGM1204	STMH1017	J-HCT4-01	153	12'' DIA	9.5%	192.51	163.00	194.6	185.0	192.9	164.4	192.9	164.4	10.9	3.4	3.4	--
STGM1226	STMI121	STMH128	273	27'' DIA	2.1%	179.45	173.60	189.9	186.6	180.2	176.2	180.2	176.3	46.1	9.7	9.7	--
STGM1229	STIH1040	STMH1011	234	12'' DIA	5.1%	211.00	199.00	218.0	207.8	211.3	199.4	211.3	199.4	8.0	1.9	1.9	--
STGM1260	STMH137	STMH138	23	12'' DIA	56.6%	136.08	124.75	148.3	138.8	136.3	125.1	136.3	125.1	26.4	1.9	2.2	--
STGM128	STIH146	STIH144	126	12'' DIA	2.3%	163.62	160.75	166.2	165.5	164.2	161.3	164.2	161.3	5.4	3.4	3.4	--
STGM129	STMH0910	J5480	635	15'' DIA	0.1%	229.00	228.10	242.2	240.3	242.2	241.7	243.0	242.4	2.4	5.6	6.4	Existing 10-yr
STGM1294	STII0962	J35	46	18'' DIA	0.4%	254.00	253.80	261.7	256.7	254.8	254.1	255.0	254.2	7.2	4.0	5.7	--
STGM1312	STMH096	STMH097	203	15'' DIA	0.5%	224.00	223.00	237.9	232.9	237.9	232.6	238.4	233.5	4.5	11.5	11.6	Future 10-yr
STGM1313	STMH1112	J4918	119	21'' DIA	0.6%	202.70	202.00	211.0	207.5	203.3	203.0	203.3	203.0	12.0	3.4	3.4	--
STGM1330	J4554	J4556	48	15'' DIA	2.1%	312.00	310.00	319.7	318.9	312.5	310.4	312.8	310.4	9.3	3.4	6.5	--
STGM1334	STMH1129	J5110	19	24'' DIA	2.7%	193.00	192.50	197.9	197.6	193.9	193.5	193.9	193.5	36.9	14.4	14.6	--
STGM1345	STMG118	J-HC-22	551	12'' DIA	8.1%	183.75	137.00	188.9	147.0	184.4	143.0	184.4	143.6	10.5	7.7	7.7	--
STGM1350	J3696	J-HC-28	139	Irregular Channel	3.3%	156.53	151.80	166.6	170.0	157.1	155.9	157.1	156.2		22.4	23.6	--
STGM1358	STMI111	J5444	18	18'' DIA	1.1%	212.62	212.42	219.8	219.8	215.4	215.0	215.7	215.3	11.1	15.2	16.1	--
STGM1362	J-HC-42	J-HC-41	911	Irregular Channel	4.3%	344.20	304.90	351.7	309.3	345.4	306.0	345.4	306.0		38.7	40.8	--
STGM1382	STMH1226	STMH1211	48	12'' DIA	1.0%	169.99	169.52	173.7	174.7	178.3	178.0	178.4	178.2	3.7	3.6	3.6	Existing 10-yr
STGM139	STIH144	J3504	63	18'' DIA	1.2%	160.75	160.00	165.5	164.3	161.3	160.4	161.3	160.4	11.5	3.4	3.4	--
STGM1393	J3504	J4862	255	Irregular Channel	15.9%	160.00	120.00	164.3	130.0	160.4	120.5	160.4	120.5		3.4	3.4	--
STGM1397	STMH1110	STMH1126	363	12'' DIA	0.4%	200.50	199.00	204.3	205.7	204.3	200.0	204.3	200.0	2.3	3.3	3.8	Future 10-yr
STGM1418	STMI1122	STMI1141	101	24'' DIA	0.5%	204.90	204.40	212.9	215.1	206.6	205.8	206.6	205.8	15.9	19.3	19.9	--
STGM143	STMG126	J-HC-18	212	12'' DIA	16.5%	163.00	128.00	172.1	154.7	163.5	133.2	163.5	133.7	14.4	7.8	7.8	--
STGM1476	STMH097	STMH098	388	18'' DIA	2.2%	223.00	214.50	232.9	223.9	232.6	224.6	233.5	225.8	15.6	15.3	15.2	Future 10-yr
STGM1480	J4042	J-HC-33	68	24'' DIA	10.3%	176.00	169.00	204.0	195.0	176.2	170.5	176.2	170.7	74.0	2.2	2.2	--
STGM1484	J4918	STMH1144	39	21'' DIA	0.8%	202.00	201.70	207.5	207.2	203.0	203.0	203.0	203.0	14.1	3.4	3.4	--
STGM1508	J-HC-41	J-HC-40	436	Irregular Channel	2.5%	304.90	294.00	309.3	330.0	306.0	295.8	306.0	295.9		38.5	40.6	--
STGM1528	STII0961	STII0962	48	18'' DIA	1.0%	254.48	254.00	261.9	261.7	255.1	254.8	255.3	255.0	10.9	4.0	5.7	--
STGM1533	STMH0923	J4002	159	36'' DIA	4.1%	189.37	182.80	198.7	191.9	189.9	183.6	189.9	183.6	138.7	8.3	9.2	--
STGM1575	J3474	STMG1010	20	21'' DIA	0.5%	189.28	189.18	201.5	201.5	190.4	190.2	190.4	190.2	11.1	8.3	8.6	--
STGM1579	J3612	J3614	93	12'' DIA	1.1%	174.00	172.00	178.0	178.3	180.4	173.0	180.4	173.0	3.7	9.4	9.4	Existing 10-yr
STGM1598	STMH136	STMH137	43	12'' DIA	33.9%	149.85	136.08	162.9	148.3	150.1	136.3	150.1	136.3	20.6	1.9	2.2	--
STGM1652	STMH1310	J-HCT3-02	117	12'' DIA	0.3%	147.10	146.80	159.9	155.0	148.3	147.7	148.4	147.7	1.9	2.8	3.0	--
STGM167	STMI1141	J4872	36	24'' DIA	1.1%	204.40	204.00	215.1	212.1	205.8	205.4	205.8	205.5	23.8	19.3	19.9	--
STGM1685	STMH1022	J5266	21	12'' DIA	2.5%	186.19	185.66	193.1	193.0	186.6	185.9	186.6	185.9	5.6	2.1	2.4	--
STGM1690	STII0944	J4628	83	12'' DIA	4.8%	246.13	242.10	252.4	252.5	246.6	242.5	246.8	243.2	8.2	3.8	6.9	--
STGM1713	J5640	J-HC-09	473	Irregular Channel	10.5%	158.50	109.00	164.0	145.0	159.1	111.3	159.2	111.4		7.2	8.0	--
STGM1719	STII0947	J5012	523	Irregular Channel	2.7%	248.11	234.00	252.1	240.5	248.4	236.3	248.4	236.8		1.2	1.4	--
STGM1720	STIH081	J5450	46	12'' DIA	12.7%	286.77	280.00	288.5	288.9	287.1	280.3	287.1	280.3	13.1	2.4	2.7	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM1726	J5084	J5190	53	12'' DIA	3.4%	233.00	231.20	238.3	238.3	233.6	231.8	233.6	231.9	6.6	3.8	4.2	--
STGM1763	STMH1220	STMH1221	226	12'' DIA	0.4%	171.26	170.42	176.3	174.9	181.1	179.7	181.2	179.8	2.3	3.5	3.3	Existing 10-yr
STGM1768	STIH118	J-HC-24	72	18'' DIA	36.1%	163.50	139.00	170.0	149.0	164.1	143.6	164.1	144.2	62.2	19.9	20.2	--
STGM177	STMH1248	J-HCT3-03	183	15'' DIA	3.2%	160.76	155.00	169.6	165.0	161.2	155.7	161.3	155.7	12.0	3.6	4.3	--
STGM1793	STMH1231	J-HCT3-09	111	42'' DIA	1.0%	171.56	170.50	179.7	177.1	173.4	171.8	173.5	171.8	98.8	55.3	56.3	--
STGM1814	J4160	STMI132	90	42'' DIA	4.0%	147.33	143.41	154.4	162.1	148.2	144.7	148.3	144.9	201.1	24.2	30.2	--
STGM1859	STMI117	STMI114	548	33'' DIA	1.1%	194.00	185.80	208.9	195.9	195.2	187.1	195.2	187.2	56.9	22.8	23.4	--
STGM1860	STMI113	J3762	44	18'' DIA	0.9%	187.80	187.40	195.2	195.6	188.8	188.4	188.8	188.4	10.1	7.5	7.5	--
STGM1862	J-HC-18	J-HC-17	203	72'' DIA	0.5%	128.00	127.00	154.7	160.0	133.2	130.0	133.7	130.4	296.8	337.3	419.7	--
STGM1864	STII0957	STII0961	216	15'' DIA	1.0%	256.62	254.48	263.3	261.9	257.3	255.1	257.5	255.3	6.4	4.0	5.7	--
STGM1867	J-HCT4-05	J-HCT4-04	69	48'' DIA	1.3%	176.50	175.60	188.8	195.0	177.7	177.0	177.7	177.0	163.6	31.1	31.5	--
STGM1908	STMH1239	STMH1240	279	18'' DIA	0.6%	164.09	162.29	170.2	167.9	164.7	162.9	164.7	162.9	8.8	2.7	2.7	--
STGM192	STMH1228	J-HCT3-06	72	12'' DIA	1.5%	165.50	164.40	173.4	170.0	167.6	167.2	167.7	167.2	4.4	2.6	2.7	--
STGM1925	STIH1038	STMH1010	86	12'' DIA	5.5%	197.70	193.00	205.3	206.2	198.0	193.9	198.0	193.9	8.3	1.9	1.9	--
STGM193	J5190	J4370	360	24'' DIA	0.7%	231.20	228.80	238.3	234.8	231.8	229.9	231.9	230.0	18.3	3.8	4.2	--
STGM194	STMH093	J4042	167	12'' DIA	11.6%	195.22	176.00	204.4	204.0	195.5	176.2	195.5	176.2	12.3	2.2	2.2	--
STGM1956	STMH1314	STMH1315	461	10'' DIA	1.1%	163.00	158.10	169.9	169.3	196.6	183.9	200.1	187.7	2.2	4.9	4.8	Existing 10-yr
STGM1958	STMI1140	STMI1122	39	24'' DIA	0.6%	205.14	204.90	210.6	212.9	206.9	206.6	206.9	206.6	17.7	19.3	19.9	--
STGM1992-A	J4668	J4290	348	12'' DIA	0.6%	164.65	162.40	173.3	169.9	190.1	180.0	191.1	181.1	2.9	6.7	6.7	Existing 10-yr
STGM1992-B	J4290	J-HC-14	595	12'' DIA	3.9%	162.40	120.50	169.9	150.0	180.0	125.2	181.1	125.5	7.1	10.3	10.5	Existing 10-yr
STGM2041	STMH105	STMH104	76	21'' DIA	2.9%	194.00	191.80	201.1	199.5	194.7	192.6	194.7	192.6	26.9	8.4	8.6	--
STGM2096_1	STMH1027	STMH1026	384	24'' DIA	5.1%	191.50	172.00	205.8	187.5	192.6	173.2	192.6	173.2	51.3	28.7	29.3	--
STGM2096_2	STMH0918	STMH1027	241	18'' DIA	5.1%	203.70	191.50	214.4	205.8	212.4	192.6	213.1	192.6	23.5	28.7	29.3	--
STGM2096_3	STMH0919	STMH0918	109	18'' DIA	5.0%	209.20	203.70	217.9	214.4	220.5	212.4	221.5	213.1	23.5	29.0	29.4	Existing 10-yr
STGM2103	STMI132	J-HCT2-03	100	33'' DIA	2.1%	143.41	141.00	162.1	160.0	144.7	142.1	144.9	142.2	76.4	35.1	41.7	--
STGM2111	J4002	J-HC-32	378	Irregular Channel	4.2%	182.80	167.00	191.9	180.0	183.6	168.9	183.6	169.1		9.4	10.4	--
STGM2132	STMH1010	STIH1036	163	15'' DIA	1.8%	193.00	190.00	206.2	197.3	193.9	191.3	193.9	191.3	8.8	7.2	7.2	--
STGM2173	STMH1144	STMH1110	252	12'' DIA	0.5%	201.70	200.50	207.2	204.3	203.0	204.3	203.0	204.3	2.5	8.2	8.4	--
STGM218	STIH107	STMH1018	127	12'' DIA	17.6%	185.07	163.00	192.2	189.4	185.3	167.0	185.3	167.1	15.2	1.8	1.9	--
STGM2180	STMH1213	STMH1214	39	15'' DIA	2.6%	161.30	160.30	169.8	168.3	162.1	161.2	162.1	161.2	10.4	7.0	7.0	--
STGM219	STMH1212	STMH1213	367	12'' DIA	1.9%	168.22	161.30	173.3	169.8	176.4	162.1	176.6	162.1	4.9	7.2	7.3	Existing 10-yr
STGM2191	STMH135	STMH136	40	12'' DIA	20.3%	157.70	149.85	165.3	162.9	157.9	150.1	158.0	150.1	15.4	1.9	2.2	--
STGM2194	STMH1128	STMH1127	153	15'' DIA	2.2%	203.80	200.50	216.9	212.7	204.3	201.8	204.3	201.9	9.5	3.2	3.4	--
STGM2205	STMH098	STMH0920	43	18'' DIA	5.8%	214.50	212.00	223.9	221.4	224.6	222.8	225.8	223.9	25.5	21.9	22.3	Existing 10-yr
STGM2215	J5266	J4642	492	24'' DIA	5.8%	185.66	157.20	193.0	168.2	185.9	157.5	185.9	157.5	53.0	2.1	2.4	--
STGM2226	STMH132	J5640	109	12'' DIA	5.1%	154.52	158.50	164.7	164.0	164.6	159.1	164.7	159.2	8.0	5.8	6.1	--
STGM2240	STMH118	STMH1133	153	18'' DIA	1.6%	184.00	181.30	189.9	188.4	184.6	181.9	184.6	181.9	13.4	4.9	5.1	--
STGM228	J5484	J3588	295	Irregular Channel	0.6%	211.80	209.90	218.5	215.2	213.1	211.2	213.1	211.4		15.2	16.1	--
STGM2288	J4282	J5560	878	Irregular Channel	0.5%	169.70	165.00	174.0	168.9	170.6	166.4	170.6	166.4		11.7	11.7	--
STGM2291	STMH125	J4636	54	18'' DIA	2.2%	177.69	176.50	185.8	183.6	178.2	177.8	178.2	177.8	15.7	3.1	3.1	--
STGM2308	STIH0917	STMH0910	190	18'' DIA	0.5%	230.00	229.00	242.0	242.2	242.3	242.2	243.2	243.0	7.6	3.8	6.3	Existing 10-yr
STGM231	J3	STMH1314	357	10'' DIA	0.3%	164.00	163.00	169.8	169.9	198.4	196.6	201.8	200.1	1.2	2.5	2.5	Existing 10-yr
STGM2313	STMH1243	STMH1244	299	12'' DIA	0.6%	168.94	167.19	173.5	172.6	169.6	167.9	169.6	167.9	2.8	2.0	2.0	--
STGM2326	STMH1021	STMH1022	263	12'' DIA	2.5%	192.77	186.19	200.1	193.1	193.2	186.6	193.2	186.6	5.6	2.1	2.4	--
STGM233	STMH1018	J-HC-30	141	12'' DIA	0.7%	163.00	162.00	189.4	180.0	167.0	166.7	167.1	166.8	3.0	1.8	1.9	--
STGM2342	J4504	J-HC-13	173	Irregular Channel	17.3%	146.42	117.00	159.2	140.0	147.2	121.5	147.3	121.7		8.9	9.2	--
STGM2361_a	J-HC-04	J-HC-03	735	96'' DIA	0.4%	100.00	97.20	145.0	168.5	105.6	102.8	106.6	103.6	564.0	468.3	576.4	--
STGM2361_b	J-HC-03	OF_J-HC-02	560	96'' DIA	0.4%	97.20	95.00	168.5	104.0	102.8	100.6	103.6	101.1	572.4	475.1	579.2	--
STGM2366	STMH115	STMH116	227	27'' DIA	0.8%	186.02	184.21	200.7	195.5	187.4	185.3	187.4	185.3	27.5	18.2	18.4	--
STGM24	J4556	J5628	1004	Irregular Channel	4.5%	310.00	264.50	318.9	271.1	310.4	267.6	310.4	268.7		12.0	18.0	--
STGM241	J3630	STMG115	239	33'' DIA	0.2%	187.50	187.00	191.1	192.7	193.0	193.1	193.1	193.0	23.9	9.5	9.0	Existing 10-yr
STGM2425	STMH101	J3474	68	21'' DIA	0.9%	189.90	189.28	200.2	201.5	190.9	190.4	190.9	190.4	15.2	8.3	8.6	--
STGM2439	STMH095	STMH094	86	12'' DIA	0.7%	196.44	195.80	204.9	204.5	197.1	196.4	197.1	196.4	3.1	2.2	2.2	--
STGM2442	J4608	J4610	1371	Irregular Channel	0.1%	101.00	100.00	163.5	156.6	103.3	103.3	104.0	156.6		10.2	54.9	--
STGM2451	STMI0911	STII0955	80	15'' DIA	2.1%	259.63	257.95	264.5	263.9	260.2	258.6	260.3	258.7	9.6	4.1	5.7	--
STGM2459	STIH12139	STMH1224	90	15'' DIA	0.3%	173.26	172.96	178.7	180.0	178.7	180.0	178.7	180.0	3.7	7.5	7.5	--
STGM2478	J4398	J-HC-19	342	Irregular Channel	3.5%	141.00	129.00	160.6	155.0	141.7	134.0	141.7	134.4		11.9	12.1	--
STGM2497	STMH1315	STMH133	433	10'' DIA	1.1%	158.10	153.50	169.3	163.4	183.9	154.2	187.7	154.2	2.3	6.3	6.9	Existing 10-yr
STGM2498	STII11135	STMI117	37	24'' DIA	2.7%	198.00	194.00	211.4	208.9	199.1	195.2	199.2	195.2	37.3	22.8	23.4	--
STGM2500	J5110	STMH117	81	24'' DIA	2.2%	192.50	190.68	197.6	195.9	193.5	192.1	193.5	192.1	33.5	17.4	17.6	--
STGM2515	STMH104	STMH101	122	21'' DIA	1.6%	191.80	189.90	199.5	200.2	192.6	190.9	192.6	190.9	19.9	8.3	8.6	--
STGM2516	STMH1014	STMH1010	65	15'' DIA	6.9%	197.45	193.00	207.5	206.2	197.8	193.9	197.8	193.9	16.5	3.1	3.1	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM2530	J4642	J3696	21	Irregular Channel	3.3%	157.20	156.53	168.2	166.6	157.5	157.1	157.5	157.1		4.3	5.1	--
STGM2534	STMI151	J4974	49	15'' DIA	0.8%	156.80	156.40	164.7	163.4	158.0	156.7	160.4	156.7	5.9	8.0	14.5	--
STGM2535	STMG117	STMG118	441	18'' DIA	0.3%	185.00	183.75	192.3	188.9	186.1	184.4	186.1	184.4	5.6	5.1	5.1	--
STGM2558	J4576	J5090	1209	Irregular Channel	5.7%	313.00	244.00	319.3	260.8	313.2	245.6	313.2	246.0		10.7	13.2	--
STGM2566	STMI114	STMH129	334	33'' DIA	1.5%	185.80	180.81	195.9	192.2	187.1	182.0	187.2	182.1	64.2	30.2	30.8	--
STGM2577	STMH109	J-HCT4-04	20	12'' DIA	52.3%	185.00	175.60	193.1	195.0	185.1	177.0	185.1	177.0	27.0	1.1	1.1	--
STGM2584	STMH1222	STMH1220	227	12'' DIA	0.4%	172.10	171.26	176.3	176.3	182.5	181.1	182.7	181.2	2.3	3.4	3.4	Existing 10-yr
STGM2587	STMH1242	STMH1243	114	12'' DIA	0.9%	169.93	168.94	174.2	173.5	170.5	169.6	170.5	169.6	3.5	2.0	2.0	--
STGM2598	J3588	STII1179	307	Irregular Channel	0.7%	209.90	205.36	215.2	212.9	211.2	207.2	211.4	207.3		15.1	16.0	--
STGM2644	STMH0912	STMH0911	54	12'' DIA	5.9%	204.00	200.85	211.5	211.6	222.0	222.0	228.3	228.3	8.9	1.5	1.7	Existing 10-yr
STGM2658	J5562	J4160	454	Irregular Channel	3.7%	164.00	147.33	171.1	154.4	165.0	148.2	165.0	148.3		20.3	22.0	--
STGM2660	STMH1227	J-HCT3-09	345	15'' DIA	0.3%	171.54	170.50	180.9	177.1	180.9	171.8	180.9	171.8	3.5	5.5	5.5	--
STGM2680	STII0941	STII0945	192	12'' DIA	2.7%	252.00	246.63	258.1	252.5	252.6	247.7	256.6	249.2	6.1	3.8	6.8	--
STGM2704	STII0940	STII0941	78	12'' DIA	0.9%	252.88	252.00	259.1	258.1	253.8	252.6	259.1	256.6	3.5	3.8	6.8	--
STGM2730	STII118	STII116	200	18'' DIA	0.9%	190.63	188.91	202.3	198.4	191.6	190.0	191.6	190.0	9.7	7.5	7.5	--
STGM2732	STMH1013	STMH1014	123	12'' DIA	6.0%	204.80	197.45	214.2	207.5	205.1	197.8	205.1	197.8	8.5	1.2	1.2	--
STGM2734	STMG114	J4784	79	18'' DIA	1.3%	191.00	190.00	197.1	195.9	193.2	193.0	193.4	193.2	11.9	5.7	5.9	--
STGM2743	J-HC-26	J-HC-25	232	78'' DIA	0.5%	140.40	139.30	146.1	160.0	144.8	143.8	145.5	144.3	362.4	282.5	357.8	--
STGM2754	J3936	J3938	164	18'' DIA	6.7%	398.00	387.00	415.0	397.0	399.1	388.0	399.1	388.0	27.2	24.5	24.5	--
STGM2778	STMI131	STMI132	236	18'' DIA	3.6%	151.80	143.41	167.5	162.1	152.4	144.7	152.4	144.9	20.3	5.9	5.9	--
STGM28	J4200	J4398	66	18'' DIA	18.5%	153.00	141.00	155.5	160.6	153.5	141.7	153.5	141.7	45.8	11.9	12.1	--
STGM2830	STII093	J5084	172	12'' DIA	0.3%	233.50	233.00	240.0	238.3	236.0	233.6	236.4	233.6	1.9	6.2	6.3	--
STGM2831	J4734	STMI096	552	12'' DIA	1.3%	264.00	256.00	268.3	258.7	266.9	256.6	268.0	256.7	4.0	4.7	4.9	--
STGM285	STIH1033	STMH1015	113	12'' DIA	3.5%	209.00	205.00	215.9	216.2	209.3	205.5	209.3	205.5	6.6	1.2	1.2	--
STGM286	STMI141	STMI135	312	18'' DIA	0.7%	154.90	152.82	167.6	166.1	155.8	154.0	155.8	154.0	8.9	5.9	5.9	--
STGM2874	STIH12182	STIH12125	196	15'' DIA	0.5%	179.31	178.25	187.1	181.7	180.1	179.0	180.1	179.0	4.6	3.1	3.1	--
STGM2917	J5012	STII093	74	12'' DIA	0.7%	234.00	233.50	240.5	240.0	236.3	236.0	236.8	236.4	2.9	11.0	15.9	--
STGM2928	STMH0911	STMH0913	319	12'' DIA	1.6%	200.85	195.61	211.6	206.5	222.0	206.0	228.3	208.4	4.8	9.0	10.4	Existing 10-yr
STGM2953	STII141	OF_J5066	152	18'' DIA	0.2%	167.21	166.90	173.9	174.0	169.1	168.4	170.3	168.4	4.9	7.4	8.1	--
STGM2979	STMH133	J4098	66	15'' DIA	2.3%	153.50	152.00	163.4	157.4	154.2	152.4	154.2	152.4	9.7	5.6	6.0	--
STGM2985	STMH114	STMH115	40	24'' DIA	1.8%	186.75	186.02	200.8	200.7	187.9	187.4	187.9	187.4	30.3	18.2	18.4	--
STGM2986	J4862	J-HC-07	94	Irregular Channel	15.8%	120.00	105.30	130.0	140.0	120.5	111.0	120.5	110.9		5.0	5.7	--
STGM2998	STMH107	STMH108	67	12'' DIA	7.0%	191.68	187.00	199.5	196.1	192.0	187.2	192.0	187.2	9.3	1.7	1.7	--
STGM3054	STMG1010	STMG109	317	18'' DIA	1.4%	189.18	184.62	201.5	199.7	190.2	185.9	190.2	185.9	12.6	10.5	10.8	--
STGM3056	STII116	STMI113	161	18'' DIA	0.7%	188.91	187.80	198.4	195.2	190.0	188.8	190.0	188.8	8.7	7.5	7.5	--
STGM3060	STMI081	STIL085	648	12'' DIA	4.6%	305.96	276.09	310.7	280.1	306.5	276.6	306.6	276.7	7.9	4.1	5.7	--
STGM3072	STMI1312	STMI1311	168	21'' DIA	1.7%	157.19	154.39	167.1	162.6	157.7	154.8	158.0	154.9	20.5	3.9	8.2	--
STGM311	J4198	J4200	251	Irregular Channel	2.8%	160.00	153.00	165.7	155.5	160.5	153.5	160.5	153.5		11.9	12.1	--
STGM3123	J5284	J5090	622	Irregular Channel	1.3%	252.00	244.00	280.7	260.8	252.7	245.6	252.8	246.0		5.2	6.5	--
STGM3128	J5628	J4734	39	12'' DIA	1.3%	264.50	264.00	271.1	268.3	267.6	266.9	268.7	268.0	4.0	11.8	17.9	--
STGM3138	STMH1313	STMH1312	49	12'' DIA	11.7%	153.35	147.62	163.3	162.4	153.6	147.9	153.7	147.9	12.9	2.2	2.7	--
STGM3166	STMI122	STMI121	491	24'' DIA	0.5%	182.11	179.45	192.6	189.9	183.3	180.2	183.3	180.2	16.7	9.7	9.7	--
STGM3183	STII0956	STII0957	79	15'' DIA	0.7%	257.19	256.62	263.8	263.3	258.0	257.3	258.2	257.5	5.7	4.0	5.7	--
STGM319	STII0955	STII0956	38	15'' DIA	2.0%	257.95	257.19	263.9	263.8	258.6	258.0	258.7	258.2	9.2	4.0	5.7	--
STGM3202	J4690	J-HC-40	763	Irregular Channel	8.1%	355.60	294.00	362.6	330.0	356.3	295.8	356.3	295.9		27.0	27.6	--
STGM3225	STII0948	STII0942	165	18'' DIA	0.5%	251.09	250.05	259.8	260.6	251.5	250.4	251.5	250.5	7.7	1.2	1.4	--
STGM3238	STII142	STII141	197	15'' DIA	0.2%	167.62	167.21	172.1	173.9	171.5	169.1	172.1	170.3	3.1	7.4	8.1	Future 10-yr
STGM3239	STII151	STMI151	314	18'' DIA	0.8%	159.50	156.80	167.6	164.7	160.6	158.0	167.6	160.4	9.4	8.0	14.5	--
STGM3242	STMG1015	STMG1019	29	24'' DIA	14.1%	181.87	177.80	191.3	190.8	182.4	178.9	182.4	178.9	83.9	14.3	14.5	--
STGM3263	STII0952	STII0948	79	18'' DIA	0.5%	251.69	251.09	259.1	259.8	252.1	251.5	252.1	251.5	7.7	1.2	1.4	--
STGM3271	J-HC-43	J-HC-42	49	18'' DIA	4.3%	348.30	344.20	365.0	351.7	352.8	345.4	352.8	345.4	21.7	33.9	33.9	--
STGM3278	STMH0916	STMH0923	40	12'' DIA	9.4%	193.13	189.37	199.8	198.7	193.8	189.9	193.8	189.9	11.4	8.3	9.2	--
STGM329	STMH106	STMH105	266	15'' DIA	1.4%	197.65	194.00	208.4	201.1	198.2	194.7	198.2	194.7	7.6	3.1	3.1	--
STGM3290	STMH1221	STMH1226	228	12'' DIA	0.2%	170.42	169.99	174.9	173.7	179.7	178.3	179.8	178.4	1.6	3.7	3.4	Existing 10-yr
STGM3325	J5324	J5326	46	12'' DIA	5.5%	436.50	434.00	460.0	439.5	437.3	434.3	437.3	434.3	8.3	7.3	7.3	--
STGM3337	STMH1137	J4198	581	18'' DIA	2.9%	177.67	160.00	185.0	165.7	178.4	160.5	178.4	160.5	17.9	8.6	8.8	--
STGM3381	STMI096	J-HC-36	2189	18'' DIA	3.4%	256.00	180.50	258.7	187.0	256.6	184.1	256.7	184.3	19.6	6.3	7.6	--
STGM3389	STII11281	STII11135	84	24'' DIA	1.2%	201.50	198.00	211.5	211.4	203.0	199.1	203.1	199.2	24.7	22.8	23.4	--
STGM3407	STIH1013	STMH109	184	12'' DIA	9.0%	201.50	185.00	209.0	193.1	201.7	185.1	201.7	185.1	10.8	1.2	1.2	--
STGM3431	STMH1215	STMH1216	41	15'' DIA	1.9%	157.22	156.42	163.5	162.7	158.2	156.9	158.3	157.0	8.9	8.9	9.2	--
STGM3432	J5026	STMH096	261	15'' DIA	0.8%	226.00	224.00	239.1	237.9	240.0	237.9	240.7	238.4	5.7	8.6	8.8	Existing 10-yr
STGM3445	STMI135	STMI131	340	18'' DIA	0.3%	152.82	151.80	166.1	167.5	154.0	152.4	154.0	152.4	6.0	5.9	5.9	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM3453	STMH1116	STMH1128	185	12'' DIA	5.1%	213.23	203.80	216.3	216.9	213.7	204.3	213.7	204.3	8.1	3.2	3.4	--
STGM3474	J5046	J4738	138	24'' DIA	1.4%	228.00	226.00	234.2	234.5	228.8	227.0	228.8	227.0	27.6	8.8	9.3	--
STGM351	J4636	STIH12139	376	Irregular Channel	0.9%	176.50	173.26	183.6	178.7	177.8	178.7	177.8	178.7		7.1	7.1	--
STGM3528	J4620	STMG1228	786	12'' DIA	0.5%	176.30	172.00	186.6	183.2	203.6	195.4	203.6	195.4	2.6	4.6	4.6	Existing 10-yr
STGM3539	STMG1223	STMG1213	526	12'' DIA	0.5%	170.31	167.50	176.1	174.0	180.2	167.9	180.2	167.9	2.6	5.0	5.0	Existing 10-yr
STGM3548	STMH1311	STMH1310	114	12'' DIA	6.6%	154.60	147.10	165.6	159.9	155.0	148.3	155.0	148.4	9.7	2.8	3.0	--
STGM355	STMH1230	STMH1222	116	12'' DIA	0.5%	172.72	172.10	176.7	176.3	183.3	182.5	183.4	182.7	2.7	3.6	3.6	Existing 10-yr
STGM3558	STMI112	STII118	164	18'' DIA	1.1%	192.35	190.63	203.9	202.3	192.9	191.6	192.9	191.6	10.7	3.2	3.2	--
STGM3568	J4234	STMI114	34	18'' DIA	1.0%	187.20	185.80	195.7	195.9	188.1	187.1	188.1	187.2	10.7	7.5	7.5	--
STGM3572	STMH1126	STMH1129	386	24'' DIA	1.6%	199.00	193.00	205.7	197.9	200.0	193.9	200.0	193.9	28.2	14.4	14.6	--
STGM3599	STIG1139	J4068	81	12'' DIA	0.5%	186.50	186.10	191.5	192.4	192.8	192.8	192.9	192.9	2.6	2.9	3.0	Existing 10-yr
STGM3602	STMH1224	STMH1227	430	15'' DIA	0.3%	172.96	171.54	180.0	180.9	180.0	180.9	180.0	180.9	3.7	5.5	5.5	--
STGM3610	STIL085	STMI0911	413	15'' DIA	4.0%	276.09	259.63	280.1	264.5	276.6	260.2	276.7	260.3	13.5	4.1	5.7	--
STGM3620	STII0942	STII0943	51	18'' DIA	0.5%	250.05	249.57	260.6	260.1	250.4	250.0	250.5	250.0	8.2	1.2	1.4	--
STGM3629	J3614	J4282	389	Irregular Channel	0.6%	172.00	169.70	178.3	174.0	173.0	170.6	173.0	170.6		11.7	11.7	--
STGM3680	J4784	J3628	466	Irregular Channel	0.4%	190.00	188.00	195.9	194.3	193.0	194.3	193.2	194.3		56.3	61.0	--
STGM3682	STIH1036	J-HCT4-06	63	27'' DIA	7.9%	190.00	185.00	197.3	195.0	191.3	186.3	191.3	186.4	47.5	29.9	30.3	--
STGM37	STMH1135	STMH118	320	15'' DIA	0.5%	185.80	184.00	193.2	189.9	186.6	184.6	186.6	184.6	4.4	3.2	3.3	--
STGM3704	STMG115	STIG1142	121	12'' DIA	0.4%	187.00	186.50	192.7	192.4	193.1	192.8	193.0	192.9	2.3	6.7	6.7	Existing 10-yr
STGM3712	STMH116	STIH118	310	18'' DIA	6.7%	184.21	163.50	195.5	170.0	185.3	164.1	185.3	164.1	27.2	19.9	20.2	--
STGM3729	J4098	J-HC-11	325	Irregular Channel	12.3%	152.00	112.50	157.4	119.0	152.4	115.2	152.4	115.4		7.1	8.1	--
STGM3730	J5510	STMH1137	162	18'' DIA	1.8%	180.53	177.67	188.5	185.0	181.2	178.4	181.2	178.4	14.1	4.9	5.1	--
STGM3756	J4370	J5046	214	Irregular Channel	0.4%	228.80	228.00	234.8	234.2	229.9	228.8	230.0	228.8		8.9	9.3	--
STGM3759	STMG125	STMG126	306	12'' DIA	1.3%	166.96	163.00	177.0	172.1	177.9	163.5	177.9	163.5	4.1	7.1	7.1	Existing 10-yr
STGM3771	STMH102	STMH103	272	24'' DIA	1.7%	174.70	169.99	182.3	181.1	175.9	170.9	175.9	170.9	29.7	18.1	18.5	--
STGM3809	STIH145	STIH146	105	12'' DIA	-0.3%	163.35	163.62	167.1	166.2	165.5	164.2	165.6	164.2	1.8	3.4	3.4	--
STGM3810	STMH1254	J4668	579	12'' DIA	0.8%	169.50	164.65	176.8	173.3	208.0	190.1	208.6	191.1	3.3	8.2	8.2	Existing 10-yr
STGM383	STMH1011	STIH1038	54	12'' DIA	2.4%	199.00	197.70	207.8	205.3	199.4	198.0	199.4	198.0	5.6	1.9	1.9	--
STGM3836	J3938	J4688	349	Irregular Channel	8.6%	387.00	357.00	397.0	364.2	388.0	358.2	388.0	358.2		27.1	27.7	--
STGM3848	STMG122	STMG1223	261	12'' DIA	0.5%	171.50	170.31	177.4	176.1	185.2	180.2	185.2	180.2	2.4	5.2	5.2	Existing 10-yr
STGM3855	J4628	STIH0917	253	Irregular Channel	4.8%	242.10	230.00	252.5	242.0	242.5	242.3	243.2	243.2		3.8	6.8	--
STGM3862	J4688	J4690	40	Irregular Channel	3.5%	357.00	355.60	364.2	362.6	358.2	356.3	358.2	356.3		27.1	27.7	--
STGM3868	J6	STIH145	135	12'' DIA	0.5%	164.00	163.35	169.4	167.1	166.7	165.5	166.9	165.6	2.5	3.4	3.4	--
STGM3906	STMH094	STMH093	78	12'' DIA	0.7%	195.80	195.22	204.5	204.4	196.4	195.5	196.4	195.5	3.0	2.2	2.2	--
STGM3923	STMH1124	STMH1112	28	21'' DIA	2.1%	203.30	202.70	211.4	211.0	203.8	203.3	203.8	203.3	22.5	3.4	3.4	--
STGM3927	STMG1228	STMG125	449	12'' DIA	1.1%	172.00	166.96	183.2	177.0	195.4	177.9	195.4	177.9	3.8	8.1	8.1	Existing 10-yr
STGM3952	J4738	J4740	1597	Irregular Channel	2.0%	226.00	194.00	234.5	202.9	227.0	195.6	227.0	195.6		23.7	24.1	--
STGM3954	STMH103	J3696	206	21'' DIA	6.5%	169.99	156.53	181.1	166.6	170.9	157.1	170.9	157.1	40.3	18.1	18.5	--
STGM396	STIH1035	STIH1036	38	27'' DIA	2.3%	190.90	190.00	197.0	197.3	192.6	191.3	192.6	191.3	25.8	22.9	23.3	--
STGM3971	J4050	STMI096	50	18'' DIA	2.0%	258.00	256.00	262.3	258.7	258.4	256.6	258.5	256.7	15.0	1.8	3.1	--
STGM3990	STMG108	STMG109	128	21'' DIA	3.0%	188.50	184.62	199.3	199.7	189.0	185.9	189.0	185.9	27.5	4.2	4.2	--
STGM4004	STMH129	STMH128	444	36'' DIA	1.6%	180.81	173.60	192.2	186.6	182.0	176.2	182.1	176.3	86.2	30.2	30.8	--
STGM4009	STII0943	STII0947	281	18'' DIA	0.5%	249.57	248.11	260.1	252.1	250.0	248.4	250.0	248.4	7.7	1.2	1.4	--
STGM4036	STII0950	STII0952	174	18'' DIA	0.5%	252.77	251.69	260.3	259.1	253.2	252.1	253.2	252.1	7.7	1.2	1.4	--
STGM407	J5480	J5026	184	15'' DIA	1.1%	228.10	226.00	240.3	239.1	241.7	240.0	242.4	240.7	6.9	8.4	8.6	Existing 10-yr
STGM4082	J4740	STIH1035	116	27'' DIA	2.7%	194.00	190.90	202.9	197.0	195.6	192.6	195.6	192.6	27.3	23.5	24.0	--
STGM4085	STMG106	STMG1035	184	18'' DIA	0.5%	190.00	189.00	200.6	197.3	190.8	189.8	190.8	189.8	7.7	4.1	4.1	--
STGM4187	STIH1012	STIH1013	35	12'' DIA	0.3%	201.60	201.50	209.0	209.0	202.1	201.7	202.1	201.7	1.9	1.1	1.1	--
STGM4198	STMH0913	STMH0916	214	12'' DIA	1.2%	195.61	193.13	206.5	199.8	206.0	193.8	208.4	193.8	4.0	8.3	9.3	Future 10-yr
STGM4205	STMH0920	STMH0919	55	18'' DIA	5.1%	212.00	209.20	221.4	217.9	222.8	220.5	223.9	221.5	23.8	21.9	22.2	Existing 10-yr
STGM4217	J5242	J4050	531	Irregular Channel	0.4%	260.00	258.00	262.2	262.3	260.3	258.4	260.4	258.5		1.9	3.2	--
STGM4228	J-HC-35	J-HC-34	88	60'' DIA	1.9%	178.70	177.00	185.2	190.0	181.7	180.8	182.1	181.0	364.5	193.2	250.1	--
STGM4240	J4610	J-HC-03	540	24'' DIA	0.2%	100.00	97.20	156.6	168.5	103.3	102.8	156.6	103.6	9.7	18.7	48.3	--
STGM425	STMH128	STMH127	415	42'' DIA	0.1%	173.60	173.13	186.6	181.8	176.2	174.6	176.3	174.6	33.8	50.0	50.8	--
STGM4250	J3872	STMG112	167	12'' DIA	0.2%	185.80	185.51	193.2	194.4	192.6	192.2	193.2	192.3	1.5	2.9	3.0	--
STGM4256	STMH1127	STMH1126	268	21'' DIA	0.6%	200.50	199.00	212.7	205.7	201.8	200.0	201.9	200.0	11.8	11.2	11.5	--
STGM4274	STMH127	STMH1231	81	48'' DIA	1.9%	173.13	171.56	181.8	179.7	174.6	173.4	174.6	173.5	197.6	55.3	56.3	--
STGM4279	STII0953	STII0954	78	18'' DIA	1.3%	260.00	259.00	263.3	261.0	260.2	259.3	260.2	259.3	13.3	0.4	0.6	--
STGM428	STMH1241	J-HCT3-03	132	18'' DIA	5.3%	161.94	155.00	167.6	165.0	162.3	155.7	162.3	155.7	24.0	2.7	2.7	--
STGM4297	STMH1214	STMH1215	185	15'' DIA	1.7%	160.30	157.22	168.3	163.5	161.2	158.2	161.2	158.3	8.3	7.0	7.0	--
STGM4325	STMH1244	STMH1245	195	12'' DIA	0.5%	167.19	166.12	172.6	172.5	167.9	166.5	167.9	166.5	2.8	2.0	2.0	--
STGM4334	STMH1024	STMH0912	207	12'' DIA	0.5%	205.02	204.00	212.8	211.5	222.1	222.0	228.4	228.3	2.6	1.0	1.2	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM4460	J3628	J3630	62	12'' DIA	0.8%	188.00	187.50	194.3	191.1	194.3	193.0	194.3	193.1	3.2	63.1	68.1	Existing 10-yr
STGM461	STMG1019	STMH102	153	24'' DIA	2.0%	177.80	174.70	190.8	182.3	178.9	175.9	178.9	175.9	32.4	18.1	18.5	--
STGM480	J5560	J5562	66	18'' DIA	1.5%	165.00	164.00	168.9	171.1	166.4	165.0	166.4	165.0	12.9	15.6	15.9	--
STGM496	STMH1240	STMH1241	57	18'' DIA	0.6%	162.29	161.94	167.9	167.6	162.9	162.3	162.9	162.3	8.5	2.7	2.7	--
STGM522	STMG1035	STMG108	111	18'' DIA	0.5%	189.00	188.50	197.3	199.3	189.8	189.0	189.8	189.0	7.1	4.1	4.1	--
STGM525	STMH1253	STMH1254	74	12'' DIA	1.8%	170.83	169.50	177.3	176.8	210.7	208.0	211.3	208.6	4.8	9.0	9.0	Existing 10-yr
STGM526	STMH1015	STMH1013	50	12'' DIA	0.4%	205.00	204.80	216.2	214.2	205.5	205.1	205.5	205.1	2.2	1.2	1.2	--
STGM545	STMH1125	STMH1124	106	21'' DIA	3.2%	206.69	203.30	211.6	211.4	207.1	203.8	207.1	203.8	28.1	3.4	3.4	--
STGM546	STMH1144	STMH1127	360	21'' DIA	0.3%	201.70	200.50	207.2	212.7	203.0	201.8	203.0	201.9	9.2	8.2	8.4	--
STGM551	STII1179	STMI1140	50	24'' DIA	0.4%	205.36	205.14	212.9	210.6	207.2	206.9	207.3	206.9	15.0	19.3	19.9	--
STGM610	J5444	J5484	87	18'' DIA	0.7%	212.42	211.80	219.8	218.5	215.0	213.1	215.3	213.1	8.9	15.2	16.1	--
STGM614	STMH111	STMH1017	416	12'' DIA	1.4%	198.50	192.51	201.8	194.6	199.2	192.9	199.3	192.9	4.3	3.4	3.4	--
STGM615	J5450	J-HC-37	1211	Irregular Channel	7.0%	280.00	196.00	288.9	220.0	280.3	199.0	280.3	199.3		2.4	2.7	--
STGM619	STMH1211	STMH1212	125	12'' DIA	1.0%	169.52	168.22	174.7	173.3	178.0	176.4	178.2	176.6	3.6	5.5	5.0	Existing 10-yr
STGM630	STII0945	STII0944	48	12'' DIA	0.6%	246.63	246.13	252.5	252.4	247.7	246.6	249.2	246.8	2.9	3.8	6.8	--
STGM658	J-HCT3-09	J-HCT3-08	49	24'' DIA	0.6%	170.50	170.20	177.1	175.0	171.8	171.6	171.8	171.7	89.1	60.6	61.5	--
STGM674	STMH1229	STMH1228	221	12'' DIA	1.5%	168.72	165.50	176.6	173.4	169.3	167.6	169.3	167.7	4.5	2.6	2.7	--
STGM712	STIG1142	STIG1139	115	12'' DIA	0.0%	186.50	186.50	192.4	191.5	192.8	192.8	192.9	192.9	0.1	2.9	3.0	Existing 10-yr
STGM727	STMH138	J-HC-12	142	12'' DIA	6.6%	124.75	115.43	138.8	140.0	125.1	120.1	125.1	120.3	9.7	1.9	2.2	--
STGM734	J-HCT3-07	J-HCT3-06	45	36'' DIA	0.4%	164.60	164.40	173.0	170.0	167.6	167.2	167.6	167.2	44.5	60.6	61.5	--
STGM74	J5090	J4956	96	36'' DIA	4.2%	244.00	240.00	260.8	254.2	245.6	241.6	246.0	241.8	136.8	79.6	113.0	--
STGM748	STMH1216	J4504	72	15'' DIA	13.9%	156.42	146.42	162.7	159.2	156.9	147.2	157.0	147.3	23.9	8.9	9.2	--
STGM761_a	STII0954	J35	321	Irregular Channel	1.6%	259.00	253.80	261.0	256.7	259.3	254.1	259.3	254.2		3.9	6.8	--
STGM761_b	J35	J5012	1225	Irregular Channel	1.6%	253.80	234.00	256.7	240.5	254.1	236.3	254.2	236.8		8.1	12.9	--
STGM793	J4066	STIG11113	27	12'' DIA	0.4%	186.00	185.90	192.0	192.8	192.7	192.7	192.8	192.8	2.3	3.2	3.2	Existing 10-yr
STGM855	J5326	J4576	942	Irregular Channel	13.0%	434.00	313.00	439.5	319.3	434.3	313.2	434.3	313.2		7.3	7.3	--
STGM857	STMH117	STMH114	443	24'' DIA	0.9%	190.68	186.75	195.9	200.8	192.1	187.9	192.1	187.9	21.3	17.4	17.6	--
STGM900	STMH1233	STMH1211	313	15'' DIA	0.4%	170.71	169.52	177.2	174.7	178.1	178.0	178.3	178.2	4.0	2.0	2.0	Existing 10-yr
STGM910	STIG11113	J3872	49	12'' DIA	0.2%	185.90	185.80	192.8	193.2	192.7	192.6	192.8	193.2	1.7	3.1	3.2	--
STGM937	STIH12125	STMH125	90	15'' DIA	0.6%	178.25	177.69	181.7	185.8	179.0	178.2	179.0	178.2	5.1	3.1	3.1	--
STGM952	STIH1043	STMH1014	82	12'' DIA	8.0%	204.00	197.45	210.2	207.5	204.3	197.8	204.3	197.8	10.2	1.9	1.9	--
STGM962	STMH1238	STMH1239	206	15'' DIA	0.5%	165.13	164.09	170.5	170.2	165.8	164.7	165.8	164.7	4.8	2.7	2.7	--
STGM98	STMG109	STMG1015	220	21'' DIA	1.2%	184.62	181.87	199.7	191.3	185.9	182.4	185.9	182.4	17.6	14.3	14.5	--
VILLA_CULVERT_1	J-HC-29	J-HC-28	59	30'' DIA	2.9%	153.50	151.80	160.0	170.0	156.5	155.9	156.9	156.2	69.9	234.7	300.4	--
VILLA_CULVERT_2	J-HC-29	J-HC-28	58	60'' DIA	2.9%	153.50	151.80	160.0	170.0	156.5	155.9	156.9	156.2	450.5	234.7	300.4	--
SPRING BROOK																	
C4	J5	J4848	282	Irregular Channel	1.3%	247.57	244.00	255.0	250.9	251.0	250.9	255.0	253.4		15.6	45.7	Future 10-yr
C52	J4990	STMJ1236	76	Irregular Channel	2.5%	167.85	165.95	179.0	178.4	168.0	166.6	168.0	166.7		2.0	2.2	--
HAYES_CULVERT	J-SBT1-05	J-SBT1-04	105	72'' DIA	2.7%	157.40	154.61	180.0	180.0	159.6	157.6	159.7	157.7	379.1	106.2	112.5	--
SB-00	J-SB-02	OF_J-SB-01	16	Irregular Channel	6.8%	106.10	105.00	130.0	165.0	109.0	108.2	109.2	108.4		616.3	671.8	--
SB-01	J-SB-03	J-SB-02	1345	Irregular Channel	0.2%	108.60	106.10	140.0	130.0	114.6	109.0	114.8	109.2		520.4	566.4	--
SB-02	J-SB-04	J-SB-03	4551	Irregular Channel	0.2%	115.90	108.60	125.0	140.0	121.4	114.6	121.4	114.8		409.2	437.7	--
SB-03	J-SB-06	J-SB-05	437	Irregular Channel	0.4%	119.00	117.10	125.0	125.0	122.5	122.1	122.7	122.2		425.7	454.9	--
SB-04	J-SB-07	J-SB-06	2465	Irregular Channel	0.3%	126.60	119.00	150.0	125.0	131.9	122.5	131.9	122.7		372.3	403.6	--
SB-05	J-SB-08	J-SB-07	2409	Irregular Channel	0.3%	134.00	126.60	160.0	150.0	139.5	131.9	139.6	131.9		347.1	369.5	--
SB-06	J-SB-09	J-SB-08	1627	Irregular Channel	0.3%	139.00	134.00	165.0	160.0	142.9	139.5	143.0	139.6		341.8	367.6	--
SB-07	J-SB-10	J-SB-09	1031	Irregular Channel	1.1%	150.00	139.00	155.0	165.0	152.9	142.9	153.2	143.0		240.1	269.4	--
SB-08	J-SB-11	J-SB-10	537	Irregular Channel	0.2%	151.00	150.00	153.2	155.0	154.9	152.9	155.0	153.2		198.5	221.0	Existing 10-yr
SB-09	J-SB-13	J-SB-12	2247	Irregular Channel	1.1%	177.00	152.70	185.0	156.3	179.4	157.9	179.5	158.6		177.3	210.0	--
SB-10	J-SB-14	J-SB-13	2491	Irregular Channel	1.9%	224.00	177.00	235.0	185.0	225.5	179.4	225.7	179.5		98.2	132.2	--
SB-11	J-SB-15	J-SB-14	1149	Irregular Channel	3.2%	260.20	224.00	270.0	235.0	261.4	225.5	261.5	225.7		64.0	94.0	--
SBT1-01	J-SBT1-01	J-SB-03	2512	Irregular Channel	1.2%	137.80	108.60	150.0	140.0	140.3	114.6	140.4	114.8		147.8	165.4	--
SBT1-02	J-SBT1-03	J-SBT1-02	1576	Irregular Channel	0.9%	152.20	138.80	175.0	152.6	155.2	145.9	155.3	146.8		118.1	128.9	--
SBT1-03	J-SBT1-04	J-SBT1-03	284	Irregular Channel	0.8%	154.61	152.20	180.0	175.0	157.6	155.2	157.7	155.3		113.2	123.4	--
SBT1-04	J-SBT1-06	J-SBT1-05	645	Irregular Channel	2.9%	176.00	157.40	185.0	180.0	178.2	159.6	178.2	159.7		89.0	92.2	--
SBT1-05	J-SBT1-08	J-SBT1-07	139	Irregular Channel	1.4%	182.00	180.00	199.2	197.0	182.7	181.4	182.7	181.4		81.4	84.4	--
SBT1-06	J-SBT1-09	J-SBT1-08	68	Irregular Channel	4.3%	188.95	182.00	196.5	199.2	189.2	182.7	189.2	182.7		15.8	15.8	--
SBT2-01	STMJ1242	J-SB-06	236	Irregular Channel	7.3%	136.14	119.00	145.0	125.0	136.5	122.5	136.5	122.7		10.7	11.2	--
SBT3-01	J-SBT3-01	J-SB-06	874	Irregular Channel	3.3%	147.70	119.00	160.0	125.0	148.5	122.5	148.6	122.7		26.2	36.7	--
SBT4-01	J-SBT4-01	J-SB-07	283	Irregular Channel	4.9%	140.54	126.60	145.0	150.0	141.2	131.9	141.2	131.9		21.4	21.4	--
SBT4-02	J-SBT4-02	STMK1113	198	Irregular Channel	-0.2%	153.60	154.00	157.0	167.8	155.5	155.2	155.7	155.6		18.3	19.5	--
SBT4-03	J-SBT4-03	J-SBT4-02	411	Irregular Channel	1.9%	161.31	153.60	170.0	157.0	161.9	155.5	161.9	155.7		13.0	13.5	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
SBT4-04	J-SBT4-05	J-SBT4-02	329	Irregular Channel	4.3%	167.77	153.60	173.0	157.0	168.0	155.5	168.0	155.7		3.5	3.9	--
SBT5-01	J-SBT5-01	J-SB-08	860	Irregular Channel	4.1%	169.20	134.00	180.0	160.0	169.8	139.5	169.8	139.6		15.2	17.4	--
SBT6-01	J-SBT6-01	J-SB-09	1563	Irregular Channel	0.3%	143.00	139.00	160.0	165.0	144.0	142.9	144.0	143.0		116.3	116.3	--
SBT7-01	J-SBT7-01	J-SB-10	684	Irregular Channel	2.6%	168.00	150.00	170.0	155.0	169.0	152.9	169.0	153.2		43.8	49.7	--
SBT7-02	J-SBT7-03	J-SBT7-02	382	Irregular Channel	4.4%	189.88	173.00	193.6	179.5	190.3	175.0	190.3	175.0		3.5	3.5	--
SPRINGBROOK_CULVERT	J-SB-16	J-SB-15	113	36'' DIA	6.0%	267.00	260.20	272.2	270.0	268.3	261.4	268.7	261.5	164.2	64.0	94.0	--
STGM1004	J5124	STMI0910	143	12'' DIA	2.8%	233.00	229.00	235.4	235.6	233.8	232.6	236.5	235.3	6.0	3.6	5.6	Future 10-yr
STGM1013	STMJ1136	STMJ1132	488	18'' DIA	0.6%	178.62	175.66	191.8	181.2	179.4	176.3	179.5	176.4	8.6	4.3	5.3	--
STGM1026	STMI1218	STMI1217	124	12'' DIA	1.6%	180.87	178.84	187.2	185.2	181.2	179.5	181.2	179.5	4.7	1.4	1.4	--
STGM1031	STMK1216	STMK1215	237	12'' DIA	12.7%	204.42	174.52	215.4	185.0	204.7	174.9	204.7	174.9	13.5	2.3	2.3	--
STGM1034	STMJ092	STMJ091	61	12'' DIA	0.3%	222.67	222.46	232.5	232.9	252.2	250.2	267.8	264.8	2.1	7.2	9.9	Existing 10-yr
STGM1040	STII0983	STII0916	198	21'' DIA	0.8%	232.30	230.80	238.3	236.9	237.1	234.6	238.8	237.3	13.9	14.6	15.0	Future 10-yr
STGM1043	STMJ1228	STMJ1229	80	15'' DIA	5.3%	142.40	138.19	152.3	150.4	143.2	139.0	143.2	139.0	15.5	10.7	11.2	--
STGM1064	STMI095	STII104	249	15'' DIA	-0.1%	232.85	233.15	244.0	239.5	238.6	233.9	236.9	233.9	2.2	4.0	4.1	--
STGM1074	STMJ1134	STMJ1135	247	15'' DIA	5.1%	184.75	172.13	193.7	184.2	185.1	173.3	185.2	173.5	15.4	3.1	3.8	--
STGM1080	STMI091	STMI1014	252	21'' DIA	1.1%	220.03	217.26	229.9	225.1	223.4	218.9	226.9	223.1	16.6	21.1	21.6	--
STGM1083	STII1033	STII1034	141	12'' DIA	1.1%	224.79	223.24	227.9	226.1	239.9	233.7	260.3	249.2	3.7	8.4	11.1	Existing 10-yr
STGM1099	STII0967	STII0968	33	12'' DIA	2.9%	255.36	254.20	261.6	260.1	255.6	254.5	255.7	254.5	6.3	1.1	1.4	--
STGM1105	STMK117	STMK118	144	12'' DIA	2.6%	173.50	169.71	180.8	178.2	174.0	170.3	174.0	170.3	6.1	3.2	3.4	--
STGM1126	J3524	STMI1015	178	15'' DIA	1.9%	217.58	213.55	225.1	221.8	223.5	221.8	231.6	227.9	9.0	7.4	9.7	Future 10-yr
STGM1130	STII10109	STII1030	119	12'' DIA	1.9%	223.00	220.80	231.7	229.4	237.8	237.1	241.3	240.7	4.8	4.4	5.5	Existing 10-yr
STGM1144	STMK1120	STMK1119	91	12'' DIA	5.8%	172.58	167.33	180.2	175.6	173.0	167.9	173.0	167.9	8.9	2.8	3.0	--
STGM1194	STMJ1219	STMJ1220	59	12'' DIA	3.0%	127.73	125.95	133.3	134.1	128.2	126.6	128.2	126.6	6.4	2.5	3.2	--
STGM1206	STMI1013	STMI109	362	21'' DIA	1.6%	222.05	216.25	230.4	223.3	222.5	218.4	222.5	222.7	10.8	1.5	1.5	--
STGM1211	STMI106	STMI1021	401	21'' DIA	2.6%	222.18	211.58	225.8	215.2	222.9	212.5	222.9	212.5	25.6	9.0	9.1	--
STGM1213	STII1056	STMI108	206	12'' DIA	1.6%	213.00	209.79	220.4	221.0	216.9	216.9	219.7	219.7	4.5	1.6	1.6	--
STGM1231	STII0988	STMI099	66	30'' DIA	0.5%	228.75	228.23	239.6	241.7	237.8	237.8	241.3	241.4	29.4	3.2	4.2	Future 10-yr
STGM1241	J-SB-12	J-SB-11	185	48'' DIA	0.9%	152.70	151.00	156.3	153.2	157.9	154.9	158.6	155.0	137.3	204.3	231.2	Existing 10-yr
STGM1265	J5216	J4424	585	Irregular Channel	0.7%	206.00	202.00	211.3	204.8	216.6	203.1	218.9	203.4		48.9	52.2	Existing 10-yr
STGM1277	STMK1110	STMK117	115	12'' DIA	3.7%	177.71	173.50	187.2	180.8	178.2	174.0	178.2	174.0	7.2	3.2	3.4	--
STGM1287	STII09103	STII09106	123	18'' DIA	1.1%	250.92	249.39	259.4	257.7	252.0	252.2	259.4	257.8	11.4	9.3	18.1	Future 10-yr
STGM1289	J4834	STII1194	312	24'' DIA	1.0%	197.00	193.95	209.4	202.5	198.3	195.7	198.3	195.9	22.5	17.3	17.4	--
STGM1305	STMJ1121	STMJ1120	211	12'' DIA	0.7%	186.07	184.60	195.3	193.0	186.9	185.3	189.3	185.4	3.1	3.0	4.3	--
STGM1306	STMJ1127	STMJ1113	74	15'' DIA	2.3%	208.87	207.14	213.0	211.5	209.2	207.4	209.2	207.4	10.1	1.4	1.5	--
STGM1321	STML1131	STML1132	245	27'' DIA	1.8%	194.81	190.42	207.4	202.9	195.8	191.4	195.8	191.4	41.6	15.8	15.8	--
STGM133	STII09106	J5	144	18'' DIA	1.3%	249.39	247.57	257.7	255.0	252.2	251.0	257.8	255.0	12.3	9.3	17.7	Future 10-yr
STGM1348	STMJ1222	STMJ1220	110	18'' DIA	6.8%	133.40	125.95	138.2	134.1	134.0	126.6	134.0	126.6	28.0	9.0	9.0	--
STGM1359	J5382	J5178	136	Irregular Channel	7.1%	214.65	205.00	219.1	210.4	214.9	205.5	214.9	205.5		5.3	5.3	--
STGM1360	STMJ1010	STMJ1012	157	12'' DIA	2.5%	185.18	181.23	193.3	191.5	185.4	181.6	185.4	181.7	5.9	0.7	0.7	--
STGM14	STMK116	STMK115	109	12'' DIA	5.6%	179.68	173.64	190.1	181.5	180.3	174.2	180.4	174.2	8.7	6.6	6.8	--
STGM1405	STMK1223	STMK1224	353	12'' DIA	5.4%	263.91	244.69	272.9	253.2	264.3	245.0	264.3	245.0	8.5	2.3	2.3	--
STGM1422	STMK1119	STMK1118	113	12'' DIA	1.7%	167.33	165.41	175.6	174.1	167.9	165.9	167.9	166.0	4.6	2.8	3.0	--
STGM1444	STMJ1229	STMJ1242	39	15'' DIA	5.3%	138.19	136.14	150.4	145.0	139.0	136.5	139.0	136.5	15.5	10.7	11.2	--
STGM1460	STMJ1126	STMJ1128	241	12'' DIA	2.0%	219.30	214.51	223.5	218.8	219.7	214.9	219.7	214.9	5.3	1.4	1.5	--
STGM1504	STII0990	STII0991	106	30'' DIA	0.5%	227.59	226.87	238.2	235.7	237.8	237.8	241.3	241.3	30.5	4.6	5.8	Future 10-yr
STGM1581	STMK119	STIK117	141	15'' DIA	0.3%	168.40	167.96	177.3	175.0	169.3	168.7	169.3	168.8	3.8	3.1	3.4	--
STGM1593	J4848	STII0913	499	12'' DIA	1.8%	244.00	235.00	250.9	243.0	250.9	238.1	253.4	241.5	4.8	17.2	41.6	Existing 10-yr
STGM1611	STMI1177	J-SBT1-08	153	42'' DIA	2.0%	185.02	182.00	201.0	199.2	186.6	182.7	186.6	182.7	142.9	52.9	55.1	--
STGM1627	STMI1168	STMI1167	98	15'' DIA	1.2%	194.76	193.54	202.0	199.4	195.4	194.2	195.4	194.5	7.4	3.4	3.7	--
STGM1637	STMJ1216	J4990	84	18'' DIA	5.1%	172.18	167.85	179.1	179.0	172.5	168.0	172.5	168.0	25.0	2.0	2.2	--
STGM1646	J3668	STII0913	55	21'' DIA	0.9%	235.50	235.00	241.6	243.0	237.5	238.1	241.7	241.5	15.0	12.6	16.3	Future 10-yr
STGM1647	STMJ1239	STMJ1233	158	36'' DIA	0.8%	160.72	159.41	175.8	172.3	161.7	160.5	161.9	160.7	33.2	7.6	10.3	--
STGM1650	STMK124	STMK122	179	18'' DIA	0.5%	164.12	163.17	169.3	171.4	164.9	164.0	164.9	164.0	8.0	4.5	4.5	--
STGM1667	STMI1171	STMI1170	62	12'' DIA	1.1%	197.53	196.84	203.5	202.7	198.1	197.4	198.1	197.4	3.9	2.1	2.3	--
STGM17	STMJ128	STMI1212	450	33'' DIA	0.5%	167.85	165.74	175.6	175.9	169.1	166.9	169.2	167.0	37.9	15.9	17.8	--
STGM1701	STMI094	STMI093	256	21'' DIA	1.2%	226.07	223.04	236.0	232.8	231.8	227.6	234.6	230.7	18.0	21.1	21.6	--
STGM1739	J-SBT4-04	J-SBT4-03	68	33'' DIA	3.3%	163.59	161.31	171.9	170.0	164.3	161.9	164.3	161.9	100.2	13.1	13.5	--
STGM1742	STMK123	STMK122	248	12'' DIA	6.2%	178.61	163.17	184.0	171.4	178.8	164.0	178.8	164.0	9.5	1.1	1.1	--
STGM1757	STII0915	STMI0910	87	21'' DIA	0.8%	229.70	229.00	236.6	235.6	233.2	232.6	236.0	235.3	14.3	15.1	15.4	--
STGM1784	STMI099	STII0990	90	30'' DIA	0.5%	228.23	227.59	241.7	238.2	237.8	237.8	241.4	241.3	29.5	3.2	4.5	--
STGM1822	STMJ1235	STMJ1234	228	24'' DIA	1.7%	170.33	166.39	176.9	173.8	171.1	167.2	171.2	167.3	30.6	10.4	13.1	--
STGM1824	STMJ105	J3522	28	15'' DIA	0.3%	212.09	212.00	221.3	221.6	216.1	213.8	216.4	213.9	3.7	18.3	19.2	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM1893	STMK1224	STMK1225	64	12'' DIA	8.2%	244.69	239.49	253.2	249.0	245.0	239.8	245.0	239.8	10.4	2.3	2.3	--
STGM1917	STII09125	STII09124	140	15'' DIA	0.3%	248.36	247.94	254.3	253.5	249.8	249.0	252.2	249.3	3.7	5.3	7.9	--
STGM1943	STMJ1210	STMJ128	156	21'' DIA	0.6%	168.84	167.85	174.5	175.6	170.1	169.1	170.2	169.2	13.1	11.0	12.7	--
STGM1946	STMK1232	STMK1231	271	12'' DIA	10.7%	248.53	219.71	252.9	228.0	248.8	220.0	248.8	220.0	12.3	2.6	2.6	--
STGM1948_a	J5178	J4094	903	Irregular Channel	2.2%	205.00	185.00	210.4	190.0	205.5	185.4	205.5	185.5		37.7	40.9	--
STGM1948_b	J4094	J4284	257	Irregular Channel	3.9%	185.00	174.80	190.0	184.9	185.4	179.6	185.5	180.5		42.1	52.9	--
STGM1949	STMI1017	J5216	86	24'' DIA	0.6%	206.55	206.00	215.3	211.3	216.6	216.6	219.0	218.9	18.1	13.9	15.6	Existing 10-yr
STGM1954	STMI1222	STMI1212	231	18'' DIA	3.0%	172.59	165.74	178.7	175.9	173.2	166.9	173.2	167.0	18.8	5.6	5.8	--
STGM1965	STMI1012	STMI103	93	27'' DIA	0.4%	211.40	210.80	219.9	220.7	218.5	217.6	219.8	219.2	20.3	29.5	30.0	--
STGM197	STMK1117	STMK1116	135	15'' DIA	1.3%	164.26	162.55	173.2	171.6	164.8	163.0	164.8	163.0	7.6	2.8	3.0	--
STGM1978	STII09111	STII09112	77	18'' DIA	0.5%	247.51	247.12	252.8	253.4	248.4	247.7	248.7	247.8	7.8	5.3	7.9	--
STGM1994	STII104	STMI1010	59	15'' DIA	0.8%	233.15	232.65	239.5	240.0	233.9	233.4	233.9	233.4	5.9	4.0	4.1	--
STGM2002	STMI1215	STMI1210	123	18'' DIA	1.2%	170.24	168.81	177.1	175.7	170.8	169.2	170.8	169.2	12.0	3.4	3.4	--
STGM201	STMI1113	STMI1123	445	36'' DIA	0.8%	193.31	189.65	203.0	206.2	195.5	191.5	195.5	191.6	60.5	52.0	54.1	--
STGM203	STMJ1213	STMJ1214	166	12'' DIA	1.1%	180.53	178.72	185.1	183.1	181.4	181.2	185.1	183.1	3.8	2.1	2.3	--
STGM2032	STMI128	STII1245	602	24'' DIA	2.2%	173.00	160.00	180.2	167.7	174.0	161.1	174.0	161.2	34.3	16.1	17.2	--
STGM2036	STMK1121	STMK116	208	12'' DIA	5.1%	190.20	179.68	198.3	190.1	190.9	180.3	190.9	180.4	8.4	6.6	6.8	--
STGM2043	STMJ1143	STMJ1238	499	24'' DIA	1.4%	176.00	168.99	184.3	178.5	176.4	169.4	176.5	169.5	28.0	2.8	3.9	--
STGM2050	STMK115	STMK114	111	12'' DIA	7.6%	173.64	165.22	181.5	172.5	174.2	166.0	174.2	166.0	10.2	6.6	6.8	--
STGM2060	STMI1214	J-SBT1-02	124	24'' DIA	15.0%	157.09	138.80	166.7	152.6	157.8	145.9	157.9	146.8	91.6	26.6	28.6	--
STGM2072	STMI1160	STMI1144	101	15'' DIA	0.6%	187.86	187.23	195.0	193.5	188.5	187.8	188.6	187.8	5.3	3.1	3.2	--
STGM2081	STMJ103	STMJ106	121	21'' DIA	0.3%	213.12	212.77	221.6	222.2	217.8	217.1	219.0	218.2	8.5	8.8	8.8	--
STGM2099	J5236	J4848	331	12'' DIA	2.1%	252.00	244.00	258.6	250.9	252.5	250.9	258.6	253.4	5.1	2.1	3.3	--
STGM210	STMI109	STMI105	34	33'' DIA	3.1%	216.25	215.20	223.3	223.5	218.4	223.5	222.7	223.5	93.8	25.5	26.0	--
STGM2106	STMK1228	STMK124	54	18'' DIA	3.7%	166.09	164.12	170.3	169.3	166.5	164.9	166.5	164.9	20.7	3.7	3.8	--
STGM2113	STIK116	J-SBT4-04	29	33'' DIA	3.3%	164.54	163.59	173.0	171.9	164.9	164.3	164.9	164.3	108.0	3.2	3.4	--
STGM2171	STMJ104	STMJ107	332	36'' DIA	0.4%	211.50	210.16	221.3	224.1	213.1	212.0	213.1	212.1	41.5	22.0	23.0	--
STGM2217	STMJ122	STMJ123	421	12'' DIA	1.6%	183.38	176.80	188.7	182.2	183.9	181.1	184.1	182.2	4.6	2.7	2.7	--
STGM2225	STMJ125	STMJ126	496	12'' DIA	1.5%	181.17	173.71	186.0	178.9	181.4	174.4	181.5	174.4	4.6	0.7	0.8	--
STGM223	STMI107	STMI1020	361	18'' DIA	0.9%	226.24	223.16	230.9	227.0	227.4	224.3	227.4	224.3	9.8	9.0	9.1	--
STGM2230	STMI1167	STMI1174	51	18'' DIA	1.2%	193.54	192.91	199.4	198.4	194.2	194.3	194.5	194.5	12.3	3.4	3.7	--
STGM2234	STMK1211	STMK1210	229	12'' DIA	8.4%	188.97	169.93	197.2	178.4	189.4	170.4	189.4	170.4	10.7	3.4	3.5	--
STGM2235	STMI1023	STMI1014	127	12'' DIA	1.9%	219.69	217.26	226.2	225.1	220.0	218.9	223.2	223.1	5.0	1.0	1.0	--
STGM2255	STMK125	STMK124	244	12'' DIA	2.2%	169.53	164.12	176.2	169.3	169.8	164.9	169.8	164.9	5.4	0.8	0.8	--
STGM2295	STMI1225	STMI1224	82	12'' DIA	0.6%	182.19	181.67	187.1	186.6	182.7	182.1	182.7	182.1	2.9	1.4	1.4	--
STGM2304-A	STMJ129	STMJ1244	147	18'' DIA	1.3%	171.98	170.00	177.0	175.9	172.9	171.0	173.0	171.1	12.7	8.8	9.6	--
STGM2304-B	STMJ1244	STMJ1210	113	18'' DIA	1.0%	170.00	168.84	175.9	174.5	171.0	170.1	171.1	170.2	11.1	8.8	9.6	--
STGM2380	STMI1161	STMI1160	48	12'' DIA	1.1%	188.40	187.86	195.6	195.0	188.6	188.5	188.6	188.6	4.1	0.5	0.5	--
STGM239	STMK1220	STMK1219	240	12'' DIA	13.6%	242.37	210.12	254.9	227.5	242.6	210.4	242.6	210.4	13.0	0.9	1.0	--
STGM2399	STII0986	STII0988	78	24'' DIA	0.5%	229.64	228.75	238.5	239.6	237.8	237.8	241.3	241.3	16.2	3.3	4.2	Future 10-yr
STGM2412	STMI1175	STMI1176	162	21'' DIA	6.5%	188.72	178.28	194.8	184.9	189.5	179.2	189.5	179.3	42.4	15.7	18.1	--
STGM2429	STMJ1215	STMJ1216	73	15'' DIA	0.9%	172.85	172.18	178.9	179.1	173.3	172.5	173.4	172.5	6.5	2.0	2.2	--
STGM2476	STMJ106	STMJ105	253	24'' DIA	0.3%	212.77	212.09	222.2	221.3	217.1	216.1	218.2	216.4	11.7	10.4	10.5	--
STGM2543	STMK1215	STMK1214	82	12'' DIA	5.4%	174.52	170.13	185.0	179.9	174.9	170.6	174.9	170.6	8.5	2.3	2.3	--
STGM2593	STMK114	STMK113	51	18'' DIA	1.5%	165.22	164.46	172.5	171.4	166.0	165.5	166.0	165.5	12.7	6.6	6.8	--
STGM2621	STMJ1211	STMJ1210	112	15'' DIA	0.4%	169.30	168.84	173.6	174.5	170.2	170.1	170.4	170.2	4.3	2.2	3.2	--
STGM2622	STII1028	STII1027	118	12'' DIA	1.9%	213.20	211.00	223.1	220.4	219.1	218.4	221.9	221.0	4.9	3.2	3.2	--
STGM2654	STMJ1237	STMJ1239	64	24'' DIA	3.7%	163.11	160.72	175.8	175.8	163.7	161.7	163.8	161.9	42.4	7.6	10.3	--
STGM2662	STII092	STMI095	217	15'' DIA	0.4%	233.85	232.85	240.6	244.0	238.4	238.6	239.3	236.9	4.2	4.0	4.1	--
STGM2664	STMI137	STII137	342	18'' DIA	0.3%	162.42	161.23	174.0	173.1	182.2	179.2	183.7	180.6	6.2	10.1	10.1	Existing 10-yr
STGM2666	STMK1118	STMK1117	83	15'' DIA	1.4%	165.41	164.26	174.1	173.2	165.9	164.8	166.0	164.8	7.9	2.8	3.0	--
STGM2682	J3960	STMI124	180	12'' DIA	0.9%	182.33	180.75	189.0	187.5	182.9	182.8	189.0	184.7	3.3	2.2	3.2	--
STGM2694	J4270	J3668	872	Irregular Channel	0.8%	243.00	235.50	250.6	241.6	243.9	237.5	244.0	241.7		9.4	14.3	--
STGM2707	STMI1165	STMI1225	159	12'' DIA	0.6%	183.22	182.19	188.7	187.1	183.7	182.7	183.7	182.7	3.0	1.4	1.4	--
STGM2709	STMI149	STMI142	287	21'' DIA	0.2%	158.85	158.20	172.2	173.6	170.5	167.7	171.9	168.8	7.5	15.7	16.4	--
STGM2715	STII09124	STII09111	110	18'' DIA	0.3%	247.94	247.51	253.5	252.8	249.0	248.4	249.3	248.7	6.0	5.3	7.9	--
STGM2729	STII1029	STII1050	119	8'' DIA	1.9%	217.94	215.72	225.7	223.6	227.1	220.0	230.5	222.9	1.6	3.3	3.4	Existing 10-yr
STGM2731	STMJ1022	STIJ1021	321	12'' DIA	1.1%	219.49	215.79	227.5	223.2	241.8	223.5	252.0	227.0	3.8	8.7	10.4	Existing 10-yr
STGM274	STMJ1230	STIJ1234	40	12'' DIA	0.6%	160.57	160.31	162.7	164.6	161.1	160.5	161.1	160.5	3.0	1.5	1.5	--
STGM2755	STMI1172	STMI1171	54	12'' DIA	1.2%	198.19	197.53	204.6	203.5	198.7	198.1	198.7	198.1	4.1	2.1	2.3	--
STGM2771	J3852	STMI102	247	15'' DIA	2.2%	218.54	213.03	225.6	219.9	219.0	218.6	219.6	219.8	9.8	2.5	2.6	--
STGM2785	STMI1216	STMI1215	312	15'' DIA	1.6%	175.24	170.24	180.9	177.1	175.8	170.8	175.8	170.8	8.6	3.4	3.4	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM281	STIJ1066	STIJ1069	175	12'' DIA	2.0%	198.06	194.56	206.5	202.2	198.7	195.1	198.7	195.1	5.3	3.5	3.5	--
STGM2811	STMJ1217	STMJ1215	189	15'' DIA	0.6%	173.99	172.85	182.2	178.9	174.5	173.3	174.6	173.4	5.3	2.0	2.2	--
STGM2823	STMK1222	STMK1221	169	12'' DIA	8.6%	259.18	244.72	269.4	256.0	259.4	245.0	259.4	245.0	11.4	0.9	1.0	--
STGM2828	J-SBT6-02	J-SBT6-01	306	48'' DIA	0.1%	143.40	143.00	170.0	160.0	146.1	144.0	146.1	144.0	36.8	46.1	46.1	--
STGM283	STII0975	STII0977	122	18'' DIA	1.0%	242.11	240.65	251.0	247.7	242.6	241.0	242.7	241.4	10.9	3.0	3.8	--
STGM2832	STMI148	STMI144	427	21'' DIA	0.2%	157.99	156.95	174.8	174.6	167.4	167.7	167.9	170.9	7.8	15.7	16.4	--
STGM2834	STMI1144	STMI1220	427	15'' DIA	1.4%	187.23	181.41	193.5	186.3	187.8	182.0	187.8	182.0	7.9	3.1	3.2	--
STGM2839	STMI1021	STII102	332	21'' DIA	2.2%	211.58	204.20	215.2	212.6	212.5	205.9	212.5	205.9	23.7	12.3	12.4	--
STGM2844	STIK117	J-SBT4-05	62	15'' DIA	0.3%	167.96	167.77	175.0	173.0	168.7	168.0	168.8	168.0	3.7	3.2	3.5	--
STGM2861	STIJ1060	STIJ1061	30	12'' DIA	2.3%	223.73	222.82	229.6	231.0	224.3	223.5	224.3	223.5	5.7	3.5	3.5	--
STGM2863	STMJ1226	STMJ1227	268	15'' DIA	5.0%	159.59	146.32	170.0	156.3	160.4	147.1	160.4	147.1	14.9	10.7	11.2	--
STGM2864	STMJ119	STMJ118	214	15'' DIA	1.9%	207.67	203.56	214.5	210.4	208.0	203.9	208.0	203.9	9.4	1.3	1.4	--
STGM2866	STMI1123	STMI1124	92	36'' DIA	1.3%	189.65	188.46	206.2	204.7	191.5	190.3	191.6	190.4	75.6	52.9	55.1	--
STGM2871	STMK1214	STMK111	169	15'' DIA	3.2%	170.13	164.77	179.9	172.0	170.6	165.1	170.6	165.1	11.9	3.2	3.3	--
STGM2880	STII102	STMI1121	66	18'' DIA	0.5%	204.20	203.84	212.6	212.6	205.9	204.8	205.9	204.8	7.8	12.3	12.4	--
STGM2885	STMJ117	STMJ116	53	15'' DIA	2.1%	199.99	198.86	206.8	205.8	200.3	199.2	200.3	199.2	10.1	1.3	1.4	--
STGM2889	STMI1164	STMI1163	49	12'' DIA	1.1%	190.45	189.92	194.9	196.2	190.7	190.2	190.7	190.2	3.8	0.5	0.5	--
STGM2899	STMK121	STMJ1225	199	21'' DIA	1.3%	160.93	158.36	166.7	166.7	161.7	159.1	161.7	159.1	18.8	7.5	7.5	--
STGM2905	STII09100	STII10109	112	30'' DIA	1.6%	224.82	223.00	233.6	231.7	237.8	237.8	241.3	241.3	54.8	4.7	6.5	Existing 10-yr
STGM2906	STII1030	STII1029	150	8'' DIA	1.9%	220.80	217.94	229.4	225.7	237.1	227.1	240.7	230.5	1.7	3.9	4.3	Existing 10-yr
STGM2936	STII0982	STII0985	199	24'' DIA	1.1%	232.49	230.09	240.2	237.4	237.8	237.8	241.4	241.3	25.2	3.0	4.0	Future 10-yr
STGM2965	STMI1219	STMI1221	220	18'' DIA	1.2%	176.01	173.35	181.1	179.0	176.7	174.0	176.8	174.0	12.0	5.6	5.8	--
STGM297	STII0977	STII0980	99	18'' DIA	3.4%	240.65	236.84	247.7	244.0	241.0	237.8	241.4	241.4	19.7	3.0	3.8	--
STGM2971	STMK1112	STMK1111	155	12'' DIA	12.4%	210.00	190.91	218.6	200.0	210.3	191.3	210.4	191.3	13.1	3.2	3.4	--
STGM2977	STIJ1234	STMJ1224	28	10'' DIA	15.7%	160.31	155.98	164.6	163.9	160.5	156.6	160.5	156.6	9.1	1.5	1.5	--
STGM3022	J5176	J5178	186	Irregular Channel	2.2%	209.16	205.00	215.7	210.4	210.3	205.5	210.3	205.5		27.8	28.8	--
STGM3031	STMJ121	STMJ1212	310	12'' DIA	0.9%	179.24	176.56	184.6	181.1	179.8	177.0	179.8	177.0	3.4	1.9	1.9	--
STGM3039	STMJ124	STMJ129	260	15'' DIA	1.1%	174.83	171.98	180.0	177.0	180.0	172.9	180.0	173.0	7.0	8.8	9.6	--
STGM304	STIJ1021	STMJ105	483	15'' DIA	0.8%	215.79	212.09	223.2	221.3	223.5	216.1	227.0	216.4	5.6	8.5	10.0	Existing 10-yr
STGM3068	STMK129	STMK128	184	12'' DIA	0.6%	163.14	162.01	171.9	171.6	166.1	164.7	166.8	165.1	2.9	3.4	3.5	--
STGM3110	STMK1114	J-SBT4-01	62	15'' DIA	6.2%	144.32	140.54	160.0	145.0	148.9	141.2	148.9	141.2	16.7	21.4	21.4	--
STGM3131	STIJ102	STMJ108	32	18'' DIA	20.6%	216.00	209.51	223.9	224.4	216.3	211.6	216.3	211.6	46.3	3.2	3.2	--
STGM3134	STIJ1063	STIJ1064	251	12'' DIA	2.4%	218.91	212.68	227.3	221.3	219.5	213.3	219.5	213.3	5.8	3.5	3.5	--
STGM314	STII1055	STII1056	64	12'' DIA	0.8%	213.50	213.00	221.1	220.4	216.9	216.9	219.7	219.7	3.2	1.5	1.6	--
STGM3145	STMJ107	STMJ108	192	36'' DIA	0.3%	210.16	209.51	224.1	224.4	212.0	211.6	212.1	211.6	35.6	24.6	25.6	--
STGM3147	STMJ1012	J-SBT5-01	293	18'' DIA	4.1%	181.23	169.20	191.5	180.0	181.6	169.8	181.7	169.8	21.6	3.7	5.0	--
STGM3149	STMI123	STMI139	437	12'' DIA	0.2%	166.55	165.23	177.3	177.1	202.9	197.9	204.3	199.4	1.8	4.9	5.0	Existing 10-yr
STGM3159	STII1027	J4122	239	12'' DIA	0.6%	211.00	209.50	220.4	220.1	218.4	217.4	221.0	219.3	2.8	3.2	3.2	Future 10-yr
STGM3172	STII1194	STMI1113	66	24'' DIA	1.0%	193.95	193.31	202.5	203.0	195.7	195.5	195.9	195.5	22.1	17.3	17.4	--
STGM3176	STII0913	STII0928	170	21'' DIA	0.8%	235.00	233.70	243.0	240.5	238.1	238.5	241.5	240.5	13.8	14.4	15.2	--
STGM3189	STMK1235	STMK1115	181	15'' DIA	0.5%	156.63	155.74	167.2	169.2	157.3	156.4	157.4	156.4	4.7	2.9	3.6	--
STGM3192	STMI093	STMI092	113	24'' DIA	2.0%	223.04	220.75	232.8	229.0	227.6	224.5	230.7	227.9	17.4	21.1	21.6	--
STGM3193	STMJ123	STMJ124	178	15'' DIA	1.1%	176.80	174.83	182.2	180.0	181.1	180.0	182.2	180.0	7.1	8.8	9.6	--
STGM321	STII1359	STMI1310	184	18'' DIA	0.2%	160.75	160.30	173.2	172.6	178.0	176.3	179.3	177.7	5.2	10.1	10.3	Existing 10-yr
STGM3212	STMJ118	STMJ117	176	15'' DIA	2.0%	203.56	199.99	210.4	206.8	203.9	200.3	203.9	200.3	9.4	1.3	1.4	--
STGM3216	STMK1213	STMK1214	135	12'' DIA	8.1%	180.96	170.13	190.3	179.9	181.2	170.6	181.2	170.6	10.2	0.9	0.9	--
STGM323	STMI1170	STMI1169	59	15'' DIA	0.9%	196.84	196.34	202.7	203.3	197.4	196.9	197.4	197.0	6.2	2.1	2.3	--
STGM3243	STMI1173	STMI1172	117	12'' DIA	1.0%	199.33	198.19	206.7	204.6	199.9	198.7	199.9	198.7	3.6	2.1	2.3	--
STGM3260	STII09104	STII09103	36	18'' DIA	2.4%	252.46	250.92	259.5	259.4	253.3	252.0	259.6	259.4	17.0	9.3	18.3	Future 10-yr
STGM3282	STMK118	STMK119	73	12'' DIA	1.8%	169.71	168.40	178.2	177.3	170.3	169.3	170.3	169.3	5.0	3.2	3.4	--
STGM3283	STMI1220	STMI1219	379	15'' DIA	1.4%	181.41	176.01	186.3	181.1	182.0	176.7	182.0	176.8	8.1	3.1	3.2	--
STGM3285	J3522	STMJ104	164	27'' DIA	0.3%	212.00	211.50	221.6	221.3	213.8	213.1	213.9	213.1	17.1	18.3	19.2	--
STGM3287	STIL11185	J-SBT1-05	38	12'' DIA	29.5%	171.70	157.40	179.0	180.0	171.9	159.6	171.9	159.7	20.9	1.7	2.2	--
STGM3296	STMJ091	STMJ1022	261	12'' DIA	1.1%	222.46	219.49	232.9	227.5	250.2	241.8	264.8	252.0	3.8	6.5	8.4	Existing 10-yr
STGM3324	STMJ1135	STMJ1138	317	24'' DIA	0.2%	172.13	171.55	184.2	178.2	173.3	172.4	173.5	172.5	10.0	7.3	9.1	--
STGM3339	STMI144	J4032	517	21'' DIA	0.4%	156.95	155.00	174.6	160.0	167.7	155.6	170.9	155.6	9.7	15.7	16.4	--
STGM334	STII1080	STII1078	163	12'' DIA	1.9%	207.16	204.07	213.2	210.1	211.7	205.8	211.8	205.8	4.9	5.0	5.0	--
STGM3344	STII135	STMI143	182	18'' DIA	0.2%	159.82	159.08	172.7	173.0	173.7	171.4	175.0	172.8	5.2	12.5	12.7	Existing 10-yr
STGM3345	STMI129	J-SBT1-03	501	12'' DIA	4.0%	185.00	152.20	194.2	175.0	185.6	155.2	185.7	155.3	7.2	5.0	5.6	--
STGM3346	STMJ1227	STMJ1228	80	15'' DIA	4.9%	146.32	142.40	156.3	152.3	147.1	143.2	147.1	143.2	14.9	10.7	11.2	--
STGM3352	STII1034	J3524	242	12'' DIA	2.3%	223.24	217.58	226.1	225.1	233.7	223.5	249.2	231.6	5.4	7.7	10.4	Existing 10-yr
STGM3365	STII1050	STII1028	133	12'' DIA	1.9%	215.72	213.20	223.6	223.1	220.0	219.1	222.9	221.9	4.9	3.2	3.2	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM3370	STMI1211	STMI1214	138	24'' DIA	5.8%	165.11	157.09	175.9	166.7	166.1	157.8	166.2	157.9	56.5	26.6	28.6	--
STGM3371	STMK1210	STMK129	108	12'' DIA	6.3%	169.93	163.14	178.4	171.9	170.4	166.1	170.4	166.8	9.3	3.4	3.5	--
STGM3442	STMJ1231	STMJ1232	65	33'' DIA	0.7%	165.26	164.80	172.5	173.1	166.2	165.4	166.3	165.4	45.2	10.4	13.1	--
STGM3452	STMK1217	STMK1216	141	12'' DIA	12.1%	221.37	204.42	232.0	215.4	221.5	204.7	221.5	204.7	12.3	0.7	0.7	--
STGM3457	STMI1121	J4834	345	24'' DIA	2.0%	203.84	197.00	212.6	209.4	204.8	198.3	204.8	198.3	32.1	15.1	15.2	--
STGM3459	J-SBT1-02	J-SBT1-01	132	36'' DIA	0.8%	138.80	137.80	152.6	150.0	145.9	140.3	146.8	140.4	58.2	159.1	174.1	--
STGM346	STMI1110	STMI1121	250	15'' DIA	1.2%	206.93	203.84	213.9	212.6	207.5	204.8	207.5	204.8	7.2	2.8	2.8	--
STGM3464	STII081	STII09126	157	12'' DIA	0.8%	249.94	248.74	258.0	255.8	254.4	250.6	260.2	255.8	3.2	5.3	8.0	Future 10-yr
STGM3469	STMI142	STMI148	86	21'' DIA	0.2%	158.20	157.99	173.6	174.8	167.7	167.4	168.8	167.9	7.8	15.7	16.4	--
STGM3490	STII0992	STII09100	234	30'' DIA	0.5%	226.18	224.82	235.1	233.6	237.8	237.8	241.3	241.3	29.6	4.6	6.0	Existing 10-yr
STGM3512	STMI1162	STMI1160	62	12'' DIA	1.9%	189.01	187.86	193.9	195.0	189.4	188.5	189.4	188.6	5.0	1.3	1.3	--
STGM352	STII1245	STMI1226	77	24'' DIA	1.3%	160.00	159.00	167.7	169.0	161.1	159.5	161.2	159.6	26.9	16.1	17.2	--
STGM3521	J4292	J4150	661	18'' DIA	0.7%	179.90	175.00	185.1	180.5	180.6	175.6	180.7	175.7	9.0	4.2	5.2	--
STGM3546	STIJ081	STII081	220	12'' DIA	1.3%	253.03	249.94	261.1	258.0	259.5	254.4	270.4	260.2	4.3	5.3	8.1	Future 10-yr
STGM3550	STMJ1113	STMJ1114	290	15'' DIA	3.5%	207.14	196.97	211.5	204.9	207.4	198.0	207.4	198.1	12.9	1.4	1.5	--
STGM3551	STMK1221	STMK1220	66	12'' DIA	3.6%	244.72	242.37	256.0	254.9	245.0	242.6	245.0	242.6	7.0	0.9	1.0	--
STGM356	STMI124	J4292	104	12'' DIA	0.8%	180.75	179.90	187.5	185.1	182.8	180.6	184.7	180.7	3.2	4.2	5.2	--
STGM3560	J4268	J4270	219	Irregular Channel	0.9%	245.00	243.00	251.0	250.6	245.6	243.9	245.7	244.0		9.5	14.4	--
STGM3563	STMI1020	STMI106	115	18'' DIA	0.9%	223.16	222.18	227.0	225.8	224.3	222.9	224.3	222.9	9.7	9.0	9.1	--
STGM3595	STMI126	STMI127	24	12'' DIA	2.9%	175.00	174.30	181.6	180.1	176.2	175.1	176.2	175.1	6.1	7.5	7.5	--
STGM3598	STMJ1013	STMJ1015	121	15'' DIA	0.5%	219.30	218.73	228.0	223.7	220.0	219.3	220.0	219.3	4.6	3.2	3.2	--
STGM3617	STMK1113	STMK1114	73	15'' DIA	13.4%	154.00	144.32	167.8	160.0	155.2	148.9	155.6	148.9	24.5	21.7	22.0	--
STGM3624	STII0966	STII0967	54	12'' DIA	0.5%	255.84	255.36	261.7	261.6	256.3	255.6	256.4	255.7	2.7	1.1	1.4	--
STGM3631	STMJ127	STMJ128	263	18'' DIA	0.9%	170.29	167.85	176.7	175.6	171.0	169.1	171.0	169.2	10.5	4.9	5.1	--
STGM3637	STMJ1224	STMJ1223	237	18'' DIA	7.0%	155.98	139.50	163.9	145.0	156.6	140.1	156.6	140.1	28.9	9.0	9.0	--
STGM3638	STMK122	STMK121	208	21'' DIA	1.1%	163.17	160.93	171.4	166.7	164.0	161.7	164.0	161.7	17.1	7.5	7.6	--
STGM3651	STMI105	STMI1022	162	27'' DIA	0.7%	215.20	214.00	223.5	223.0	223.5	221.7	223.5	221.7	26.6	30.0	26.8	--
STGM3656	STMJ1128	STMJ1127	254	12'' DIA	2.2%	214.51	208.87	218.8	213.0	214.9	209.2	214.9	209.2	5.5	1.4	1.5	--
STGM3668	STMK1225	STMK1226	174	12'' DIA	18.3%	239.49	208.13	249.0	221.2	239.8	208.4	239.8	208.4	16.4	2.3	2.3	--
STGM3669	STMI1014	STMI109	288	33'' DIA	0.4%	217.26	216.25	225.1	223.3	218.9	218.4	223.1	222.7	31.2	24.0	24.5	--
STGM3674	J4424	J4426	132	42'' DIA	1.1%	202.00	200.50	204.8	207.0	203.1	201.7	203.4	202.0	106.0	24.4	40.6	--
STGM3678	STMI1169	STMI1168	126	15'' DIA	1.3%	196.34	194.76	203.3	202.0	196.9	195.4	197.0	195.4	7.4	3.4	3.7	--
STGM3689	STMI1310	STII135	191	18'' DIA	0.2%	160.30	159.82	172.6	172.7	176.3	173.7	177.7	175.0	5.1	12.3	12.5	Existing 10-yr
STGM3690	STML1146	STML1131	109	12'' DIA	2.8%	197.83	194.81	206.0	207.4	202.5	195.8	202.6	195.8	5.9	8.5	8.5	--
STGM3714	STIJ1069	STIJ1070	160	12'' DIA	2.4%	194.56	190.71	202.2	198.4	195.1	191.4	195.1	191.4	5.8	3.5	3.5	--
STGM3715	STMK126	STMJ1226	356	12'' DIA	4.7%	176.34	159.59	185.7	170.0	176.8	160.4	176.8	160.4	8.0	4.0	4.0	--
STGM3717	STMI108	STMI1018	221	21'' DIA	0.6%	209.79	208.30	221.0	219.3	216.9	216.7	219.7	219.2	12.0	10.8	12.6	--
STGM3728	STMK1226	STMK1227	92	12'' DIA	15.8%	208.13	193.74	221.2	207.5	208.4	194.1	208.4	194.1	14.3	2.3	2.3	--
STGM3752	STMK113	J-SBT4-04	142	18'' DIA	0.6%	164.46	163.59	171.4	171.9	165.5	164.3	165.5	164.3	8.3	6.6	6.8	--
STGM3779	STII1149	STML1146	422	12'' DIA	1.3%	203.31	197.83	211.4	206.0	226.2	202.5	226.2	202.6	4.1	8.9	8.9	Existing 10-yr
STGM3789	STMK128	STMK127	202	12'' DIA	0.7%	162.01	160.59	171.6	170.3	164.7	162.4	165.1	162.8	3.1	3.4	3.5	--
STGM3792	STMI102	STMI1012	50	15'' DIA	1.7%	213.03	211.40	219.9	219.9	218.6	218.5	219.8	219.8	8.4	2.5	2.6	--
STGM3804	STIJ1064	STIJ1065	199	12'' DIA	2.3%	212.68	207.91	221.3	216.5	213.3	208.5	213.3	208.5	5.6	3.5	3.5	--
STGM3819	STMK1230	STMK1229	205	12'' DIA	10.0%	209.01	188.72	216.0	195.1	209.3	189.1	209.3	189.1	11.8	2.6	2.6	--
STGM3824	J-SB-05	J-SB-04	141	84'' DIA	0.9%	117.10	115.90	125.0	125.0	122.1	121.4	122.2	121.4	585.8	405.9	434.2	--
STGM3827	STMK1116	STMK1113	320	15'' DIA	2.7%	162.55	154.00	171.6	167.8	163.0	155.2	163.0	155.6	10.9	2.8	3.0	--
STGM3829	STMK1212	STMK126	156	12'' DIA	4.9%	183.98	176.34	198.0	185.7	184.5	176.8	184.5	176.8	8.1	4.0	4.0	--
STGM3850	STMI1174	STMI1175	350	21'' DIA	1.2%	192.91	188.72	198.4	194.8	194.3	189.5	194.5	189.5	18.0	15.7	18.9	--
STGM3851	STMK1111	STMK1110	134	12'' DIA	9.9%	190.91	177.71	200.0	187.2	191.3	178.2	191.3	178.2	11.7	3.2	3.4	--
STGM3873	STMK111	J-SBT4-04	7	15'' DIA	16.6%	164.77	163.59	172.0	171.9	165.1	164.3	165.1	164.3	26.8	3.2	3.3	--
STGM3882	STMI1022	STMI1012	271	27'' DIA	0.7%	214.00	211.40	223.0	219.9	221.7	218.5	221.7	219.8	25.3	27.1	27.4	--
STGM391	STMI1114	STMI1113	84	42'' DIA	0.8%	194.00	193.31	203.0	203.0	195.7	195.5	195.8	195.5	91.6	34.8	41.8	--
STGM3914	STMJ1011	STMJ1013	220	12'' DIA	0.5%	220.37	219.30	229.5	228.0	221.8	220.0	221.8	220.0	2.6	3.2	3.2	--
STGM3915	STMK1231	STMK1230	124	12'' DIA	8.7%	219.71	209.01	228.0	216.0	220.0	209.3	220.0	209.3	10.8	2.6	2.6	--
STGM392	STII1078	STMI1019	20	12'' DIA	3.9%	204.07	199.50	210.1	209.3	205.8	200.7	205.8	200.9	7.1	8.5	8.6	--
STGM3924	STMI104	J5216	352	60'' DIA	0.8%	209.30	206.00	220.3	211.3	217.2	216.6	219.0	218.9	231.4	32.6	32.7	--
STGM3926	STMI1019	STMI1114	351	42'' DIA	1.6%	199.50	194.00	209.3	203.0	200.7	195.7	200.9	195.8	128.5	30.9	40.3	--
STGM3931	STMI1176	J-SBT1-05	183	21'' DIA	3.4%	178.28	157.40	184.9	180.0	179.2	159.6	179.3	159.7	30.1	15.7	18.1	--
STGM3943	STMI1224	STMI1223	63	12'' DIA	0.7%	181.67	181.20	186.6	187.9	182.1	181.6	182.1	181.6	3.2	1.4	1.4	--
STGM3951	STII0926	STII0915	98	21'' DIA	0.7%	230.40	229.70	236.9	236.6	234.0	233.2	236.9	236.0	13.4	15.1	15.4	--
STGM3955	STMJ1214	STMJ123	210	15'' DIA	0.9%	178.72	176.80	183.1	182.2	181.2	181.1	183.1	182.2	6.5	2.2	2.4	--
STGM3989	STMK1218	STMK1217	177	12'' DIA	15.0%	247.63	221.37	257.8	232.0	247.8	221.5	247.8	221.5	14.8	0.7	0.7	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM3997	STMI139	STMI138	487	15'' DIA	0.3%	165.23	163.98	177.1	175.6	197.9	190.1	199.4	191.5	3.3	10.2	10.2	Existing 10-yr
STGM4001	J4116	J4118	54	24'' DIA	0.9%	242.00	241.50	247.5	246.1	242.4	242.1	242.6	242.2	20.9	1.9	3.3	--
STGM4020	STMJ1119	STMJ1012	268	15'' DIA	0.9%	183.51	181.23	193.4	191.5	184.2	181.6	184.3	181.7	6.2	3.0	4.3	--
STGM4021	STIJ1062	STIJ1063	74	12'' DIA	1.2%	220.00	218.91	228.4	227.3	220.7	219.5	220.7	219.5	4.1	3.5	3.5	--
STGM4022	STMJ1114	STMI1174	548	21'' DIA	0.7%	196.97	192.91	204.9	198.4	198.0	194.3	198.1	194.5	14.3	9.9	10.7	--
STGM4063	STMJ102	STMJ103	259	18'' DIA	0.3%	213.81	213.12	221.6	221.6	221.5	217.8	221.0	219.0	5.4	6.5	6.5	--
STGM4067	STMI1115	STMI1177	89	36'' DIA	2.0%	186.78	185.02	204.2	201.0	188.4	186.6	188.4	186.6	94.4	52.9	55.1	--
STGM4076	STMI1210	STMI1211	97	18'' DIA	3.8%	168.81	165.11	175.7	175.9	169.2	166.1	169.2	166.2	20.9	3.4	3.4	--
STGM408	STMI0910	STMI094	43	21'' DIA	6.8%	229.00	226.07	235.6	236.0	232.6	231.8	235.3	234.6	41.3	21.1	21.6	--
STGM4081	STII0928	STII0983	186	21'' DIA	0.8%	233.70	232.30	240.5	238.3	238.5	237.1	240.5	238.8	14.3	14.5	15.0	--
STGM4090	J4118	J4114	433	Irregular Channel	1.7%	241.50	234.00	246.1	239.2	242.1	234.9	242.2	239.2		3.7	6.2	--
STGM4122	J4092	J4094	929	Irregular Channel	1.4%	202.00	185.00	209.3	190.0	202.6	185.4	202.9	185.5		5.4	9.9	--
STGM4123	STMI092	STMI091	69	27'' DIA	1.0%	220.75	220.03	229.0	229.9	224.5	223.4	227.9	226.9	17.1	21.1	21.6	--
STGM4128	STIL11186	STIL11185	36	12'' DIA	2.2%	172.50	171.70	179.0	179.0	172.9	171.9	173.0	171.9	5.6	1.7	2.2	--
STGM413	STMJ116	STMI1169	235	15'' DIA	1.1%	198.86	196.34	205.8	203.3	199.2	196.9	199.2	197.0	6.9	1.3	1.4	--
STGM4173	STMJ1110	STMJ119	90	15'' DIA	2.8%	210.16	207.67	216.1	214.5	210.5	208.0	210.5	208.0	11.0	1.3	1.4	--
STGM4181	STMJ1111	STMI1173	212	12'' DIA	1.8%	203.20	199.33	210.5	206.7	203.7	199.9	203.7	199.9	5.0	2.1	2.3	--
STGM4222	STMJ108	J5176	336	36'' DIA	0.1%	209.51	209.16	224.4	215.7	211.6	210.3	211.6	210.3	23.0	27.8	28.8	--
STGM4239	STMJ1142	STMJ1143	264	24'' DIA	2.2%	181.80	176.00	196.2	184.3	182.2	176.4	182.3	176.5	35.0	2.8	3.9	--
STGM4243	STMI1226	J-SBT1-02	108	24'' DIA	19.1%	159.00	138.80	169.0	152.6	159.5	145.9	159.6	146.8	100.8	16.1	17.2	--
STGM4253	STII0972	STII0975	63	15'' DIA	1.3%	243.16	242.11	251.4	251.0	243.5	242.6	243.5	242.7	7.1	1.1	1.4	--
STGM4314	STMJ1015	STIJ102	135	12'' DIA	2.0%	218.73	216.00	223.7	223.9	219.3	216.3	219.3	216.3	5.1	3.2	3.2	--
STGM4327	STMJ1133	STMJ1135	216	24'' DIA	1.3%	174.87	172.13	180.8	184.2	175.4	173.3	175.5	173.5	26.7	4.3	5.3	--
STGM4335	J4426	STMI1019	97	42'' DIA	1.0%	200.50	199.50	207.0	209.3	201.7	200.7	202.0	200.9	101.5	24.4	37.3	--
STGM434	STMK127	STMJ1226	168	12'' DIA	0.6%	160.59	159.59	170.3	170.0	162.4	160.4	162.8	160.4	2.9	3.4	3.5	--
STGM4360	STMJ1236	STMJ1237	122	24'' DIA	2.3%	165.95	163.11	178.4	175.8	166.6	163.7	166.7	163.8	34.7	7.7	10.3	--
STGM4372	STIJ0916	STIJ0917	44	15'' DIA	0.5%	226.92	226.69	235.6	236.0	227.9	227.6	227.9	227.6	4.8	5.3	5.3	--
STGM4376	STIJ0917	STIJ0919	193	15'' DIA	0.7%	226.69	225.32	236.0	235.2	227.6	226.1	227.6	226.1	5.7	5.3	5.3	--
STGM4395	STIJ0919	STIJ0923	80	15'' DIA	1.3%	225.32	224.31	235.2	232.9	226.1	224.9	226.1	224.9	7.5	5.3	5.3	--
STGM4396	STIJ0923	STIJ0924	106	15'' DIA	2.8%	224.31	221.30	232.9	230.6	224.9	221.9	224.9	221.9	11.2	5.3	5.3	--
STGM440	STMK1219	STMK1216	126	12'' DIA	4.5%	210.12	204.42	227.5	215.4	210.4	204.7	210.4	204.7	7.6	0.9	1.0	--
STGM4400	STIJ0924	STIJ0927	90	15'' DIA	2.3%	221.30	219.25	230.6	228.3	221.9	219.9	221.9	219.9	10.1	5.3	5.3	--
STGM4405	STIJ0927	STIJ0915	120	15'' DIA	2.4%	219.25	216.42	228.3	225.1	219.9	217.4	219.9	217.4	10.3	5.3	5.3	--
STGM4406	STIJ0915	STIJ10111	124	15'' DIA	0.7%	216.42	215.60	225.1	221.9	217.4	216.6	217.4	216.6	5.5	5.3	5.3	--
STGM4407	STIJ10111	STIJ10112	38	15'' DIA	0.8%	215.60	215.31	221.9	221.9	216.6	216.3	216.6	216.3	5.6	5.3	5.3	--
STGM4408	STIJ10112	J5382	111	15'' DIA	0.6%	215.31	214.65	221.9	219.1	216.3	214.9	216.3	214.9	5.1	5.3	5.3	--
STGM4459	STII09112	J4268	78	21'' DIA	2.7%	247.12	245.00	253.4	251.0	247.7	245.6	247.8	245.7	26.4	5.4	8.5	--
STGM4465	J4122	STMI104	37	12'' DIA	0.5%	209.50	209.30	220.1	220.3	217.4	217.2	219.3	219.0	2.6	3.2	3.2	--
STGM448	STMK1227	STMK1212	180	12'' DIA	5.4%	193.74	183.98	207.5	198.0	194.1	184.5	194.1	184.5	8.5	2.3	2.3	--
STGM4509	STMI1227	STMI127	12	18'' DIA	0.9%	174.40	174.30	180.5	180.1	175.2	175.1	175.2	175.1	9.8	3.8	3.8	--
STGM4510	STMI1234	STMI1227	138	18'' DIA	0.4%	175.00	174.40	181.6	180.5	175.8	175.2	175.8	175.2	6.9	3.8	3.8	--
STGM4512	STMI1228	STMI1234	293	18'' DIA	0.5%	176.50	175.00	183.0	181.6	177.2	175.8	177.2	175.8	7.8	3.8	3.8	--
STGM4514	STMI1229	STMI1228	646	18'' DIA	0.5%	179.71	176.50	185.4	183.0	180.5	177.2	180.5	177.2	7.6	3.8	3.8	--
STGM4517	J4	STML1232	171	12'' DIA	0.3%	179.71	179.20	184.2	183.3	197.3	197.3	197.3	197.2	2.0	1.0	1.2	Existing 10-yr
STGM452	STML1132	J-SBT1-09	90	30'' DIA	1.6%	190.42	188.95	202.9	196.5	191.4	189.2	191.4	189.2	52.6	15.8	15.8	--
STGM4524	STML1232	STMI1233	417	12'' DIA	0.3%	179.20	178.00	183.3	182.9	197.3	191.7	197.2	191.7	2.0	5.1	5.1	Existing 10-yr
STGM4525	STMI1233	STMI126	383	12'' DIA	0.8%	178.00	175.00	182.9	181.6	191.7	176.2	191.7	176.2	3.3	7.9	7.9	Existing 10-yr
STGM4542	STMI138	STMI137	500	15'' DIA	0.3%	163.98	162.42	175.6	174.0	190.1	182.2	191.5	183.7	3.2	8.8	8.8	Existing 10-yr
STGM4556	STII137	STII1359	138	18'' DIA	0.3%	161.23	160.75	173.1	173.2	179.2	178.0	180.6	179.3	6.2	9.9	10.0	Existing 10-yr
STGM487	STMI1212	STMI1211	56	33'' DIA	1.1%	165.74	165.11	175.9	175.9	166.9	166.1	167.0	166.2	58.0	23.2	25.2	--
STGM493	STIJ1061	STIJ1062	180	12'' DIA	1.5%	222.82	220.00	231.0	228.4	223.5	220.7	223.5	220.7	4.5	3.5	3.5	--
STGM501	STMJ1234	STMJ1231	117	33'' DIA	1.0%	166.39	165.26	173.8	172.5	167.2	166.2	167.3	166.3	52.0	10.4	13.1	--
STGM504	STMK1122	STMK1121	204	12'' DIA	3.2%	196.81	190.20	204.2	198.3	197.7	190.9	197.7	190.9	6.7	6.6	6.8	--
STGM523	STMI101	STMI107	468	15'' DIA	0.9%	230.23	226.24	234.6	230.9	231.0	227.4	231.0	227.4	6.0	4.0	4.1	--
STGM527	STIJ1070	J-SBT7-03	83	15'' DIA	1.0%	190.71	189.88	198.4	193.6	191.4	190.3	191.4	190.3	6.7	3.5	3.5	--
STGM528	STII0980	STII0982	188	24'' DIA	2.2%	236.84	232.49	244.0	240.2	237.8	237.8	241.4	241.4	36.9	3.0	3.8	--
STGM547	STII09101	STII09104	106	18'' DIA	0.5%	253.18	252.46	261.0	259.5	254.6	253.3	261.2	259.6	7.6	9.3	15.8	Future 10-yr
STGM55	STMI125	STMI1229	203	15'' DIA	0.3%	180.40	179.71	186.3	185.4	181.4	180.5	181.4	180.5	3.8	3.8	3.8	--
STGM554	STII0991	STII0992	98	30'' DIA	0.5%	226.87	226.18	235.7	235.1	237.8	237.8	241.3	241.3	30.5	4.6	5.9	Existing 10-yr
STGM56	STMJ1120	STMJ1119	162	15'' DIA	0.7%	184.60	183.51	193.0	193.4	185.3	184.2	185.4	184.3	5.5	3.0	4.3	--
STGM578	STMK1233	STMK1229	116	12'' DIA	0.8%	189.66	188.72	196.5	195.1	190.1	189.1	190.1	189.1	3.4	1.1	1.2	--
STGM580	STMJ1238	STMJ1236	55	24'' DIA	5.5%	168.99	165.95	178.5	178.4	169.4	166.6	169.5	166.7	51.5	5.7	8.1	--

Table B-2. Hydraulic Model Parameters and Results

Conduit ID	Up and Downstream Model Node		Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
	US	DS				US	DS	US	DS	US	DS	US	DS				
STGM585	STMK1115	STMK1113	215	15'' DIA	0.8%	155.74	154.00	169.2	167.8	156.4	155.2	156.4	155.6	6.1	2.9	3.6	--
STGM6	J-SBT1-07	J-SBT1-06	107	60'' DIA	3.8%	180.00	176.00	197.0	185.0	181.4	178.2	181.4	178.2	514.9	82.4	85.6	--
STGM608	STMJ1223	STMJ1222	95	18'' DIA	6.4%	139.50	133.40	145.0	138.2	140.1	134.0	140.1	134.0	28.0	9.0	9.0	--
STGM621	STMK1229	STMK1228	210	15'' DIA	10.8%	188.72	166.09	195.1	170.3	189.1	166.5	189.1	166.5	21.9	3.7	3.8	--
STGM623	STMI1223	STMI1218	27	12'' DIA	1.2%	181.20	180.87	187.9	187.2	181.6	181.2	181.6	181.2	4.0	1.4	1.4	--
STGM627	J4284	J-SBT7-02	143	24'' DIA	0.4%	174.80	173.00	184.9	179.5	179.6	175.0	180.5	175.0	14.6	42.0	51.6	--
STGM646	STIJ1065	STIJ1066	369	12'' DIA	2.6%	207.91	198.06	216.5	206.5	208.5	198.7	208.5	198.7	6.0	3.5	3.5	--
STGM692	STMI1010	STMI101	283	15'' DIA	0.9%	232.65	230.23	240.0	234.6	233.4	231.0	233.4	231.0	6.0	4.0	4.1	--
STGM693	STMJ115	STMI1162	339	12'' DIA	0.6%	190.96	189.01	195.5	193.9	191.5	189.4	191.5	189.4	2.8	1.3	1.3	--
STGM72	STII0965	STII0966	36	12'' DIA	0.7%	256.31	255.84	262.6	261.7	256.7	256.3	256.8	256.4	3.1	1.1	1.4	--
STGM735	STMJ1232	STMJ1233	111	33'' DIA	4.8%	164.80	159.41	173.1	172.3	165.4	160.5	165.4	160.7	115.4	10.4	13.1	--
STGM736	STMJ1225	STMJ1224	175	21'' DIA	1.4%	158.36	155.98	166.7	163.9	159.1	156.6	159.1	156.6	19.3	7.5	7.5	--
STGM737	STMJ1233	J-SBT3-01	355	36'' DIA	3.3%	159.41	147.70	172.3	160.0	160.5	148.5	160.7	148.6	66.7	18.0	23.4	--
STGM746	STII0985	STII0986	52	24'' DIA	0.5%	230.09	229.64	237.4	238.5	237.8	237.8	241.3	241.3	16.3	3.3	4.2	Existing 10-yr
STGM757	J4150	STMI128	60	12'' DIA	3.3%	175.00	173.00	180.5	180.2	175.6	174.0	175.7	174.0	6.5	4.2	5.2	--
STGM760	STMI143	STMI149	83	21'' DIA	0.3%	159.08	158.85	173.0	172.2	171.4	170.5	172.8	171.9	8.3	15.7	16.4	--
STGM767	STMI127	STMI128	64	24'' DIA	2.0%	174.30	173.00	180.1	180.2	175.1	174.0	175.1	174.0	32.1	11.2	11.2	--
STGM773	STII0968	STII0970	113	12'' DIA	3.9%	254.20	249.55	260.1	256.0	254.5	249.8	254.5	249.9	7.1	1.1	1.4	--
STGM777	STMI1124	STMI1115	130	36'' DIA	1.3%	188.46	186.78	204.7	204.2	190.3	188.4	190.4	188.4	75.6	52.9	55.1	--
STGM794	STMJ1132	STMJ1133	149	24'' DIA	0.5%	175.66	174.87	181.2	180.8	176.3	175.4	176.4	175.5	17.1	4.3	5.3	--
STGM796	STMJ1220	J-SB-04	36	21'' DIA	7.1%	125.95	115.90	134.1	125.0	126.6	121.4	126.6	121.4	42.4	11.5	12.1	--
STGM822	STMI103	STMI104	72	36'' DIA	0.8%	210.80	209.30	220.7	220.3	217.6	217.2	219.2	219.0	61.4	29.5	29.8	--
STGM824	STII09126	STII09125	128	15'' DIA	0.3%	248.74	248.36	255.8	254.3	250.6	249.8	255.8	252.2	3.7	5.3	7.9	--
STGM825	STMI1018	STMI1017	130	24'' DIA	1.3%	208.30	206.55	219.3	215.3	216.7	216.6	219.2	219.0	25.8	10.8	12.6	--
STGM835	STMJ1218	STMJ1219	253	12'' DIA	3.1%	135.56	127.73	144.3	133.3	136.0	128.2	136.1	128.2	6.6	2.5	3.2	--
STGM856	STMI1163	STMI1161	187	12'' DIA	0.8%	189.92	188.40	196.2	195.6	190.2	188.6	190.2	188.6	3.3	0.5	0.5	--
STGM866	STMI1015	STMI108	340	15'' DIA	1.0%	213.55	209.79	221.8	221.0	221.8	216.9	227.9	219.7	6.6	9.5	11.5	Future 10-yr
STGM876	STIJ0911	STMJ092	400	12'' DIA	2.5%	232.75	222.67	239.7	232.5	258.6	252.2	279.1	267.8	5.7	5.4	8.5	Existing 10-yr
STGM885	STMJ1141	STMJ1142	95	24'' DIA	2.3%	184.00	181.80	198.1	196.2	184.4	182.2	184.5	182.3	35.1	2.8	3.9	--
STGM886	STMI1221	STMI1222	45	18'' DIA	1.7%	173.35	172.59	179.0	178.7	174.0	173.2	174.0	173.2	14.1	5.6	5.8	--
STGM901	J-SBT7-02	J-SBT7-01	590	Irregular Channel	0.8%	173.00	168.00	179.5	170.0	175.0	169.0	175.0	169.0		40.2	43.9	--
STGM91	STMI1217	STMI1216	431	15'' DIA	0.8%	178.84	175.24	185.2	180.9	179.5	175.8	179.5	175.8	6.1	3.4	3.4	--
STGM921	STMJ126	STMJ127	220	15'' DIA	1.6%	173.71	170.29	178.9	176.7	174.4	171.0	174.4	171.0	8.4	4.9	5.1	--
STGM943	STII0970	STII0972	210	12'' DIA	2.4%	249.55	243.16	256.0	251.4	249.8	243.5	249.9	243.5	5.6	1.1	1.4	--
STGM946	STMJ1212	STMJ126	217	12'' DIA	1.3%	176.56	173.71	181.1	178.9	177.0	174.4	177.0	174.4	4.2	1.9	1.9	--
STGM953	STMJ1138	STMJ1235	85	24'' DIA	1.4%	171.55	170.33	178.2	176.9	172.4	171.1	172.5	171.2	28.1	10.4	13.1	--
STGM973	J4114	J5124	122	12'' DIA	0.8%	234.00	233.00	239.2	235.4	234.9	233.8	239.2	236.5	3.2	3.7	6.1	--
STGM984	STII0916	STII0926	51	21'' DIA	0.8%	230.80	230.40	236.9	236.9	234.6	234.0	237.3	236.9	14.0	15.1	15.4	Future 10-yr
STGM988	J4032	J-SB-02	404	Irregular Channel	11.2%	155.00	106.10	160.0	130.0	155.6	109.0	155.6	109.2		15.7	16.4	--

MEMORANDUM

ENGINEERING SERVICES DEPARTMENT
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SUBJECT: **Addendum for the Stormwater Master Plan 2014**
DATE: February 2, 2015

To make the adopted Stormwater Master Plan (2014 edition) more user friendly, the following attachments are added:

- Table B-2, sorted by the Upstream Node names. Note that the table is still arranged into 3 sections – Chehalem starting on Page 1, Hess on Page 8, and Spring Brook on Page 13. (Note: Table B-2 in the original master plan was sorted by the Conduit ID.) Please insert to Appendix B.

- Supplemental map for CIP C-1, showing the proposed pipe sizes.
  Please insert to the fact sheets in Appendix D.

Thank you.

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
CHEHALEM CREEK																	
J1	STMG0911	C2	163	12'' DIA	0.7%	203.00	201.80	210.7	208.1	203.5	202.9	203.6	203.0	3.1	1.4	1.9	--
J2	STIG1022	STGM2506	135	12'' DIA	0.3%	188.89	188.47	193.9	191.4	204.1	201.1	207.4	203.9	2.0	6.2	6.7	Existing 10-yr
J3498	STMG149	STGM3252	242	12'' DIA	0.8%	159.00	157.06	166.5	162.2	159.6	157.6	166.5	157.7	3.2	2.3	4.3	--
J3514	J3516	STGM987	46	18'' DIA	1.0%	224.80	224.36	227.3	227.2	228.3	227.9	228.5	228.1	10.3	11.6	11.8	Existing 10-yr
J3516	STIG0894	STGM245	33	Irregular Channel	3.3%	224.36	223.30	227.2	226.8	227.9	227.9	228.1	228.1		15.2	14.5	Existing 10-yr
J3530	STMG1036	STGM2210	314	18'' DIA	5.1%	217.00	201.00	219.0	204.9	217.5	201.8	217.7	202.0	25.1	6.8	10.0	--
J3540	STMG071	STGM3105	248	12'' DIA	5.4%	239.50	226.07	242.8	230.4	240.4	227.0	240.4	227.0	8.3	8.8	8.9	--
J3646	STMF113	STGM3518	49	21'' DIA	2.4%	161.58	160.38	173.8	168.7	162.4	161.0	162.5	161.0	24.6	11.3	12.6	--
J3664	J3666	STGM1532	375	Irregular Channel	0.1%	200.30	200.00	205.2	203.9	216.0	216.0	216.5	216.5		38.2	38.2	Existing 10-yr
J3666	STIF092	STGM3535	23	12'' DIA	3.1%	200.00	199.28	203.9	202.8	216.0	211.9	216.5	212.3	6.3	24.7	24.8	Existing 10-yr
J3688	STMF117	STGM2982	467	12'' DIA	1.2%	172.98	167.22	177.1	170.0	189.6	168.5	189.6	168.5	4.0	7.9	7.9	Existing 10-yr
J3692	J3694	STGM1212	60	18'' DIA	0.8%	185.00	184.50	191.9	187.4	187.6	186.5	188.3	186.6	9.6	14.4	15.3	--
J3694	J4318	STGM1335	354	Irregular Channel	1.1%	184.50	180.00	187.4	183.0	186.5	182.1	186.6	183.0		46.8	52.4	--
J3700	J-CCT1-03	STGM1417	114	Irregular Channel	19.7%	140.00	112.00	152.0	162.0	140.4	113.3	140.4	113.4		3.6	3.6	--
J3708	J3694	STGM2160	410	33'' DIA	0.1%	185.00	184.50	190.0	187.4	188.3	186.5	188.7	186.6	18.4	33.6	37.8	--
J3728	J3730	STGM2499	26	18'' DIA	2.7%	195.50	194.80	202.3	202.4	202.0	196.6	202.2	196.6	17.4	48.3	48.9	--
J3730	J3760	STGM4284	636	Irregular Channel	1.4%	194.80	185.90	202.4	192.5	196.6	189.7	196.6	189.8		48.3	48.9	--
J3760	OF_J4000	STGM43	50	36'' DIA	0.8%	185.90	185.50	192.5	188.5	189.7	188.5	189.8	188.5	59.7	105.8	110.1	--
J3780	STIG0710	STGM1342	192	Irregular Channel	2.0%	243.10	239.30	246.5	243.0	248.1	247.6	249.2	248.7		29.3	30.2	Existing 10-yr
J3786	J-CCT3-05	CCT3T2-01	752	Irregular Channel	1.8%	143.50	130.00	163.5	150.0	145.4	133.6	145.4	133.8		67.6	72.7	--
J3838	J4946	STGM963	603	Irregular Channel	1.8%	182.30	171.50	191.2	173.5	183.1	172.8	183.1	172.8		10.0	10.1	--
J3896	J5174	STGM2969	65	33'' DIA	1.1%	188.70	188.00	196.0	193.5	190.4	189.9	190.5	190.0	55.1	33.6	38.1	--
J3932	J-CCT1-02	STGM4043	815	Irregular Channel	2.5%	160.00	100.00	165.0	150.0	160.7	101.6	160.7	101.7		5.4	6.2	--
J3990	J-CCT3-16	STGM118	123	1' H, 1'BW, 1 SS Channel	6.3%	182.00	174.28	187.0	179.1	182.3	175.5	182.3	175.5	12.1	1.2	1.6	--
J4040	STMF102	STGM18	127	18'' DIA	2.0%	172.53	169.96	177.5	175.0	173.5	171.4	173.6	171.4	14.9	11.9	12.3	--
J4058	J4060	STGM1831	128	12'' DIA	0.8%	155.00	153.98	162.3	163.0	155.9	154.9	155.9	154.9	3.2	3.3	3.4	--
J4060	OF_J5408	STGM1136	313	12'' DIA	0.8%	153.98	151.48	163.0	158.3	154.9	152.3	154.9	152.3	3.2	3.3	3.4	--
J4120	J3728	STGM1641	173	Irregular Channel	2.0%	199.00	195.50	203.0	202.3	202.1	202.0	202.2	202.2		51.4	52.3	--
J4142	J-CCT2-06	STGM1964	266	Irregular Channel	6.2%	150.00	133.50	155.7	158.5	150.6	134.7	150.6	134.7		7.8	8.0	--
J4162	STMF0913	C6	134	30'' DIA	6.6%	199.00	190.20	202.0	203.4	199.7	191.6	199.7	191.6	105.3	15.8	16.1	--
J4216	OF_J4218	STGM4172	232	Irregular Channel	8.6%	110.00	90.00	114.3	94.0	110.3	90.4	110.4	90.4		7.2	7.6	--
J4298	J3514	STGM1854	252	Irregular Channel	0.0%	224.90	224.80	227.9	227.3	228.3	228.3	228.5	228.5		5.4	5.8	Existing 10-yr
J4318	J4482	STGM4293	186	Irregular Channel	2.0%	180.00	176.38	183.0	180.8	182.1	181.8	183.0	182.9		51.3	57.5	Future 10-yr
J4362	J-CCT3-14	STGM2147	213	Irregular Channel	3.9%	179.30	171.10	185.4	176.5	180.3	172.7	180.4	172.8		21.3	23.5	--
J4400	J3514	STGM1234	87	12'' DIA	3.1%	227.50	224.80	230.9	227.3	233.0	228.3	233.2	228.5	6.5	9.1	9.1	Existing 10-yr
J4402	STMF109	STGM2786	199	12'' DIA	0.6%	182.41	181.25	190.8	186.3	189.3	186.3	188.7	186.3	2.7	3.6	3.7	--
J4482	J4898	STGM2443	168	24'' DIA	2.4%	176.38	172.38	180.8	180.5	181.8	174.3	182.9	174.3	34.9	51.2	55.2	Existing 10-yr
J4500	OF_J5512	STGM4234	337	Irregular Channel	19.2%	146.00	82.50	152.1	84.0	146.3	82.8	146.3	82.8		3.4	3.7	--
J4526	STMG0864	STGM1638	43	12'' DIA	7.4%	229.40	226.19	230.9	231.2	235.0	234.6	235.2	234.9	10.0	3.8	3.8	Existing 10-yr
J4572	J-CCT1-07	STGM938	510	Irregular Channel	3.9%	150.00	130.00	163.6	132.0	151.1	131.2	151.1	131.3		31.3	31.3	--
J4632	J4634	STGM2046	252	Irregular Channel	0.4%	163.50	162.60	166.2	166.5	164.3	163.1	164.4	163.2		5.4	6.2	--
J4634	J3932	STGM1645	39	12'' DIA	6.7%	162.60	160.00	166.5	165.0	163.1	160.7	163.2	160.7	9.6	5.4	6.2	--
J4708	J4216	STGM4158	332	Irregular Channel	11.1%	146.50	110.00	152.6	114.3	146.6	110.3	146.6	110.4		1.2	1.3	--
J4770	STIG1016	STGM200	90	18'' DIA	0.4%	185.50	185.10	191.7	190.8	188.3	187.8	190.5	188.4	7.0	6.9	7.5	--
J4818	J5398	STGM2095	137	18'' DIA	0.7%	176.00	175.00	188.5	183.8	178.9	175.7	179.1	175.7	9.0	12.0	12.0	--
J4882	STMF118	STGM4468	25	18'' DIA	1.2%	175.58	175.28	185.8	186.4	176.5	176.0	176.5	176.0	11.9	8.8	8.8	--
J4888	J-CCT2-04	STGM2390	85	12'' DIA	25.4%	144.00	123.00	146.0	173.0	144.3	124.1	144.3	124.1	18.1	3.8	3.9	--
J4894	J4216	STGM893	517	Irregular Channel	6.6%	144.10	110.00	150.5	114.3	144.4	110.3	144.4	110.4		4.8	5.0	--
J4898	J5576	STGM2021-A	466	Irregular Channel	1.0%	172.38	167.50	180.5	172.0	174.3	169.1	174.3	169.1		47.8	50.9	--
J4938	STIF109	STGM1431	413	24'' DIA	0.7%	184.00	181.10	195.8	190.6	195.4	191.8	197.7	194.2	19.0	18.3	21.1	Future 10-yr
J4946	J4948	STGM1340	19	18'' DIA	0.5%	171.50	171.40	173.5	173.8	172.8	172.0	172.8	172.0	7.6	10.0	10.1	--
J4948	OF_J4952	STGM163	68	Irregular Channel	2.8%	171.40	169.50	173.8	171.5	172.0	170.0	172.0	170.0		12.0	12.0	--
J4972	STMH077	STGM3164	125	12'' DIA	4.6%	268.10	262.39	274.5	267.5	268.4	262.8	268.4	262.8	8.1	1.8	1.8	--
J5034	STMF1010	STGM2710	137	33'' DIA	0.8%	154.93	153.57	166.7	166.9	157.5	155.1	157.9	155.2	48.8	54.7	58.1	--
J5040	J5366	STGM751	153	Irregular Channel	0.4%	201.00	200.41	207.7	205.4	216.1	216.1	216.7	216.7		48.2	48.1	Existing 10-yr
J5064	J3530	STGM1959	53	18'' DIA	1.0%	217.53	217.00	219.0	219.0	218.4	217.5	218.7	217.7	10.4	6.8	10.1	--
J5174	J5472	STGM915	57	Irregular Channel	0.9%	188.00	187.50	193.5	192.4	189.9	189.2	190.0	189.4		33.6	38.1	--
J5220	J4770	STGM3615	571	12'' DIA	0.4%	188.00	185.50	192.5	191.7	192.5	188.3	192.8	190.5	2.4	3.0	3.2	Future 10-yr
J5304	STMF116	STGM2406	225	12'' DIA	0.4%	174.00	173.10	182.4	179.5	194.4	190.1	194.5	190.2	2.3	5.4	5.5	Existing 10-yr
J5354	J-CCT1-05	STGM3139	243	Irregular Channel	13.1%	153.00	121.50	163.0	123.4	153.4	128.1	153.5	128.4		4.0	4.3	--
J5366	J3664	STGM3465	51	27'' DIA	0.2%	200.41	200.30	205.4	205.2	216.1	216.0	216.7	216.5	14.4	45.4	44.1	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS			H = Height, BW = Bottom Width, SS = Side Slope (H:V)		US	DS	US	DS	US	DS	US	DS				
J5386	J-CCT3-06	CCT3T3-01	411	Irregular Channel	2.9%	150.00	138.00	170.0	148.0	150.8	139.9	150.8	140.0		13.7	14.2	--
J5398	J7	STGM3520_1	526	Irregular Channel	0.5%	175.00	172.43	183.8	175.3	175.7	175.4	175.7	175.4		12.0	12.0	--
J5422	STMF1221	STGM3180	150	Irregular Channel	5.2%	167.05	159.23	168.8	166.8	167.7	160.5	167.7	160.5		7.6	7.6	--
J5472	J5474	STGM1834	63	33'' DIA	0.8%	187.50	187.00	192.4	191.8	189.2	188.5	189.4	188.8	46.7	33.6	38.1	--
J5474	J3708	STGM1242	207	Irregular Channel	1.0%	187.00	185.00	191.8	190.0	188.5	188.3	188.8	188.7		33.6	38.1	--
J5554	STMF1220	STGM2689b	53	24'' DIA	7.7%	164.69	160.62	170.5	172.3	165.2	161.5	165.2	161.5	64.5	9.7	9.7	--
J5576	J5034	STGM2021-B	464	Irregular Channel	2.6%	167.50	154.93	172.0	166.7	169.1	157.5	169.1	157.9		54.7	58.1	--
J7	J5554	STGM1876	294	12'' DIA	2.6%	172.43	164.69	175.3	170.5	175.4	165.2	175.4	165.2	5.8	11.9	11.9	Existing 10-yr
J8	STIF1290	STGM694	64	8'' DIA	2.2%	169.00	167.61	171.4	170.7	172.0	168.0	172.0	168.0	1.9	2.9	2.9	Existing 10-yr
J9	STMF126	C5	119	12'' DIA	1.3%	167.60	166.02	171.8	170.4	168.0	166.7	168.0	166.7	4.2	1.2	1.2	--
J-CCT1-02	OF_J-CCT1-01	CCT1-01	913	Irregular Channel	2.6%	100.00	76.00	150.0	90.0	101.6	77.6	101.7	77.7		64.3	71.1	--
J-CCT1-03	J-CCT1-02	CCT1-02	594	Irregular Channel	2.0%	112.00	100.00	162.0	150.0	113.3	101.6	113.4	101.7		54.7	58.0	--
J-CCT1-04	J-CCT1-03	CCT1-03	335	Irregular Channel	2.7%	121.00	112.00	160.0	162.0	122.6	113.3	122.6	113.4		52.2	54.6	--
J-CCT1-05	STIG1416	STGM2909	88	24'' DIA	0.3%	121.50	121.28	123.4	144.1	128.1	124.8	128.4	125.0	11.3	50.2	51.2	Existing 10-yr
J-CCT1-06	J-CCT1-05	CCT1-04	688	Irregular Channel	1.1%	129.31	121.50	139.3	123.4	130.8	128.1	130.8	128.4		46.4	47.1	--
J-CCT1-07	J-CCT1-06	CCT1-05	61	Irregular Channel	1.1%	130.00	129.31	132.0	139.3	131.2	130.8	131.3	130.8		34.9	35.3	--
J-CCT2-02	OF_J-CCT2-01	CCT2-01	67	Irregular Channel	4.5%	100.00	97.00	109.0	109.0	101.0	100.0	101.0	100.0		48.7	51.1	--
J-CCT2-03	J-CCT2-02	CCT2-02	539	Irregular Channel	1.3%	107.00	100.00	150.0	109.0	109.1	101.0	109.1	101.0		40.3	42.0	--
J-CCT2-04	J-CCT2-03	CCT2-03	176	Irregular Channel	9.1%	123.00	107.00	173.0	150.0	124.1	109.1	124.1	109.1		37.4	38.8	--
J-CCT2-05	J-CCT2-04	CCT2-04	694	Irregular Channel	1.2%	131.00	123.00	156.0	173.0	132.8	124.1	132.8	124.1		33.8	35.1	--
J-CCT2-06	J-CCT2-05	CCT2-05	167	Irregular Channel	1.5%	133.50	131.00	158.5	156.0	134.7	132.8	134.7	132.8		31.1	31.7	--
J-CCT3-02	OF_J-CCT3-01	CCT3-01	1161	Irregular Channel	1.1%	112.00	99.00	152.0	140.0	115.5	101.9	115.6	102.0		210.7	231.6	--
J-CCT3-03	J-CCT3-02	CCT3-02	1460	Irregular Channel	0.5%	120.00	112.00	160.0	152.0	122.6	115.5	122.7	115.6		181.5	202.0	--
J-CCT3-04	J-CCT3-03	CCT3-03	644	Irregular Channel	1.2%	128.00	120.00	148.0	160.0	130.1	122.6	130.2	122.7		173.0	192.8	--
J-CCT3-05	J-CCT3-04	HWY240_1	195	Irregular Channel	1.0%	130.00	128.00	150.0	148.0	133.6	130.1	133.8	130.2		158.5	177.3	--
J-CCT3-06	J-CCT3-05	CCT3-04	319	Irregular Channel	2.5%	138.00	130.00	148.0	150.0	139.9	133.6	140.0	133.8		85.5	97.5	--
J-CCT3-07	J-CCT3-06	CCT3-05	571	Irregular Channel	1.2%	145.00	138.00	155.0	148.0	147.4	139.9	147.5	140.0		70.5	81.7	--
J-CCT3-08	J-CCT3-07	CCT3-06	149	Irregular Channel	2.0%	148.00	145.00	158.0	155.0	150.0	147.4	150.1	147.5		69.5	80.7	--
J-CCT3-09	J-CCT3-08	CCT3-07	303	Irregular Channel	2.6%	156.00	148.00	166.0	158.0	157.9	150.0	158.0	150.1		68.4	79.7	--
J-CCT3-10	J-CCT3-09	CCT3-08	215	Irregular Channel	1.9%	160.00	156.00	170.0	166.0	162.0	157.9	162.2	158.0		66.8	78.0	--
J-CCT3-11	J-CCT3-10	STGM1273	67	42'' DIA	0.6%	160.41	160.00	169.0	170.0	163.2	162.0	163.6	162.2	42.5	66.8	78.0	--
J-CCT3-12	J-CCT3-11	STGM3489	107	42'' DIA	2.3%	162.90	160.41	167.4	169.0	165.3	163.2	165.6	163.6	83.7	65.4	76.6	--
J-CCT3-13	J-CCT3-12	CCT3-09	393	Irregular Channel	1.4%	168.45	162.90	171.5	167.4	170.1	165.3	170.2	165.6		56.7	62.8	--
J-CCT3-14	J-CCT3-13	CCT3-10	188	Irregular Channel	1.4%	171.10	168.45	176.5	171.5	172.7	170.1	172.8	170.2		55.6	61.5	--
J-CCT3-15	J-CCT3-14	STGM4167	31	24'' DIA	1.0%	171.40	171.10	176.3	176.5	173.5	172.7	173.7	172.8	22.3	35.0	38.5	--
J-CCT3-16	J-CCT3-15	STGM3778_b	195	Irregular Channel	1.5%	174.28	171.40	179.1	176.3	175.5	173.5	175.5	173.7		32.3	33.7	--
J-CCT3-18	J-CCT3-16	STGM3778_a	440	Irregular Channel	1.3%	180.00	174.28	185.0	179.1	181.2	175.5	181.2	175.5		31.2	32.2	--
STIF0817	J4120	STGM3780	231	Irregular Channel	0.5%	200.10	199.00	207.3	203.0	202.1	202.1	202.3	202.2		49.8	51.1	--
STIF0867	STIF0876	STGM196	176	12'' DIA	0.6%	193.06	191.96	196.9	195.5	193.8	192.7	193.8	192.7	2.9	2.6	2.6	--
STIF0874	OF_J4224	STGM406	31	12'' DIA	0.6%	186.57	186.40	194.6	194.0	187.3	187.1	187.3	187.1	2.7	2.6	2.6	--
STIF0875	STIF0874	STGM3330	140	12'' DIA	2.9%	190.90	186.57	194.3	194.6	191.3	187.3	191.3	187.3	6.3	2.6	2.6	--
STIF0876	STIF0875	STGM1718	154	12'' DIA	0.7%	191.96	190.90	195.5	194.3	192.7	191.3	192.7	191.3	3.1	2.6	2.6	--
STIF0877	STIF0867	STGM3028	159	12'' DIA	0.8%	194.40	193.06	199.1	196.9	195.1	193.8	195.1	193.8	3.4	2.6	2.6	--
STIF092	STMF092	STGM800	34	12'' DIA	0.1%	199.28	199.23	202.8	203.2	211.9	206.1	212.3	206.3	1.4	14.9	15.2	Existing 10-yr
STIF1030	STMF101	STGM4226	278	18'' DIA	5.4%	169.70	154.80	174.7	170.5	170.5	155.8	170.5	155.8	24.1	13.7	14.0	--
STIF109	STMF103	STGM3276	51	18'' DIA	0.2%	181.10	181.00	190.6	190.5	191.8	190.3	194.2	192.3	4.6	18.3	20.8	Existing 10-yr
STIF1132	STIF1133	STGM2705	73	12'' DIA	0.7%	172.10	171.50	177.9	175.3	172.9	172.2	172.9	172.2	2.9	3.0	3.1	--
STIF1133	STIF1134	STGM2973	98	12'' DIA	1.0%	171.50	170.40	175.3	174.7	172.2	171.1	172.2	171.1	3.6	3.0	3.1	--
STIF1134	STIF1135	STGM555	158	12'' DIA	1.1%	170.40	168.60	174.7	173.0	171.1	169.5	171.1	169.5	3.7	3.0	3.1	--
STIF1135	STIF1138	STGM2219	58	12'' DIA	0.5%	168.60	168.00	173.0	171.8	169.5	168.7	169.5	168.8	2.6	3.0	3.1	--
STIF1138	J-CCT3-04	STGM1249	352	12'' DIA	0.9%	168.00	128.00	171.8	148.0	168.7	130.1	168.8	130.2	3.3	3.0	3.1	--
STIF1210	J8	STGM4476	39	12'' DIA	-0.2%	168.92	169.00	171.3	171.4	172.2	172.0	172.2	172.0	1.7	2.9	2.9	Existing 10-yr
STIF1262	OF_J3682	STGM2761	296	12'' DIA	19.3%	145.18	93.00	154.2	123.8	149.6	93.6	149.6	93.6	15.7	10.4	10.4	--
STIF1287	STIF129	STGM2635	206	12'' DIA	1.0%	171.84	169.71	174.6	172.8	211.2	209.8	211.2	209.8	3.6	4.6	4.6	Existing 10-yr
STIF129	STIF1210	STGM4474	139	6'' DIA	0.6%	169.71	168.92	172.8	171.3	209.8	172.2	209.8	172.2	0.4	3.7	3.7	Existing 10-yr
STIF1290	STMF126	STGM1830	13	8'' DIA	12.0%	167.61	166.02	170.7	170.4	168.0	166.7	168.0	166.7	4.2	2.9	2.9	--
STIF131	J-CCT2-03	STGM3334	197	15'' DIA	23.2%	151.40	107.00	157.4	150.0	151.7	109.1	151.7	109.1	29.7	3.0	3.3	--
STIF132	STIF131	STGM1327	60	15'' DIA	0.2%	151.50	151.40	157.4	157.4	152.2	151.7	152.2	151.7	2.6	3.0	3.3	--
STIF1324	J-CCT2-02	STGM2972	493	12'' DIA	8.1%	140.00	100.00	149.5	109.0	140.6	101.0	140.6	101.0	10.2	6.1	6.1	--
STIF1329	STMF134	STGM485	504	12'' DIA	1.5%	154.00	146.60	163.2	152.3	163.2	151.3	163.2	152.3	4.3	4.8	5.0	--
STIF137	J4500	STGM1679	273	12'' DIA	1.5%	150.10	146.00	158.8	152.1	150.7	146.3	150.7	146.3	4.4	2.2	2.4	--
STIG0710	STMG0727	STGM443	231	18'' DIA	2.0%	239.30	234.70	243.0	238.6	247.6	235.9	248.7	236.1	14.9	32.5	28.1	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STIG07112	STMG0772	STGM4305	358	15'' DIA	3.1%	255.04	244.30	258.7	247.5	270.9	253.4	278.5	255.3	11.3	15.6	17.8	Existing 10-yr
STIG0777	STIG0778	STGM2591	30	10'' DIA	0.6%	290.71	290.53	296.5	297.0	291.2	290.9	291.2	290.9	1.8	1.2	1.3	--
STIG0778	STMG0751	STGM1384	174	12'' DIA	2.2%	290.53	286.67	297.0	289.9	290.9	287.0	290.9	287.0	5.5	1.3	1.3	--
STIG0837	STIG0890	STGM3781	21	12'' DIA	9.7%	222.00	219.93	226.2	226.2	227.4	227.4	227.6	227.6	10.6	0.6	0.6	Existing 10-yr
STIG0890	STMG0845	STGM1500	14	18'' DIA	0.2%	219.93	219.90	226.2	225.8	227.4	227.3	227.6	227.5	4.9	15.6	15.5	Existing 10-yr
STIG0894	STIG0890	STGM3587	73	18'' DIA	4.6%	223.30	219.93	226.8	226.2	227.9	227.4	228.1	227.6	22.6	15.1	14.6	Existing 10-yr
STIG09106	STMG1027	STGM779	27	21'' DIA	1.1%	196.30	195.00	198.4	198.2	197.1	195.6	199.4	199.3	17.4	6.8	10.0	Future 10-yr
STIG1016	J3692	STGM3710	26	18'' DIA	0.4%	185.10	185.00	190.8	191.9	187.8	187.6	188.4	188.3	6.5	6.9	7.5	--
STIG1022	STIG1023	STGM2903	278	12'' DIA	0.5%	188.47	187.20	191.4	189.5	201.1	195.4	203.9	197.4	2.4	5.8	6.2	Existing 10-yr
STIG1023	STIG1024	STGM958	33	12'' DIA	0.5%	187.20	187.02	189.5	189.4	195.4	194.7	197.4	196.6	2.6	5.3	5.7	Existing 10-yr
STIG1024	STIG1031	STGM2108	130	12'' DIA	0.0%	187.02	187.00	189.4	190.4	194.7	192.1	196.6	193.8	0.4	5.1	5.4	Existing 10-yr
STIG1031	STMG1030	STGM375	298	12'' DIA	1.3%	187.00	183.05	190.4	188.1	192.1	188.1	193.8	188.1	4.1	5.0	5.3	Existing 10-yr
STIG1072	STIG1075	STGM929	282	12'' DIA	1.0%	193.00	190.14	199.2	198.9	208.2	204.5	208.9	205.0	3.6	4.5	4.6	Existing 10-yr
STIG1075	J3896	STGM3785	525	12'' DIA	0.3%	190.14	188.70	198.9	196.0	204.5	190.4	205.0	190.5	1.9	6.2	6.3	Existing 10-yr
STIG108	J5576	STGM602	98	12'' DIA	0.8%	168.30	167.50	174.5	172.0	169.1	169.1	169.2	169.1	3.3	0.9	0.9	--
STIG1348	STIG1349	STGM3029	39	12'' DIA	2.1%	162.33	161.50	167.7	168.1	173.8	172.5	175.1	173.7	5.2	6.7	7.0	Existing 10-yr
STIG1349	STMG1325	STGM3379	138	12'' DIA	0.5%	161.50	160.87	168.1	166.8	172.5	167.8	173.7	168.7	2.4	6.6	6.8	Existing 10-yr
STIG1416	J-CCT1-04	STGM1882	42	24'' DIA	0.7%	121.28	121.00	144.1	160.0	124.8	122.6	125.0	122.6	18.5	50.1	52.1	--
STIH077	STMH077	STGM4212	56	12'' DIA	4.6%	264.96	262.39	271.4	267.5	265.1	262.8	265.1	262.8	8.4	0.4	0.6	--
STMF071	STMF072	STGM3524	19	18'' DIA	1.9%	220.65	220.30	225.8	226.0	222.3	222.2	222.3	222.2	14.4	8.8	8.9	--
STMF0713	STMF076	STGM1942	281	27'' DIA	1.1%	204.26	201.20	207.9	205.0	205.2	202.2	205.2	202.2	32.6	11.4	11.4	--
STMF0716	STMF0713	STGM149	227	21'' DIA	1.5%	207.75	204.26	213.2	207.9	208.7	205.2	208.7	205.2	19.7	11.4	11.4	--
STMF072	STMF084	STGM2847	183	18'' DIA	0.9%	220.30	218.62	226.0	225.3	222.2	220.9	222.2	221.0	10.0	8.8	8.9	--
STMF0720	STMF0833	STGM2669	216	12'' DIA	0.8%	202.21	200.47	204.2	202.5	202.7	201.0	202.7	201.0	3.4	1.8	1.8	--
STMF073	STMF071	STGM1993	102	18'' DIA	1.2%	221.91	220.65	224.4	225.8	222.9	222.3	223.0	222.3	11.6	8.8	8.9	--
STMF074	STMF0810	STGM1604	478	36'' DIA	0.5%	199.28	196.84	202.6	201.4	201.5	198.6	201.7	198.8	47.8	45.0	48.8	--
STMF075	STMF074	STGM275	155	36'' DIA	0.6%	200.16	199.28	203.5	202.6	201.5	201.5	201.7	201.7	50.3	11.4	11.4	--
STMF076	STMF075	STGM4140	208	36'' DIA	0.5%	201.20	200.16	205.0	203.5	202.2	201.5	202.2	201.7	47.5	11.4	11.4	--
STMF078	STMG0718	STGM1534	121	12'' DIA	1.8%	258.86	256.68	262.9	270.1	262.9	260.0	262.9	260.2	5.0	6.7	6.7	--
STMF081	STMF082	STGM402	340	12'' DIA	1.4%	212.38	207.57	217.1	212.1	217.4	217.1	217.7	217.5	4.2	2.7	2.7	Existing 10-yr
STMF0810	STMF0826	STGM2556	392	36'' DIA	1.4%	196.84	191.54	201.4	199.3	198.6	195.2	198.8	195.6	77.6	49.7	53.5	--
STMF0811	STMF0842	STGM244	161	36'' DIA	0.3%	191.30	190.80	199.9	196.4	194.5	193.3	194.7	193.4	37.1	56.0	59.8	--
STMF0812	J3760	STGM1885	35	36'' DIA	10.8%	189.70	185.90	195.7	192.5	190.9	189.7	191.0	189.8	216.7	58.5	63.6	--
STMF0813	STIF0817	STGM2699	243	36'' DIA	1.7%	204.29	200.10	212.5	207.3	205.9	202.1	205.9	202.3	87.4	49.9	51.2	--
STMF0814	STMF0815	STGM1276	163	12'' DIA	0.3%	205.00	204.50	211.0	212.1	205.5	204.9	205.5	204.9	2.0	1.0	1.0	--
STMF0815	STMF0816	STGM2016	263	12'' DIA	0.5%	204.50	203.09	212.1	208.7	204.9	203.6	204.9	203.6	2.7	1.0	1.0	--
STMF0816	J4120	STGM2371	160	15'' DIA	2.6%	203.09	199.00	208.7	203.0	203.6	202.1	203.6	202.2	10.8	3.9	3.9	--
STMF082	STMG0813	STGM3315	255	15'' DIA	1.2%	207.57	204.50	212.1	210.7	217.1	217.1	217.5	217.4	7.1	2.7	2.8	Existing 10-yr
STMF0821	STMF0813	STGM1727	19	24'' DIA	7.4%	205.66	204.29	212.5	212.5	206.5	205.9	206.5	205.9	61.2	16.5	16.7	--
STMF0822	STMF0816	STGM3292	55	12'' DIA	0.2%	203.22	203.09	208.7	208.7	204.0	203.6	204.0	203.6	1.8	2.9	2.9	--
STMF0823	STMF0822	STGM2845	328	12'' DIA	0.3%	204.32	203.22	210.5	208.7	207.0	204.0	206.7	204.0	2.2	2.9	2.9	--
STMF0824	STMF0825	STGM1741	108	18'' DIA	1.1%	199.23	198.00	204.5	202.9	200.0	198.8	200.0	198.8	11.7	6.3	6.4	--
STMF0825	STMF0826	STGM1540	490	18'' DIA	1.3%	198.00	191.54	202.9	199.3	198.8	195.2	198.8	195.6	12.4	6.3	6.4	--
STMF0826	STMF0811	STGM1631	108	36'' DIA	0.2%	191.54	191.30	199.3	199.9	195.2	194.5	195.6	194.7	31.5	56.0	59.8	--
STMF0827	STMF0810	STGM447	22	18'' DIA	5.4%	198.03	196.84	201.5	201.4	198.5	198.6	198.6	198.8	25.2	4.8	4.8	--
STMF0829	STMF0827	STGM2167	26	15'' DIA	1.2%	198.35	198.03	201.9	201.5	199.1	198.5	199.1	198.6	7.4	4.8	4.8	--
STMF083	STMF086	STGM1303	437	24'' DIA	1.6%	218.19	211.36	225.5	217.3	219.1	212.4	219.1	212.4	28.6	12.6	12.7	--
STMF0830	STMF0829	STGM2798	120	15'' DIA	0.6%	199.12	198.35	203.4	201.9	200.0	199.1	200.0	199.1	5.4	4.8	4.8	--
STMF0831	STMF0830	STGM1702	276	12'' DIA	0.4%	200.29	199.12	206.6	203.4	201.6	200.0	201.6	200.0	2.4	3.0	3.0	--
STMF0832	STMF0831	STGM1139	225	12'' DIA	1.4%	203.44	200.29	210.0	206.6	204.1	201.6	204.1	201.6	4.4	3.0	3.0	--
STMF0833	STMF0830	STGM975	226	12'' DIA	0.6%	200.47	199.12	202.5	203.4	201.0	200.0	201.0	200.0	2.9	1.8	1.8	--
STMF0835	STMF0836	STGM612	338	12'' DIA	1.1%	195.93	192.16	201.8	195.8	196.5	192.7	196.5	192.7	3.9	2.6	2.6	--
STMF0836	STMF0837	STGM2796	275	12'' DIA	1.8%	192.16	187.20	195.8	193.7	192.7	187.7	192.7	187.7	5.0	2.6	2.6	--
STMF0837	OF_J5574	STGM2996	42	15'' DIA	0.9%	187.20	186.80	193.7	194.0	187.7	187.3	187.7	187.3	6.6	2.6	2.6	--
STMF0838	STMF0839	STGM4059	252	12'' DIA	2.4%	203.44	197.51	213.2	207.1	204.0	198.2	204.0	198.2	5.7	3.3	3.3	--
STMF084	STMF083	STGM2237	223	21'' DIA	0.2%	218.62	218.19	225.3	225.5	220.9	219.1	221.0	219.1	7.0	12.6	12.7	--
STMF0840	STMF0839	STGM3044	249	12'' DIA	-1.1%	194.68	197.51	203.5	207.1	195.3	198.2	195.3	198.2	3.9	3.3	3.3	--
STMF0840	STMF0841	STGM3607	27	15'' DIA	1.4%	194.68	194.31	203.5	203.2	195.3	195.1	195.3	195.1	7.9	3.3	3.3	--
STMF0841	STMF0914	STGM4177	315	15'' DIA	0.5%	194.31	192.61	203.2	205.4	195.1	193.2	195.1	193.2	4.9	3.3	3.3	--
STMF0842	STMF0812	STGM2438	142	36'' DIA	0.8%	190.80	189.70	196.4	195.7	193.3	190.9	193.4	191.0	58.5	58.5	62.3	--
STMF0843	STMF0842	STGM1576	196	12'' DIA	0.6%	191.98	190.80	195.5	196.4	195.5	193.3	195.5	193.4	2.9	2.5	2.5	--
STMF0844	STMF0843	STGM272	164	12'' DIA	0.5%	192.85	191.98	196.7	195.5	196.7	195.5	196.7	195.5	2.7	2.5	2.5	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STMF0845	STMF0844	STGM1091	260	12'' DIA	1.9%	197.68	192.85	201.8	196.7	198.2	196.7	198.2	196.7	5.0	2.5	2.5	--
STMF085	STMF0813	STGM539	222	36'' DIA	1.4%	207.36	204.29	212.4	212.5	208.7	205.9	208.8	205.9	77.9	34.9	36.1	--
STMF086	STMF087	STGM541	128	24'' DIA	1.1%	211.36	210.00	217.3	215.1	212.4	211.2	212.4	211.2	23.3	12.6	12.7	--
STMF087	STMF0821	STGM3974	322	24'' DIA	1.4%	210.00	205.66	215.1	212.5	211.2	206.5	211.2	206.5	26.3	16.5	16.7	--
STMF088	STMF089	STGM1012	181	15'' DIA	2.3%	204.24	200.13	209.7	205.3	205.0	200.9	205.0	200.9	10.1	6.3	6.4	--
STMF089	STMF0824	STGM1492	60	18'' DIA	1.5%	200.13	199.23	205.3	204.5	200.9	200.0	200.9	200.0	13.5	6.3	6.4	--
STMF091	STMF0931	STGM3724	174	36'' DIA	2.1%	184.65	180.95	190.4	188.9	185.7	182.7	185.8	182.8	97.1	27.2	27.9	--
STMF0910	STMF103	STGM1485	335	12'' DIA	1.5%	186.00	181.00	191.0	190.5	192.8	190.3	194.6	192.3	4.4	3.5	3.2	Existing 10-yr
STMF0911	STMF0910	STGM2277	191	12'' DIA	0.5%	186.90	186.00	194.2	191.0	194.4	192.8	195.9	194.6	2.4	3.4	3.3	Existing 10-yr
STMF0913	STMF094	STGM2961	89	36'' DIA	0.3%	190.20	189.97	203.4	200.2	191.6	191.1	191.6	191.2	34.0	17.3	17.5	--
STMF0914	STMF0915	STGM414	30	15'' DIA	1.4%	192.61	192.18	205.4	205.6	193.2	192.9	193.2	192.9	8.1	3.3	3.3	--
STMF0915	STMF0916	STGM2165	66	15'' DIA	0.7%	192.18	191.75	205.6	207.3	192.9	192.3	192.9	192.3	5.4	3.3	3.3	--
STMF0916	STMF0917	STGM3665	117	15'' DIA	2.1%	191.75	189.31	207.3	200.0	192.3	190.3	192.3	190.3	9.7	3.3	3.3	--
STMF0917	STMF0922	STGM3732	114	18'' DIA	1.1%	189.31	188.07	200.0	199.2	190.3	189.3	190.3	189.3	11.5	9.0	9.0	--
STMF0918	STMF0919	STGM415	170	12'' DIA	1.0%	200.20	198.53	208.1	209.2	200.9	199.0	200.9	199.0	3.7	3.0	3.0	--
STMF0919	STMF0921	STGM592	205	12'' DIA	3.8%	198.53	190.78	209.2	201.7	199.0	193.1	199.0	192.9	7.1	3.0	3.0	--
STMF092	J4162	STGM4149	88	15'' DIA	0.3%	199.23	199.00	203.2	202.0	206.1	199.7	206.3	199.7	3.3	15.8	16.1	Existing 10-yr
STMF0921	STMF0917	STGM831	94	12'' DIA	1.6%	190.78	189.31	201.7	200.0	193.1	190.3	192.9	190.3	4.6	5.6	5.6	--
STMF0922	STMF0923	STGM2656	166	18'' DIA	0.9%	188.07	186.61	199.2	197.6	189.3	187.8	189.3	187.8	10.2	10.0	10.2	--
STMF0923	STMF0924	STGM865	336	18'' DIA	0.9%	186.61	183.64	197.6	193.3	187.8	184.8	187.8	184.8	10.3	10.0	10.2	--
STMF0924	J3838	STGM2383	131	18'' DIA	1.0%	183.64	182.30	193.3	191.2	184.8	183.1	184.8	183.1	11.1	10.0	10.2	--
STMF0925	STMF0922	STGM2997	297	12'' DIA	0.7%	190.26	188.07	197.5	199.2	190.7	189.3	190.7	189.3	3.1	1.1	1.2	--
STMF0926	J-CCT3-18	STGM1663	23	36'' DIA	3.5%	180.78	180.00	185.8	185.0	181.9	181.2	181.9	181.2	125.0	33.9	34.9	--
STMF0927	J3990	STGM2463	133	12'' DIA	0.5%	182.71	182.00	188.5	187.0	183.2	182.3	183.3	182.3	2.7	1.2	1.6	--
STMF0928	STMF0929	STGM4306	312	12'' DIA	0.8%	194.94	192.41	200.0	196.7	195.4	192.7	195.4	192.7	3.3	1.3	1.5	--
STMF0929	STMF097	STGM1972	35	12'' DIA	6.0%	192.41	190.32	196.7	196.5	192.7	191.0	192.7	191.0	8.9	1.3	1.5	--
STMF093	STMF0932	STGM3734	419	36'' DIA	0.8%	189.10	185.81	198.1	193.0	190.3	187.3	190.3	187.3	58.6	21.1	21.3	--
STMF0930	STMF0928	STGM3741	184	12'' DIA	1.8%	198.17	194.94	203.4	200.0	198.5	195.4	198.5	195.4	4.9	1.3	1.5	--
STMF0931	STMF0926	STGM3642	55	36'' DIA	0.3%	180.95	180.78	188.9	185.8	182.7	181.9	182.8	181.9	37.3	27.2	27.8	--
STMF0932	STMF091	STGM1524	155	36'' DIA	0.7%	185.81	184.65	193.0	190.4	187.3	185.7	187.3	185.8	57.9	27.2	27.9	--
STMF094	STMF093	STGM1494	110	36'' DIA	0.8%	189.97	189.10	200.2	198.1	191.1	190.3	191.2	190.3	60.3	19.0	19.2	--
STMF097	STMF0926	STGM1861	435	15'' DIA	1.4%	190.32	180.78	196.5	185.8	191.0	181.9	191.0	181.9	8.0	4.0	4.3	--
STMF101	STMF1014	STGM3439	93	18'' DIA	2.7%	154.80	152.30	170.5	171.4	155.8	153.3	155.8	153.3	17.2	13.1	13.7	--
STMF1010	STMF1011	STGM3618	89	33'' DIA	2.7%	153.57	150.89	166.9	166.6	155.1	152.2	155.2	152.3	88.1	54.6	57.9	--
STMF1011	STMF1012	STGM1192	29	33'' DIA	4.8%	150.89	149.35	166.6	166.1	152.2	150.7	152.3	150.8	116.2	54.6	57.9	--
STMF1012	J3786	STGM8	98	33'' DIA	6.0%	149.35	143.50	166.1	163.5	150.7	145.4	150.8	145.4	130.3	65.1	69.8	--
STMF1013	STMF1014	STGM870	181	12'' DIA	4.2%	159.85	152.30	174.7	171.4	160.1	153.3	160.1	153.3	7.5	0.9	0.9	--
STMF1014	J5386	STGM567	133	24'' DIA	1.7%	152.30	150.00	171.4	170.0	153.3	150.8	153.3	150.8	29.8	13.7	14.2	--
STMF102	STIF1030	STGM3768	43	18'' DIA	0.6%	169.96	169.70	175.0	174.7	171.4	170.5	171.4	170.5	8.2	11.9	12.3	--
STMF1022	J-CCT3-08	STGM1858	145	15'' DIA	5.7%	160.25	148.00	171.4	158.0	160.5	150.0	160.5	150.1	16.3	1.1	1.1	--
STMF1023	J-CCT3-07	STGM3141	109	12'' DIA	9.9%	160.80	145.00	169.1	155.0	161.0	147.4	161.0	147.5	12.4	1.0	1.0	--
STMF103	J4362	STGM1902	216	18'' DIA	0.8%	181.00	179.30	190.5	185.4	190.3	180.3	192.3	180.4	9.3	21.3	23.6	Future 10-yr
STMF105	STMF106	STGM3119	84	12'' DIA	2.1%	172.00	170.20	182.8	178.7	172.4	170.5	172.4	170.5	5.2	1.3	1.4	--
STMF106	J-CCT3-13	STGM3634	38	12'' DIA	3.2%	170.20	168.45	178.7	171.5	170.5	170.1	170.5	170.2	6.2	1.3	1.4	--
STMF107	J4040	STGM1182	266	15'' DIA	1.8%	177.24	172.53	182.2	177.5	183.0	173.5	183.6	173.6	8.6	12.1	12.5	Existing 10-yr
STMF109	STMF107	STGM3399	303	18'' DIA	1.3%	181.25	177.24	186.3	182.2	186.3	183.0	186.3	183.6	11.8	7.9	8.3	--
STMF113	STMF1012	STGM2686	137	33'' DIA	5.1%	160.38	149.35	168.7	166.1	161.0	150.7	161.0	150.8	125.6	11.3	12.5	--
STMF116	J3688	STGM339	32	12'' DIA	0.4%	173.10	172.98	179.5	177.1	190.1	189.6	190.2	189.6	2.2	5.0	5.1	Existing 10-yr
STMF117	J5422	STGM2536	122	18'' DIA	0.1%	167.22	167.05	170.0	168.8	168.5	167.7	168.5	167.7	3.9	7.6	7.6	--
STMF118	J3646	STGM738	477	18'' DIA	2.9%	175.28	161.58	186.4	173.8	176.0	162.4	176.0	162.5	17.9	8.8	8.8	--
STMF121	OF_J3954	STGM3636	100	12'' DIA	19.3%	151.00	132.00	153.0	135.0	151.3	132.3	151.3	132.3	15.3	2.8	2.8	--
STMF1217	STMF1218	STGM1601	228	18'' DIA	2.9%	175.00	168.49	183.8	176.9	175.6	169.1	175.6	169.1	17.8	6.2	6.2	--
STMF1218	STMF1219	STGM833	230	24'' DIA	2.4%	168.49	162.89	176.9	172.6	169.1	163.4	169.1	163.4	34.6	6.2	6.2	--
STMF1219	STMF1220	STGM3945	92	33'' DIA	2.5%	162.89	160.62	172.6	172.3	163.4	161.5	163.4	161.5	88.9	6.2	6.2	--
STMF122	STMF121	STGM3038	303	12'' DIA	1.0%	154.00	151.00	156.6	153.0	154.7	151.3	154.7	151.3	3.5	2.8	2.8	--
STMF1220	STMF1221	STGM2735	94	36'' DIA	1.5%	160.62	159.23	172.3	166.8	161.5	160.5	161.5	160.5	79.4	15.9	15.9	--
STMF1221	STMF1227	STGM3908	135	36'' DIA	0.9%	159.23	158.04	166.8	166.0	160.5	159.3	160.5	159.3	63.0	23.3	23.3	--
STMF1222	STMF1223	STGM3091	295	36'' DIA	1.2%	148.10	144.70	164.3	158.2	149.5	145.3	149.5	145.3	72.1	26.7	26.7	--
STMF1223	STMF1224	STGM3930	73	36'' DIA	21.9%	144.70	129.10	158.2	152.6	145.3	130.5	145.3	130.6	308.0	30.8	31.2	--
STMF1224	J-CCT3-02	CCT3T1-01	370	Irregular Channel	4.6%	129.10	112.00	152.6	152.0	130.5	115.5	130.6	115.6		30.8	31.2	--
STMF1225	STMF1222	STGM3132	254	36'' DIA	3.5%	156.96	148.10	165.6	164.3	157.9	149.5	157.9	149.5	127.1	26.7	26.7	--
STMF1226	STMF1225	STGM3905	39	36'' DIA	1.1%	157.40	156.96	165.5	165.6	158.7	157.9	158.7	157.9	70.3	26.7	26.7	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STMF1227	STMF1226	STGM1615	53	36'' DIA	1.2%	158.04	157.40	166.0	165.5	159.3	158.7	159.3	158.7	74.2	26.7	26.7	--
STMF126	J5554	C3	59	12'' DIA	2.3%	166.02	164.69	170.4	170.5	166.7	165.2	166.7	165.2	5.4	3.9	3.9	--
STMF131	J4708	STGM4276	122	12'' DIA	0.3%	146.92	146.50	155.4	152.6	147.5	146.6	147.5	146.6	2.1	1.2	1.3	--
STMF134	J4894	STGM2693	171	12'' DIA	1.5%	146.60	144.10	152.3	150.5	151.3	144.4	152.3	144.4	4.3	4.8	5.0	--
STMF135	J-CCT2-06	CCT2-06	477	Irregular Channel	2.4%	145.00	133.50	161.6	158.5	146.1	134.7	146.1	134.7		23.4	23.8	--
STMG071	STMG072	STGM1602	247	18'' DIA	1.3%	226.07	222.75	230.4	225.9	227.0	224.0	227.0	224.0	12.2	8.8	8.9	--
STMG0710	STMG079	STGM252	94	18'' DIA	2.7%	247.10	244.55	248.1	252.0	247.8	245.3	247.8	245.3	18.1	7.2	7.4	--
STMG0711	STMG0710	STGM2904	76	12'' DIA	3.9%	250.10	247.10	254.9	248.1	250.9	247.8	251.0	247.8	7.4	7.2	7.4	--
STMG0712	STMG0732	STGM1067	159	12'' DIA	3.2%	256.00	250.90	261.6	255.1	256.5	251.4	256.5	251.4	6.6	3.2	3.2	--
STMG0713	STMG0734	STGM320	124	12'' DIA	14.7%	280.50	262.50	284.9	270.8	280.8	262.9	280.8	262.9	14.4	3.2	3.2	--
STMG0714	STMG0713	STGM1828	261	12'' DIA	5.9%	295.85	280.50	300.4	284.9	296.3	280.8	296.3	280.8	9.1	3.2	3.2	--
STMG0715	STMG0717	STGM298	113	12'' DIA	4.4%	254.03	249.02	260.1	252.1	254.8	249.8	254.8	249.8	7.8	6.7	6.7	--
STMG0716	STMG0717	STGM3619	418	12'' DIA	3.0%	261.67	249.02	267.9	252.1	262.1	249.8	262.1	249.8	6.4	2.1	2.2	--
STMG0717	J3540	STGM1838	151	12'' DIA	6.3%	249.02	239.50	252.1	242.8	249.8	240.4	249.8	240.4	9.0	8.8	8.9	--
STMG0718	STMG0715	STGM1148	113	12'' DIA	2.4%	256.68	254.03	270.1	260.1	260.0	254.8	260.2	254.8	5.7	6.7	6.7	--
STMG072	STMF073	STGM742	114	18'' DIA	0.7%	222.75	221.91	225.9	224.4	224.0	222.9	224.0	223.0	8.8	8.8	8.9	--
STMG0720	STMG0711	STGM2549	152	12'' DIA	4.2%	256.47	250.10	261.2	254.9	257.3	250.9	257.3	251.0	7.6	7.2	7.4	--
STMG0721	STMG0720	STGM2992	257	12'' DIA	3.0%	264.20	256.47	270.5	261.2	264.5	257.3	264.5	257.3	6.2	1.2	1.2	--
STMG0722	STMG077	STGM2681	137	12'' DIA	1.1%	242.48	241.00	248.2	246.6	247.0	242.2	247.0	242.3	3.8	5.5	5.7	--
STMG0723	STMG0730	STGM3264	312	12'' DIA	0.5%	264.31	262.62	268.0	266.8	264.6	263.3	264.7	263.3	2.7	0.7	0.7	--
STMG0724	STMG076	STGM1922	138	18'' DIA	1.1%	228.95	227.40	233.0	231.5	229.6	227.7	229.6	227.7	11.0	3.5	3.6	--
STMG0725	STMG0724	STGM2690	66	12'' DIA	2.2%	230.43	228.95	233.8	233.0	231.0	229.6	231.0	229.6	5.4	3.5	3.6	--
STMG0727	STMG0729	STGM1672	114	27'' DIA	2.0%	234.70	232.43	238.6	242.9	235.9	234.9	236.1	235.4	43.8	23.0	24.4	--
STMG0729	STMG075	STGM1435	323	24'' DIA	0.8%	232.43	229.78	242.9	234.3	234.9	231.3	235.4	231.3	20.6	23.2	24.4	--
STMG073	STMG0821	STGM78	140	33'' DIA	1.0%	226.20	224.82	231.3	229.7	227.6	226.4	227.6	226.5	52.9	24.9	26.2	--
STMG0730	STMG0716	STGM4322	157	12'' DIA	0.6%	262.62	261.67	266.8	267.9	263.3	262.1	263.3	262.1	2.9	2.1	2.2	--
STMG0731	STMG0730	STGM1778	134	12'' DIA	4.2%	268.21	262.62	273.7	266.8	268.5	263.3	268.5	263.3	7.7	1.5	1.5	--
STMG0732	STMG0833	STGM3497	127	12'' DIA	3.1%	250.90	247.00	255.1	252.5	251.4	247.9	251.4	247.9	6.4	3.2	3.2	--
STMG0733	STIH077	STGM3766	354	12'' DIA	0.9%	268.14	264.96	274.9	271.4	268.4	265.1	268.4	265.1	3.5	0.4	0.6	--
STMG0734	STMG0712	STGM868	133	12'' DIA	4.9%	262.50	256.00	270.8	261.6	262.9	256.5	262.9	256.5	8.1	3.2	3.2	--
STMG0735	STMG0722	STGM755	107	12'' DIA	0.9%	243.49	242.48	249.5	248.2	248.1	247.0	249.5	247.0	3.6	5.5	5.7	--
STMG0738	STMG0735	STGM2711	143	12'' DIA	1.1%	245.09	243.49	250.3	249.5	250.4	248.1	251.1	249.5	3.9	5.5	5.7	Existing 10-yr
STMG0739	STMG0738	STGM4119	113	12'' DIA	0.2%	245.30	245.09	250.5	250.3	252.9	250.4	253.8	251.1	1.6	5.5	5.8	Existing 10-yr
STMG074	STMG073	STGM2078	160	27'' DIA	1.2%	228.10	226.20	233.7	231.3	229.5	227.6	229.5	227.6	33.9	23.0	24.4	--
STMG0742	STMG0768	STGM1868	300	12'' DIA	2.6%	257.32	249.66	262.5	253.5	262.5	259.4	262.5	260.9	6.0	1.9	2.1	--
STMG0744	STMG0742	STGM1370	156	12'' DIA	3.6%	262.97	257.32	268.2	262.5	263.3	262.5	263.4	262.5	7.1	1.9	2.1	--
STMG0747	STMG0771	STGM2595	18	15'' DIA	3.3%	261.20	260.62	265.5	265.4	261.8	261.3	261.8	261.3	12.3	6.0	6.2	--
STMG0749	STMG0767	STGM2405	239	15'' DIA	4.5%	276.33	265.52	282.8	270.7	276.9	266.2	276.9	266.2	14.3	6.0	6.2	--
STMG075	STMG074	STGM1952	129	24'' DIA	1.3%	229.78	228.10	234.3	233.7	231.3	229.5	231.3	229.5	25.9	23.0	24.4	--
STMG0750	STMG0749	STGM3703	107	15'' DIA	7.3%	284.09	276.33	290.0	282.8	284.6	276.9	284.6	276.9	18.2	6.0	6.2	--
STMG0751	STMG0750	STGM4170	133	12'' DIA	1.9%	286.67	284.09	289.9	290.0	287.0	284.6	287.0	284.6	5.1	1.2	1.3	--
STMG0754	STIG0777	STGM961	155	12'' DIA	11.2%	307.92	290.71	315.2	296.5	308.1	291.2	308.1	291.2	12.2	1.2	1.3	--
STMG0755	STMG0766	STGM5	249	12'' DIA	6.0%	315.40	300.47	318.8	305.8	315.6	300.7	315.7	300.7	9.3	1.1	1.2	--
STMG076	STMG073	STGM3886	9	27'' DIA	13.2%	227.40	226.20	231.5	231.3	227.7	227.6	227.7	227.6	117.7	3.5	3.6	--
STMG0761	STMG0754	STGM3652	144	12'' DIA	11.2%	324.00	307.92	329.7	315.2	324.2	308.1	324.2	308.1	12.2	1.2	1.3	--
STMG0762	STMG0761	STGM3911	196	12'' DIA	7.6%	338.85	324.00	344.1	329.7	339.1	324.2	339.1	324.2	10.2	1.2	1.3	--
STMG0765	STMG0762	STGM2791	247	12'' DIA	0.5%	340.04	338.85	345.6	344.1	340.6	339.1	340.6	339.1	2.5	1.2	1.3	--
STMG0766	STMG0750	STGM104	204	12'' DIA	8.1%	300.47	284.09	305.8	290.0	300.7	284.6	300.7	284.6	10.2	1.1	1.2	--
STMG0767	STMG0747	STGM2135	146	15'' DIA	3.0%	265.52	261.20	270.7	265.5	266.2	261.8	266.2	261.8	11.6	6.0	6.2	--
STMG0768	STMG0770	STGM3402	161	12'' DIA	2.4%	249.66	245.78	253.5	251.1	259.4	255.8	260.9	256.9	5.8	6.2	6.4	Existing 10-yr
STMG0769	STMG0768	STGM4289	152	12'' DIA	3.0%	254.21	249.66	259.5	253.5	259.6	259.4	261.0	260.9	6.3	1.3	1.4	Existing 10-yr
STMG077	STMG0831	STGM1325	274	18'' DIA	1.1%	241.00	238.07	246.6	243.1	242.2	243.1	242.3	243.1	11.3	10.1	10.2	--
STMG0770	STMG0739	STGM498	134	12'' DIA	0.4%	245.78	245.30	251.1	250.5	255.8	252.9	256.9	253.8	2.2	5.8	6.0	Existing 10-yr
STMG0771	STMG0720	STGM2857	133	15'' DIA	3.1%	260.62	256.47	265.4	261.2	261.3	257.3	261.3	257.3	11.3	6.0	6.2	--
STMG0772	J3780	STGM1261	34	15'' DIA	3.5%	244.30	243.10	247.5	246.5	253.4	248.1	255.3	249.2	12.2	27.9	30.4	Existing 10-yr
STMG0774	STMG0775	STGM4418	245	12'' DIA	1.0%	261.43	259.00	268.4	264.7	311.4	293.0	320.2	299.5	3.7	12.4	13.5	Existing 10-yr
STMG0775	STMG0776	STGM4127	287	12'' DIA	3.7%	259.00	248.31	264.7	256.2	293.0	265.9	299.5	269.3	7.2	12.6	13.5	Existing 10-yr
STMG0776	STMG0777	STGM2290	132	36'' DIA	2.2%	248.31	245.36	256.2	250.9	265.9	265.9	269.3	269.2	102.3	11.5	12.1	Existing 10-yr
STMG0777	STMG0772	STGM3722	139	12'' DIA	0.8%	245.36	244.30	250.9	247.5	265.9	253.4	269.2	255.3	3.2	11.3	11.9	Existing 10-yr
STMG078	STMG0851	STGM1021	129	18'' DIA	3.3%	242.40	238.10	247.2	242.8	243.4	242.9	243.6	243.2	19.9	7.2	7.4	--
STMG079	STMG078	STGM2829	121	18'' DIA	1.8%	244.55	242.40	252.0	247.2	245.3	243.4	245.3	243.6	14.5	7.2	7.4	--
STMG081	STMG096	STGM2763	106	12'' DIA	1.2%	204.25	202.94	210.0	210.5	216.0	216.0	216.6	216.6	4.0	3.0	2.9	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STMG0810	STMG089	STGM2848	175	15'' DIA	1.4%	224.14	221.73	227.4	226.5	224.6	223.4	224.6	223.4	7.5	2.3	2.3	--
STMG0811	STMG081	STGM1309	426	12'' DIA	1.6%	210.91	204.25	215.9	210.0	216.2	216.0	216.8	216.6	4.4	2.8	2.8	Existing 10-yr
STMG0812	J5040	STGM4215	26	33'' DIA	0.4%	201.10	201.00	210.0	207.7	216.1	216.1	216.7	216.7	17.8	48.3	48.3	Existing 10-yr
STMG0813	STMG0812	STGM186	145	33'' DIA	2.4%	204.50	201.10	210.7	210.0	217.1	216.1	217.4	216.7	43.9	48.7	48.6	Existing 10-yr
STMG0814	STMG087	STGM2358	290	12'' DIA	1.4%	218.02	213.97	221.3	217.3	218.8	217.5	218.8	217.8	4.2	2.7	2.7	--
STMG0815	STMG0817	STGM4047	311	15'' DIA	1.8%	231.50	226.04	235.5	229.1	232.3	229.4	232.4	229.7	8.5	5.5	5.9	--
STMG0816	STMG0815	STGM533	279	12'' DIA	1.5%	235.61	231.50	238.1	235.5	239.3	232.3	240.4	232.4	4.3	5.6	6.0	Existing 10-yr
STMG0817	STMG0818	STGM32	123	15'' DIA	0.6%	226.04	225.36	229.1	228.6	229.4	228.7	229.7	228.9	4.8	5.5	5.9	Existing 10-yr
STMG0818	J4298	STGM2064	254	18'' DIA	0.2%	225.36	224.90	228.6	227.9	228.7	228.3	228.9	228.5	4.5	5.4	5.8	Existing 10-yr
STMG0819	STMG086	STGM2842	457	33'' DIA	1.3%	218.34	212.42	223.2	217.4	221.6	219.0	221.9	219.3	60.0	44.7	44.7	--
STMG082	STMG0813	STGM420	97	36'' DIA	1.6%	206.02	204.50	211.3	210.7	217.3	217.1	217.7	217.4	84.2	46.6	46.5	Existing 10-yr
STMG0820	STMG0834	STGM442	133	33'' DIA	2.7%	220.62	217.11	225.4	223.7	221.7	218.2	221.7	218.2	84.9	26.3	27.6	--
STMG0821	STMG0822	STGM2489	63	33'' DIA	0.5%	224.82	224.48	229.7	229.2	226.4	226.0	226.5	226.0	38.8	24.9	26.2	--
STMG0822	STMG089	STGM2271	262	27'' DIA	1.0%	224.48	221.73	229.2	226.5	226.0	223.4	226.0	223.4	31.9	24.9	26.2	--
STMG0824	STMG0825	STGM4201	24	36'' DIA	1.2%	223.21	222.92	230.3	229.9	235.5	235.5	235.8	235.7	73.7	39.2	39.4	Existing 10-yr
STMG0825	STMG0828	STGM3207	47	36'' DIA	1.0%	222.92	222.44	229.9	232.2	235.5	235.4	235.7	235.6	67.8	39.1	39.3	Existing 10-yr
STMG0827	STMG0845	STGM2457	271	24'' DIA	0.6%	221.54	219.90	231.5	225.8	232.8	227.3	233.1	227.5	17.4	33.1	33.2	Existing 10-yr
STMG0828	STMG0827	STGM276	120	24'' DIA	0.8%	222.44	221.54	232.2	231.5	235.4	232.8	235.6	233.1	19.6	33.2	33.3	Existing 10-yr
STMG0829	STMG0849	STGM725	291	36'' DIA	0.9%	227.89	225.39	235.1	231.0	237.4	236.4	237.7	236.7	61.5	40.4	40.6	Existing 10-yr
STMG083	STMG082	STGM464	143	33'' DIA	1.6%	208.26	206.02	214.8	211.3	217.9	217.3	218.3	217.7	66.1	45.4	45.3	Existing 10-yr
STMG0830	STMG0850	STGM633	255	27'' DIA	1.0%	231.75	229.13	238.0	237.3	240.3	238.1	240.5	238.3	32.7	31.4	31.5	Existing 10-yr
STMG0831	STMG0850	STGM1455	270	18'' DIA	3.3%	238.07	229.13	243.1	237.3	243.1	238.1	243.1	238.3	19.8	10.1	10.2	--
STMG0832	STMG0851	STGM2759	250	21'' DIA	1.0%	240.50	238.10	245.3	242.8	245.3	242.9	245.3	243.2	15.6	10.3	10.4	--
STMG0833	STMG0832	STGM2082	259	18'' DIA	2.5%	247.00	240.50	252.5	245.3	247.9	245.3	247.9	245.3	17.5	10.3	10.5	--
STMG0834	STMG0843	STGM3769	128	33'' DIA	2.4%	217.11	214.07	223.7	219.4	218.2	215.7	218.2	215.8	82.2	26.3	27.6	--
STMG0835	STMG0836	STGM1544	164	33'' DIA	1.4%	212.96	210.60	218.4	215.4	214.4	212.3	214.4	212.3	63.0	33.4	34.4	--
STMG0836	STMG0837	STGM65	297	33'' DIA	0.9%	210.60	208.00	215.4	215.0	212.3	210.0	212.3	210.0	49.9	33.4	34.4	--
STMG0837	STMF085	STGM3293	132	33'' DIA	0.5%	208.00	207.36	215.0	212.4	210.0	208.7	210.0	208.8	36.7	33.4	34.4	--
STMG0839	STMG0840	STGM3596	194	12'' DIA	1.8%	230.00	226.50	237.2	230.2	235.6	230.1	236.1	230.2	5.0	7.2	7.2	--
STMG084	STMG083	STGM1548	161	15'' DIA	0.6%	209.23	208.26	215.2	214.8	217.9	217.9	218.3	218.3	5.0	1.7	1.7	Existing 10-yr
STMG0840	STMG0841	STGM70	155	12'' DIA	4.0%	226.50	220.30	230.2	223.9	230.1	223.9	230.2	223.9	7.4	7.2	7.2	--
STMG0841	STMG0844	STGM543	138	12'' DIA	2.8%	220.30	216.50	223.9	220.3	223.9	217.3	223.9	217.3	6.2	7.1	7.1	--
STMG0842	STMG0839	STGM890	126	12'' DIA	0.7%	230.83	230.00	235.9	237.2	239.4	235.6	239.7	236.1	3.0	7.2	7.2	Existing 10-yr
STMG0843	STMG0835	STGM3173	205	33'' DIA	0.5%	214.07	212.96	219.4	218.4	215.7	214.4	215.8	214.4	38.7	26.3	27.6	--
STMG0844	STMG0835	STGM348	82	12'' DIA	4.3%	216.50	212.96	220.3	218.4	217.3	214.4	217.3	214.4	7.4	7.1	7.1	--
STMG0845	STMG0846	STGM166	88	24'' DIA	0.5%	219.90	219.50	225.8	228.6	227.3	224.7	227.5	224.9	15.2	41.2	41.1	Existing 10-yr
STMG0846	STMG0854	STGM3314	67	27'' DIA	0.3%	219.50	219.30	228.6	224.2	224.7	223.4	224.9	223.6	16.9	44.7	44.7	--
STMG0847	J4526	STGM2468	120	12'' DIA	0.5%	229.97	229.40	233.3	230.9	236.1	235.0	236.3	235.2	2.6	4.0	4.0	Existing 10-yr
STMG0848	STMG0863	STGM3268	130	36'' DIA	0.8%	225.02	223.96	231.3	229.5	236.3	235.8	236.5	236.1	60.7	39.7	39.9	Existing 10-yr
STMG0849	STMG0848	STGM486	49	36'' DIA	0.8%	225.39	225.02	231.0	231.3	236.4	236.3	236.7	236.5	58.3	40.0	40.2	Existing 10-yr
STMG085	STMG084	STGM1815	217	15'' DIA	0.8%	211.01	209.23	216.5	215.2	218.0	217.9	218.3	218.3	5.9	1.6	1.7	Existing 10-yr
STMG0850	STMG0829	STGM1380	185	36'' DIA	0.7%	229.13	227.89	237.3	235.1	238.1	237.4	238.3	237.7	54.6	40.9	41.1	Existing 10-yr
STMG0851	STMG0852	STGM2311	262	24'' DIA	1.5%	238.10	234.17	242.8	239.1	242.9	241.6	243.2	241.8	29.0	17.5	17.7	Existing 10-yr
STMG0852	STMG0830	STGM2013	242	27'' DIA	1.0%	234.17	231.75	239.1	238.0	241.6	240.3	241.8	240.5	32.0	24.1	24.2	Existing 10-yr
STMG0853	STMG0864	STGM2213	213	18'' DIA	-0.8%	224.49	226.19	229.1	231.2	235.2	234.6	235.5	234.9	9.8	5.8	5.9	Existing 10-yr
STMG0853	STMG0825	STGM277	91	18'' DIA	1.7%	224.49	222.92	229.1	229.9	235.2	235.5	235.5	235.7	14.4	5.8	5.9	Existing 10-yr
STMG0854	STMG0819	STGM3000	96	27'' DIA	1.0%	219.30	218.34	224.2	223.2	223.4	221.6	223.6	221.9	30.8	44.7	44.7	--
STMG0855	STMG0833	STGM2801	279	15'' DIA	2.2%	253.08	247.00	266.7	252.5	253.9	247.9	253.9	247.9	9.9	7.2	7.3	--
STMG0856	STMG0865	STGM3426	499	18'' DIA	0.9%	239.74	235.06	247.0	239.5	243.7	241.7	244.9	241.9	10.6	7.0	7.1	--
STMG0857	STMG0856	STGM4204	84	15'' DIA	2.3%	241.70	239.74	247.5	247.0	244.6	243.7	246.0	244.9	10.2	7.0	7.1	--
STMG0858	STMG0857	STGM3319	120	15'' DIA	2.3%	244.49	241.70	250.3	247.5	245.6	244.6	247.4	246.0	10.2	7.1	7.2	--
STMG0859	STMG0858	STGM1356	97	15'' DIA	0.9%	245.36	244.49	250.6	250.3	246.5	245.6	248.5	247.4	6.4	7.1	7.1	--
STMG086	STMG083	STGM3214	252	33'' DIA	1.7%	212.42	208.26	217.4	214.8	219.0	217.9	219.3	218.3	67.8	44.4	44.4	Existing 10-yr
STMG0860	STMG0859	STGM1372	218	15'' DIA	2.3%	250.40	245.36	256.1	250.6	251.2	246.5	251.2	248.5	10.2	7.1	7.1	--
STMG0863	STMG0824	STGM3553	88	36'' DIA	0.8%	223.96	223.21	229.5	230.3	235.8	235.5	236.1	235.8	61.3	39.4	39.6	Existing 10-yr
STMG0864	J4400	STGM1895	28	12'' DIA	-4.6%	226.19	227.50	231.2	230.9	234.6	233.0	234.9	233.2	8.0	9.2	9.3	Existing 10-yr
STMG0865	STMG0852	STGM2269	21	18'' DIA	4.2%	235.06	234.17	239.5	239.1	241.7	241.6	241.9	241.8	22.2	7.0	7.1	Existing 10-yr
STMG087	STMF081	STGM575	116	12'' DIA	1.4%	213.97	212.38	217.3	217.1	217.5	217.4	217.8	217.7	4.2	2.7	2.7	Existing 10-yr
STMG088	STMG0816	STGM3545	191	12'' DIA	0.2%	236.00	235.61	238.8	238.1	243.9	239.3	245.7	240.4	1.6	5.7	6.1	Existing 10-yr
STMG089	STMG0820	STGM2407	199	33'' DIA	0.6%	221.73	220.62	226.5	225.4	223.4	221.7	223.4	221.7	39.3	26.3	27.6	--
STMG0910	STMG099	STGM3386	312	33'' DIA	0.4%	202.75	201.50	215.7	208.6	204.3	202.8	204.4	202.9	33.5	20.8	24.6	--
STMG0911	STMG099	STGM4268	50	12'' DIA	0.6%	201.80	201.50	208.1	208.6	202.9	202.8	203.0	202.9	2.8	1.4	1.9	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STMG0913	STMF092	STGM3236	331	12'' DIA	1.1%	203.01	199.23	207.9	203.2	208.2	206.1	208.4	206.3	3.8	3.8	3.8	Existing 10-yr
STMG0914	J3664	STGM4160	67	12'' DIA	0.4%	201.30	200.30	208.5	205.2	216.0	216.0	216.6	216.5	2.4	2.9	2.9	Existing 10-yr
STMG0916	STMG0917	STGM173	154	12'' DIA	0.9%	191.69	190.30	198.8	197.6	192.4	190.9	192.4	190.9	3.4	2.7	2.8	--
STMG0917	STMF0932	STGM3203	273	12'' DIA	1.6%	190.30	185.81	197.6	193.0	190.9	187.3	190.9	187.3	4.6	2.7	2.8	--
STMG0919	STMF0911	STGM3883	104	12'' DIA	0.9%	187.81	186.90	195.8	194.2	195.8	194.4	196.7	195.9	3.3	3.4	3.4	Future 10-yr
STMG0924	J5064	STGM2988	1248	24'' DIA	0.0%	218.00	217.53	223.8	219.0	219.5	218.4	219.5	218.7	4.4	4.1	4.5	--
STMG0928	STMG0933	STGM959	364	24'' DIA	1.6%	220.00	214.11	230.8	224.4	221.6	219.1	229.4	224.9	30.1	21.0	25.6	--
STMG0930	STMG0916	STGM4138	166	12'' DIA	2.3%	195.50	191.69	203.4	198.8	196.0	192.4	196.0	192.4	5.4	2.7	2.8	--
STMG0932	STMG0928	STGM3122	232	24'' DIA	1.6%	223.75	220.00	232.5	230.8	224.5	221.6	231.3	229.4	29.4	8.3	11.4	--
STMG0933	STMG0934	STGM3901	88	24'' DIA	1.5%	214.11	212.83	224.4	223.2	219.1	218.4	224.9	223.9	28.5	20.8	25.6	Future 10-yr
STMG0934	STMG0935	STGM66	107	24'' DIA	1.4%	212.83	211.30	223.2	221.5	218.4	217.5	223.9	222.7	28.1	20.8	25.3	Future 10-yr
STMG0935	STMG0936	STGM1326	75	24'' DIA	1.5%	211.30	210.16	221.5	221.0	217.5	217.0	222.7	221.9	29.3	20.8	25.2	Future 10-yr
STMG0936	STMG0937	STGM970	97	24'' DIA	1.5%	210.16	208.73	221.0	219.4	217.0	216.2	221.9	220.8	28.5	20.8	25.0	Future 10-yr
STMG0937	STMG098	STGM3894	259	24'' DIA	1.3%	208.73	205.33	219.4	214.9	216.2	214.2	220.8	218.0	27.0	20.8	24.9	Future 10-yr
STMG094	STMG0913	STGM1483	231	12'' DIA	0.7%	204.63	203.01	209.1	207.9	210.7	208.2	210.9	208.4	3.0	3.9	4.0	Existing 10-yr
STMG095	STMG094	STGM2281	311	12'' DIA	-0.1%	204.18	204.63	209.3	209.1	214.3	210.7	214.6	210.9	1.4	4.0	4.1	Existing 10-yr
STMG096	STMG0914	STGM2101	79	12'' DIA	2.1%	202.94	201.30	210.5	208.5	216.0	216.0	216.6	216.6	5.1	2.9	2.9	Existing 10-yr
STMG097	STMG0910	STGM1799	200	24'' DIA	0.9%	204.55	202.75	212.8	215.7	210.2	204.3	212.4	204.4	11.6	20.8	24.6	--
STMG098	STMG097	STGM2486	102	18'' DIA	0.8%	205.33	204.55	214.9	212.8	214.2	210.2	218.0	212.4	9.2	20.8	24.7	Future 10-yr
STMG099	STMG1021	STGM2596	837	33'' DIA	1.1%	201.50	192.00	208.6	202.6	202.8	193.7	202.9	193.9	56.4	24.8	29.1	--
STMG101	STMG104	STGM4016	246	18'' DIA	0.4%	188.80	187.90	200.0	200.8	189.9	188.8	189.9	188.9	6.3	5.7	5.9	--
STMG102	STMG103	STGM171	310	12'' DIA	1.7%	199.76	194.51	210.1	205.6	210.1	195.2	210.1	195.2	4.6	5.7	5.9	--
STMG1021	J3896	STGM3150	685	33'' DIA	0.5%	192.00	188.70	202.6	196.0	193.7	190.4	193.9	190.5	36.9	26.3	30.7	--
STMG1022	STMG1023	STGM2737	220	15'' DIA	0.6%	183.41	182.09	188.6	187.1	184.1	182.9	184.1	185.5	5.2	2.9	3.0	--
STMG1023	STMG1024	STGM2280	237	15'' DIA	0.6%	182.09	180.74	187.1	186.8	182.9	182.6	185.5	183.5	5.1	2.9	3.0	--
STMG1024	J4318	STGM618	120	15'' DIA	0.6%	180.74	180.00	186.8	183.0	182.6	182.1	183.5	183.0	5.3	4.6	4.8	--
STMG1025	STMG1024	STGM3527	231	15'' DIA	0.6%	182.10	180.74	187.5	186.8	182.7	182.6	183.5	183.5	5.2	1.8	1.8	--
STMG1027	STMG1029	STGM3920	247	33'' DIA	1.8%	195.00	190.30	198.2	194.4	195.6	195.6	199.3	199.2	68.1	6.8	10.2	Future 10-yr
STMG1028	J4938	STGM4199	35	18'' DIA	1.4%	184.50	184.00	194.6	195.8	195.5	195.4	199.0	197.7	12.6	18.5	21.4	Existing 10-yr
STMG1029	STMG1028	STGM1017	201	36'' DIA	2.9%	190.30	184.50	194.4	194.6	195.6	195.5	199.2	199.0	115.6	19.0	22.5	Existing 10-yr
STMG103	STMG101	STGM1223	152	12'' DIA	3.8%	194.51	188.80	205.6	200.0	195.2	189.9	195.2	189.9	7.0	5.7	5.9	--
STMG1030	STMF109	STGM609	410	15'' DIA	0.4%	183.05	181.25	188.1	186.3	188.1	186.3	188.1	186.3	4.3	5.3	5.6	--
STMG1034	J3692	STGM3835	17	18'' DIA	0.6%	185.10	185.00	191.3	191.9	187.8	187.6	188.3	188.3	8.0	7.6	7.8	--
STMG1036	STIG09106	STGM140	446	21'' DIA	1.1%	201.00	196.30	204.9	198.4	201.8	197.1	202.0	199.4	17.0	6.8	10.0	--
STMG104	STMG1034	STGM4320	690	21'' DIA	0.4%	187.90	185.10	200.8	191.3	188.8	187.8	188.9	188.3	10.1	5.7	5.9	--
STMG1112	J4882	STGM583	512	18'' DIA	1.2%	181.88	175.58	189.4	185.8	182.8	176.5	182.8	176.5	12.0	8.8	8.8	--
STMG121	STMG1226	STGM2605	321	12'' DIA	0.6%	167.00	165.13	172.7	171.9	208.7	184.6	208.6	184.5	2.7	10.6	10.6	Existing 10-yr
STMG1210	STMG1232	STGM2676	248	12'' DIA	0.6%	167.05	165.59	173.7	172.2	175.9	175.2	175.9	175.2	2.7	2.8	2.8	Existing 10-yr
STMG1215	STMG1210	STGM3838	87	12'' DIA	2.0%	168.80	167.05	175.4	173.7	176.2	175.9	176.2	175.9	5.1	2.6	2.6	Existing 10-yr
STMG1218	STMF135	STGM1879	635	18'' DIA	2.6%	161.72	145.00	168.3	161.6	173.7	146.1	173.7	146.1	17.0	21.8	21.8	Existing 10-yr
STMG1219	STMG1218	STGM2430	82	18'' DIA	0.6%	162.20	161.72	169.2	168.3	176.5	173.7	176.5	173.7	8.0	20.4	20.4	Existing 10-yr
STMG1226	STMG1227	STGM3052	225	18'' DIA	0.6%	165.13	163.82	171.9	170.6	184.6	182.7	184.5	182.6	8.0	9.9	9.9	Existing 10-yr
STMG1227	STMG1219	STGM2687	279	18'' DIA	0.6%	163.82	162.20	170.6	169.2	182.7	176.5	182.6	176.5	8.0	16.3	16.3	Existing 10-yr
STMG1232	STMG1218	STGM1872	543	12'' DIA	0.7%	165.59	161.72	172.2	168.3	175.2	173.7	175.2	173.7	3.0	2.8	2.8	Existing 10-yr
STMG1245	STMG128	STGM1039	279	12'' DIA	0.5%	166.00	164.50	174.1	172.6	204.1	200.8	204.1	200.8	2.6	5.6	5.6	Existing 10-yr
STMG128	STMG1316	STGM1563	719	18'' DIA	0.3%	164.50	162.00	172.6	169.4	200.8	195.7	200.8	195.7	6.2	12.1	12.1	Existing 10-yr
STMG1310	STMG1312	STGM1093	262	15'' DIA	0.5%	164.50	163.10	169.9	169.4	191.9	190.0	191.9	190.0	4.7	7.1	7.1	Existing 10-yr
STMG1311	STMG1315	STGM516	511	15'' DIA	0.0%	162.20	162.00	168.1	166.1	188.2	177.3	188.2	177.3	1.3	11.2	11.2	Existing 10-yr
STMG1312	STMG1311	STGM3846	258	15'' DIA	0.3%	163.10	162.20	169.4	168.1	190.0	188.2	190.0	188.2	3.8	6.3	6.3	Existing 10-yr
STMG1315	STMG1323	STGM4013	65	15'' DIA	3.1%	162.00	157.30	166.1	165.4	177.3	175.9	177.3	175.9	11.3	9.9	9.9	Existing 10-yr
STMG1316	STMG133	STGM2776	357	18'' DIA	1.1%	162.00	157.92	169.4	167.3	195.7	191.3	195.7	191.3	11.2	13.2	13.2	Existing 10-yr
STMG1317	STMG1316	STGM1085	292	12'' DIA	2.8%	167.41	162.00	171.9	169.4	197.7	195.7	197.7	195.7	6.0	4.4	4.4	Existing 10-yr
STMG1319	STIG1348	STGM52	243	10'' DIA	0.8%	164.32	162.33	169.5	167.7	181.3	173.8	182.5	175.1	2.0	4.0	3.9	Existing 10-yr
STMG132	STMG1322	STGM3936	78	18'' DIA	0.1%	157.50	157.40	165.5	165.5	180.7	178.0	180.7	178.0	3.8	19.7	19.7	Existing 10-yr
STMG1320	STMG1321	STGM685	264	10'' DIA	0.3%	166.40	165.57	173.9	171.9	198.8	189.2	199.6	190.3	1.2	5.4	5.4	Existing 10-yr
STMG1321	STMG1319	STGM1656	250	10'' DIA	0.5%	165.57	164.32	171.9	169.5	189.2	181.3	190.3	182.5	1.6	4.7	4.6	Existing 10-yr
STMG1322	STMG1323	STGM2057	59	18'' DIA	0.2%	157.40	157.30	165.5	165.4	178.0	175.9	178.0	175.9	4.3	19.7	19.7	Existing 10-yr
STMG1323	STMG1324	STGM3369	360	21'' DIA	0.1%	157.30	157.00	165.4	166.0	175.9	166.0	175.9	166.0	4.6	31.4	31.4	Existing 10-yr
STMG1324	J4572	STGM3861	112	18'' DIA	6.3%	157.00	150.00	166.0	163.6	166.0	151.1	166.0	151.1	26.3	31.3	31.3	--
STMG1325	STMG1326	STGM3808	88	12'' DIA	3.2%	160.87	158.10	166.8	165.6	167.8	163.6	168.7	164.3	6.3	7.9	8.1	Existing 10-yr
STMG1326	J4142	STGM1339	231	12'' DIA	3.5%	158.10	150.00	165.6	155.7	163.6	150.6	164.3	150.6	6.7	7.8	8.0	--
STMG133	STMG132	STGM1769	300	18'' DIA	0.1%	157.92	157.50	167.3	165.5	191.3	180.7	191.3	180.7	3.9	20.8	20.8	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS			H = Height, BW = Bottom Width, SS = Side Slope (H:V)		US	DS	US	DS	US	DS	US	DS				
STMG134	STMG133	STGM939	270	12'' DIA	0.3%	158.70	157.92	169.4	167.3	192.6	191.3	192.6	191.3	1.9	3.1	3.1	Existing 10-yr
STMG135	STMG134	STGM1333	261	12'' DIA	0.3%	159.50	158.70	170.2	169.4	193.9	192.6	194.0	192.6	2.0	3.9	3.9	Existing 10-yr
STMG136	J-CCT1-06	STGM2827	286	21'' DIA	8.8%	155.05	129.31	163.8	139.3	155.7	130.8	155.7	130.8	46.5	12.1	12.2	--
STMG138	STMG1411	STGM1971	284	12'' DIA	1.5%	159.96	155.62	168.3	163.9	160.8	156.1	160.8	156.1	4.4	3.9	4.1	--
STMG141	J3700	STGM3224	203	12'' DIA	2.1%	154.32	140.00	162.3	152.0	154.9	140.4	154.9	140.4	5.2	3.6	3.6	--
STMG1410	STIG1416	STGM916	58	12'' DIA	28.8%	137.22	121.28	145.7	144.1	137.5	124.8	137.5	125.0	18.8	3.9	4.1	--
STMG1411	STMG1410	STGM3167	227	12'' DIA	8.1%	155.62	137.22	163.9	145.7	156.1	137.5	156.1	137.5	10.1	3.9	4.1	--
STMG1412	STMG136	STGM1606	220	18'' DIA	1.7%	158.80	155.05	168.7	163.8	160.0	155.7	160.0	155.7	13.7	12.1	12.2	--
STMG1413	STMG1414	STGM1156	317	18'' DIA	0.3%	162.00	161.00	170.3	168.8	163.0	161.4	163.0	161.4	5.9	4.6	4.6	--
STMG1414	STMG1412	STGM753	21	18'' DIA	10.6%	161.00	158.80	168.8	168.7	161.4	160.0	161.4	160.0	35.2	4.6	4.6	--
STMG142	STMG145	STGM741	48	12'' DIA	0.8%	160.03	159.65	166.8	166.4	160.5	160.4	160.5	160.4	3.2	1.1	1.3	--
STMG143	STMG145	STGM1740	183	12'' DIA	0.4%	160.47	159.65	167.0	166.4	161.6	160.4	161.7	160.4	2.4	2.8	3.0	--
STMG144	STMG141	STGM2999	261	12'' DIA	1.2%	157.50	154.32	164.0	162.3	158.3	154.9	158.3	154.9	3.9	3.6	3.6	--
STMG145	STMG146	STGM3444	267	15'' DIA	1.0%	159.65	157.00	166.4	163.5	160.4	157.4	160.4	157.4	6.4	4.0	4.3	--
STMG146	J5354	STGM2055	65	15'' DIA	6.1%	157.00	153.00	163.5	163.0	157.4	153.4	157.4	153.5	15.9	4.0	4.3	--
STMG147	STIG1416	STGM156	8	12'' DIA	171.4%	128.19	121.28	143.8	144.1	128.4	124.8	128.5	125.0	44.3	4.4	7.0	--
STMG149	STMG147	STGM3611	283	12'' DIA	10.2%	157.06	128.19	162.2	143.8	157.6	128.4	157.7	128.5	11.4	4.4	7.0	--
STMH071	J4972	STGM2941	26	12'' DIA	6.1%	269.29	268.10	275.6	274.5	270.0	268.4	270.0	268.4	8.9	1.8	1.8	--
STMH072	STMH071	STGM3411	271	12'' DIA	8.5%	292.30	269.29	302.0	275.6	292.6	270.0	292.6	270.0	11.1	1.8	1.8	--
STMH073	STMH076	STGM427	169	12'' DIA	0.9%	257.00	255.50	261.5	259.7	259.7	259.7	260.1	259.7	3.5	2.2	2.3	--
STMH076	STMH081	STGM4141	129	12'' DIA	1.0%	255.50	254.22	259.7	260.1	259.7	260.1	259.7	260.1	3.7	2.2	2.3	--
STMH077	STMH073	STGM3871	122	12'' DIA	4.4%	262.39	257.00	267.5	261.5	262.8	259.7	262.8	260.1	7.9	2.2	2.3	--
STMH081	STMG0855	STGM3561	285	15'' DIA	0.4%	254.22	253.08	260.1	266.7	260.1	253.9	260.1	253.9	4.2	7.2	7.3	--
HESS CREEK																	
J3	STMH1314	STGM231	357	10'' DIA	0.3%	164.00	163.00	169.8	169.9	198.4	196.6	201.8	200.1	1.2	2.5	2.5	Existing 10-yr
J3474	STMG1010	STGM1575	20	21'' DIA	0.5%	189.28	189.18	201.5	201.5	190.4	190.2	190.4	190.2	11.1	8.3	8.6	--
J35	J5012	STGM761_b	1225	Irregular Channel	1.6%	253.80	234.00	256.7	240.5	254.1	236.3	254.2	236.8		8.1	12.9	--
J3504	J4862	STGM1393	255	Irregular Channel	15.9%	160.00	120.00	164.3	130.0	160.4	120.5	160.4	120.5		3.4	3.4	--
J3588	STII1179	STGM2598	307	Irregular Channel	0.7%	209.90	205.36	215.2	212.9	211.2	207.2	211.4	207.3		15.1	16.0	--
J3612	J3614	STGM1579	93	12'' DIA	1.1%	174.00	172.00	178.0	178.3	180.4	173.0	180.4	173.0	3.7	9.4	9.4	Existing 10-yr
J3614	J4282	STGM3629	389	Irregular Channel	0.6%	172.00	169.70	178.3	174.0	173.0	170.6	173.0	170.6		11.7	11.7	--
J3628	J3630	STGM4460	62	12'' DIA	0.8%	188.00	187.50	194.3	191.1	194.3	193.0	194.3	193.1	3.2	63.1	68.1	Existing 10-yr
J3630	STMG115	STGM241	239	33'' DIA	0.2%	187.50	187.00	191.1	192.7	193.0	193.1	193.1	193.0	23.9	9.5	9.0	Existing 10-yr
J3696	J-HC-28	STGM1350	139	Irregular Channel	3.3%	156.53	151.80	166.6	170.0	157.1	155.9	157.1	156.2		22.4	23.6	--
J3762	J4234	STGM1142	25	18'' DIA	0.8%	187.40	187.20	195.6	195.7	188.4	188.1	188.4	188.1	9.5	7.5	7.5	--
J3872	STMG112	STGM4250	167	12'' DIA	0.2%	185.80	185.51	193.2	194.4	192.6	192.2	193.2	192.3	1.5	2.9	3.0	--
J3936	J3938	STGM2754	164	18'' DIA	6.7%	398.00	387.00	415.0	397.0	399.1	388.0	399.1	388.0	27.2	24.5	24.5	--
J3938	J4688	STGM3836	349	Irregular Channel	8.6%	387.00	357.00	397.0	364.2	388.0	358.2	388.0	358.2		27.1	27.7	--
J4002	J-HC-32	STGM2111	378	Irregular Channel	4.2%	182.80	167.00	191.9	180.0	183.6	168.9	183.6	169.1		9.4	10.4	--
J4042	J-HC-33	STGM1480	68	24'' DIA	10.3%	176.00	169.00	204.0	195.0	176.2	170.5	176.2	170.7	74.0	2.2	2.2	--
J4050	STMI096	STGM3971	50	18'' DIA	2.0%	258.00	256.00	262.3	258.7	258.4	256.6	258.5	256.7	15.0	1.8	3.1	--
J4066	STIG11113	STGM793	27	12'' DIA	0.4%	186.00	185.90	192.0	192.8	192.7	192.7	192.8	192.8	2.3	3.2	3.2	Existing 10-yr
J4068	J4066	STGM1044	42	12'' DIA	0.2%	186.10	186.00	192.4	192.0	192.8	192.7	192.9	192.8	1.8	3.3	3.3	Existing 10-yr
J4098	J-HC-11	STGM3729	325	Irregular Channel	12.3%	152.00	112.50	157.4	119.0	152.4	115.2	152.4	115.4		7.1	8.1	--
J4160	STMI132	STGM1814	90	42'' DIA	4.0%	147.33	143.41	154.4	162.1	148.2	144.7	148.3	144.9	201.1	24.2	30.2	--
J4198	J4200	STGM311	251	Irregular Channel	2.8%	160.00	153.00	165.7	155.5	160.5	153.5	160.5	153.5		11.9	12.1	--
J4200	J4398	STGM28	66	18'' DIA	18.5%	153.00	141.00	155.5	160.6	153.5	141.7	153.5	141.7	45.8	11.9	12.1	--
J4234	STMI114	STGM3568	34	18'' DIA	1.0%	187.20	185.80	195.7	195.9	188.1	187.1	188.1	187.2	10.7	7.5	7.5	--
J4282	J5560	STGM2288	878	Irregular Channel	0.5%	169.70	165.00	174.0	168.9	170.6	166.4	170.6	166.4		11.7	11.7	--
J4290	J-HC-14	STGM1992-B	595	12'' DIA	3.9%	162.40	120.50	169.9	150.0	180.0	125.2	181.1	125.5	7.1	10.3	10.5	Existing 10-yr
J4370	J5046	STGM3756	214	Irregular Channel	0.4%	228.80	228.00	234.8	234.2	229.9	228.8	230.0	228.8		8.9	9.3	--
J4398	J-HC-19	STGM2478	342	Irregular Channel	3.5%	141.00	129.00	160.6	155.0	141.7	134.0	141.7	134.4		11.9	12.1	--
J4504	J-HC-13	STGM2342	173	Irregular Channel	17.3%	146.42	117.00	159.2	140.0	147.2	121.5	147.3	121.7		8.9	9.2	--
J4554	J4556	STGM1330	48	15'' DIA	2.1%	312.00	310.00	319.7	318.9	312.5	310.4	312.8	310.4	9.3	3.4	6.5	--
J4556	J5628	STGM24	1004	Irregular Channel	4.5%	310.00	264.50	318.9	271.1	310.4	267.6	310.4	268.7		12.0	18.0	--
J4576	J5090	STGM2558	1209	Irregular Channel	5.7%	313.00	244.00	319.3	260.8	313.2	245.6	313.2	246.0		10.7	13.2	--
J4608	J4610	STGM2442	1371	Irregular Channel	0.1%	101.00	100.00	163.5	156.6	103.3	103.3	104.0	156.6		10.2	54.9	--
J4610	J-HC-03	STGM4240	540	24'' DIA	0.2%	100.00	97.20	156.6	168.5	103.3	102.8	156.6	103.6	9.7	18.7	48.3	--
J4620	STMG1228	STGM3528	786	12'' DIA	0.5%	176.30	172.00	186.6	183.2	203.6	195.4	203.6	195.4	2.6	4.6	4.6	Existing 10-yr
J4628	STIH0917	STGM3855	253	Irregular Channel	4.8%	242.10	230.00	252.5	242.0	242.5	242.3	243.2	243.2		3.8	6.8	--
J4636	STIH12139	STGM351	376	Irregular Channel	0.9%	176.50	173.26	183.6	178.7	177.8	178.7	177.8	178.7		7.1	7.1	--
J4642	J3696	STGM2530	21	Irregular Channel	3.3%	157.20	156.53	168.2	166.6	157.5	157.1	157.5	157.1		4.3	5.1	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
J4668	J4290	STGM1992-A	348	12'' DIA	0.6%	164.65	162.40	173.3	169.9	190.1	180.0	191.1	181.1	2.9	6.7	6.7	Existing 10-yr
J4688	J4690	STGM3862	40	Irregular Channel	3.5%	357.00	355.60	364.2	362.6	358.2	356.3	358.2	356.3		27.1	27.7	--
J4690	J-HC-40	STGM3202	763	Irregular Channel	8.1%	355.60	294.00	362.6	330.0	356.3	295.8	356.3	295.9		27.0	27.6	--
J4734	STMI096	STGM2831	552	12'' DIA	1.3%	264.00	256.00	268.3	258.7	266.9	256.6	268.0	256.7	4.0	4.7	4.9	--
J4738	J4740	STGM3952	1597	Irregular Channel	2.0%	226.00	194.00	234.5	202.9	227.0	195.6	227.0	195.6		23.7	24.1	--
J4740	STIH1035	STGM4082	116	27'' DIA	2.7%	194.00	190.90	202.9	197.0	195.6	192.6	195.6	192.6	27.3	23.5	24.0	--
J4784	J3628	STGM3680	466	Irregular Channel	0.4%	190.00	188.00	195.9	194.3	193.0	194.3	193.2	194.3		56.3	61.0	--
J4862	J-HC-07	STGM2986	94	Irregular Channel	15.8%	120.00	105.30	130.0	140.0	120.5	111.0	120.5	110.9		5.0	5.7	--
J4872	STII11281	C9	413	36'' DIA	0.5%	204.00	201.50	212.1	211.5	205.4	203.0	205.5	203.1	48.4	22.8	23.4	--
J4918	STMH1144	STGM1484	39	21'' DIA	0.8%	202.00	201.70	207.5	207.2	203.0	203.0	203.0	203.0	14.1	3.4	3.4	--
J4956	J-HC-38	HCT6-01	1558	Irregular Channel	2.3%	240.00	203.50	254.2	230.0	241.6	207.1	241.8	207.4		84.7	118.2	--
J4974	OF_J-HC-01	HCT1-01	946	Irregular Channel	6.9%	156.40	91.70	163.4	155.0	156.7	91.9	156.7	92.0		8.4	14.5	--
J5012	STII093	STGM2917	74	12'' DIA	0.7%	234.00	233.50	240.5	240.0	236.3	236.0	236.8	236.4	2.9	11.0	15.9	--
J5026	STMH096	STGM3432	261	15'' DIA	0.8%	226.00	224.00	239.1	237.9	240.0	237.9	240.7	238.4	5.7	8.6	8.8	Existing 10-yr
J5046	J4738	STGM3474	138	24'' DIA	1.4%	228.00	226.00	234.2	234.5	228.8	227.0	228.8	227.0	27.6	8.8	9.3	--
J5084	J5190	STGM1726	53	12'' DIA	3.4%	233.00	231.20	238.3	238.3	233.6	231.8	233.6	231.9	6.6	3.8	4.2	--
J5090	J4956	STGM74	96	36'' DIA	4.2%	244.00	240.00	260.8	254.2	245.6	241.6	246.0	241.8	136.8	79.6	113.0	--
J5110	STMH117	STGM2500	81	24'' DIA	2.2%	192.50	190.68	197.6	195.9	193.5	192.1	193.5	192.1	33.5	17.4	17.6	--
J5190	J4370	STGM193	360	24'' DIA	0.7%	231.20	228.80	238.3	234.8	231.8	229.9	231.9	230.0	18.3	3.8	4.2	--
J5242	J4050	STGM4217	531	Irregular Channel	0.4%	260.00	258.00	262.2	262.3	260.3	258.4	260.4	258.5		1.9	3.2	--
J5266	J4642	STGM2215	492	24'' DIA	5.8%	185.66	157.20	193.0	168.2	185.9	157.5	185.9	157.5	53.0	2.1	2.4	--
J5284	J5090	STGM3123	622	Irregular Channel	1.3%	252.00	244.00	280.7	260.8	252.7	245.6	252.8	246.0		5.2	6.5	--
J5324	J5326	STGM3325	46	12'' DIA	5.5%	436.50	434.00	460.0	439.5	437.3	434.3	437.3	434.3	8.3	7.3	7.3	--
J5326	J4576	STGM855	942	Irregular Channel	13.0%	434.00	313.00	439.5	319.3	434.3	313.2	434.3	313.2		7.3	7.3	--
J5444	J5484	STGM610	87	18'' DIA	0.7%	212.42	211.80	219.8	218.5	215.0	213.1	215.3	213.1	8.9	15.2	16.1	--
J5450	J-HC-37	STGM615	1211	Irregular Channel	7.0%	280.00	196.00	288.9	220.0	280.3	199.0	280.3	199.3		2.4	2.7	--
J5480	J5026	STGM407	184	15'' DIA	1.1%	228.10	226.00	240.3	239.1	241.7	240.0	242.4	240.7	6.9	8.4	8.6	Existing 10-yr
J5484	J3588	STGM228	295	Irregular Channel	0.6%	211.80	209.90	218.5	215.2	213.1	211.2	213.1	211.4		15.2	16.1	--
J5510	STMH1137	STGM3730	162	18'' DIA	1.8%	180.53	177.67	188.5	185.0	181.2	178.4	181.2	178.4	14.1	4.9	5.1	--
J5560	J5562	STGM480	66	18'' DIA	1.5%	165.00	164.00	168.9	171.1	166.4	165.0	166.4	165.0	12.9	15.6	15.9	--
J5562	J4160	STGM2658	454	Irregular Channel	3.7%	164.00	147.33	171.1	154.4	165.0	148.2	165.0	148.3		20.3	22.0	--
J5628	J4734	STGM3128	39	12'' DIA	1.3%	264.50	264.00	271.1	268.3	267.6	266.9	268.7	268.0	4.0	11.8	17.9	--
J5640	J-HC-09	STGM1713	473	Irregular Channel	10.5%	158.50	109.00	164.0	145.0	159.1	111.3	159.2	111.4		7.2	8.0	--
J6	STIH145	STGM3868	135	12'' DIA	0.5%	164.00	163.35	169.4	167.1	166.7	165.5	166.9	165.6	2.5	3.4	3.4	--
J-HC-03	OF_J-HC-02	STGM2361_b	560	96'' DIA	0.4%	97.20	95.00	168.5	104.0	102.8	100.6	103.6	101.1	572.4	475.1	579.2	--
J-HC-04	J-HC-03	STGM2361_a	735	96'' DIA	0.4%	100.00	97.20	145.0	168.5	105.6	102.8	106.6	103.6	564.0	468.3	576.4	--
J-HC-05	J-HC-04	HC-02	219	Irregular Channel	0.5%	101.00	100.00	160.0	145.0	105.6	105.6	106.6	106.6		476.7	590.1	--
J-HC-06	J-HC-05	HC-03	1465	Irregular Channel	0.3%	105.00	101.00	145.0	160.0	111.0	105.6	110.9	106.6		436.5	541.0	--
J-HC-07	J-HC-06	HC-04	624	Irregular Channel	0.0%	105.30	105.00	140.0	145.0	111.0	111.0	110.9	110.9		382.9	471.7	--
J-HC-08	J-HC-07	HC-05	44	Irregular Channel	0.2%	105.40	105.30	140.0	140.0	111.0	111.0	110.9	110.9		379.5	466.1	--
J-HC-09	J-HC-08	HC-06	394	Irregular Channel	0.9%	109.00	105.40	145.0	140.0	111.3	111.0	111.4	110.9		379.6	466.4	--
J-HC-10	J-HC-09	HC-07	805	Irregular Channel	0.3%	111.50	109.00	155.0	145.0	114.5	111.3	114.6	111.4		376.5	462.1	--
J-HC-11	J-HC-10	HC-08	373	Irregular Channel	0.3%	112.50	111.50	119.0	155.0	115.2	114.5	115.4	114.6		371.5	455.7	--
J-HC-12	J-HC-11	HC-09	640	Irregular Channel	0.5%	115.43	112.50	140.0	119.0	120.1	115.2	120.3	115.4		365.0	448.4	--
J-HC-13	J-HC-12	HC-10	342	Irregular Channel	0.5%	117.00	115.43	140.0	140.0	121.5	120.1	121.7	120.3		362.8	445.5	--
J-HC-14	J-HC-13	HC-11	998	Irregular Channel	0.4%	120.50	117.00	150.0	140.0	125.2	121.5	125.5	121.7		355.8	437.9	--
J-HC-15	J-HC-14	HC-12	941	Irregular Channel	0.5%	125.00	120.50	140.0	150.0	127.7	125.2	128.0	125.5		343.1	424.1	--
J-HC-16	J-HC-15	HC-13	339	Irregular Channel	0.3%	126.00	125.00	147.0	140.0	129.1	127.7	129.3	128.0		343.0	430.4	--
J-HC-17	J-HC-16	HC-14	331	Irregular Channel	0.3%	127.00	126.00	160.0	147.0	130.0	129.1	130.4	129.3		362.6	473.1	--
J-HC-18	J-HC-17	STGM1862	203	72'' DIA	0.5%	128.00	127.00	154.7	160.0	133.2	130.0	133.7	130.4	296.8	337.3	419.7	--
J-HC-19	J-HC-18	HC-15	293	Irregular Channel	0.3%	129.00	128.00	155.0	154.7	134.0	133.2	134.4	133.7		314.1	391.0	--
J-HC-20	J-HC-19	HC-16	752	Irregular Channel	0.6%	133.80	129.00	143.8	155.0	138.5	134.0	139.0	134.4		307.9	384.4	--
J-HC-21	J-HC-20	HC-17	348	Irregular Channel	0.6%	136.00	133.80	146.0	143.8	140.7	138.5	141.2	139.0		303.8	380.0	--
J-HC-22	J-HC-21	HC-18	569	Irregular Channel	0.2%	137.00	136.00	147.0	146.0	143.0	140.7	143.6	141.2		301.6	377.6	--
J-HC-23	J-HC-22	HC-19	155	Irregular Channel	0.5%	137.76	137.00	147.8	147.0	143.2	143.0	143.7	143.6		296.1	372.0	--
J-HC-24	J-HC-23	HC-20	255	Irregular Channel	0.5%	139.00	137.76	149.0	147.8	143.6	143.2	144.2	143.7		295.0	370.9	--
J-HC-25	J-HC-24	HC-21	236	Irregular Channel	0.1%	139.30	139.00	160.0	149.0	143.8	143.6	144.3	144.2		280.9	355.2	--
J-HC-26	J-HC-25	STGM2743	232	78'' DIA	0.5%	140.40	139.30	146.1	160.0	144.8	143.8	145.5	144.3	362.4	282.5	357.8	--
J-HC-27	J-HC-26	HC-22	1573	Irregular Channel	0.7%	151.50	140.40	170.0	146.1	154.9	144.8	155.1	145.5		280.4	354.8	--
J-HC-28	J-HC-27	HC-23	179	Irregular Channel	0.2%	151.80	151.50	170.0	170.0	155.9	154.9	156.2	155.1		247.9	317.1	--
J-HC-29	J-HC-28	VILLA_CULVERT_1	59	30'' DIA	2.9%	153.50	151.80	160.0	170.0	156.5	155.9	156.9	156.2	69.9	234.7	300.4	--
J-HC-29	J-HC-28	VILLA_CULVERT_2	58	60'' DIA	2.9%	153.50	151.80	160.0	170.0	156.5	155.9	156.9	156.2	450.5	234.7	300.4	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
J-HC-30	J-HC-29	HC-24	1069	Irregular Channel	0.8%	162.00	153.50	180.0	160.0	166.7	156.5	166.8	156.9		232.4	299.8	--
J-HC-31	J-HC-30	HC-25	181	Irregular Channel	1.4%	164.50	162.00	180.0	180.0	168.1	166.7	168.4	166.8		232.6	299.2	--
J-HC-32	J-HC-31	HC-26	822	Irregular Channel	0.3%	167.00	164.50	180.0	180.0	168.9	168.1	169.1	168.4		209.0	270.5	--
J-HC-33	J-HC-32	HC-27	583	Irregular Channel	0.3%	169.00	167.00	195.0	180.0	170.5	168.9	170.7	169.1		200.3	260.3	--
J-HC-34	J-HC-33	HC-28	755	Irregular Channel	1.1%	177.00	169.00	190.0	195.0	180.8	170.5	181.0	170.7		195.5	253.5	--
J-HC-35	J-HC-34	STGM4228	88	60'' DIA	1.9%	178.70	177.00	185.2	190.0	181.7	180.8	182.1	181.0	364.5	193.2	250.1	--
J-HC-36	J-HC-35	HC-29	356	Irregular Channel	0.5%	180.50	178.70	187.0	185.2	184.1	181.7	184.3	182.1		187.0	241.4	--
J-HC-37	J-HC-36	HC-30	1760	Irregular Channel	0.9%	196.00	180.50	220.0	187.0	199.0	184.1	199.3	184.3		175.5	228.4	--
J-HC-38	J-HC-37	HC-31	691	Irregular Channel	1.1%	203.50	196.00	230.0	220.0	207.1	199.0	207.4	199.3		164.7	210.7	--
J-HC-39	J-HC-38	HC-32	785	Irregular Channel	3.3%	229.60	203.50	245.0	230.0	231.5	207.1	231.6	207.4		76.2	86.1	--
J-HC-40	J-HC-39	HC-33	1818	Irregular Channel	3.5%	294.00	229.60	330.0	245.0	295.8	231.5	295.9	231.6		71.8	78.1	--
J-HC-41	J-HC-40	STGM1508	436	Irregular Channel	2.5%	304.90	294.00	309.3	330.0	306.0	295.8	306.0	295.9		38.5	40.6	--
J-HC-42	J-HC-41	STGM1362	911	Irregular Channel	4.3%	344.20	304.90	351.7	309.3	345.4	306.0	345.4	306.0		38.7	40.8	--
J-HC-43	J-HC-42	STGM3271	49	18'' DIA	4.3%	348.30	344.20	365.0	351.7	352.8	345.4	352.8	345.4	21.7	33.9	33.9	--
J-HCT2-01	J-HC-05	HCT2-01	680	Irregular Channel	0.9%	107.00	101.00	165.0	160.0	108.5	105.6	108.7	106.6		47.2	63.3	--
J-HCT2-02	J-HCT2-01	HCT2-02	688	Irregular Channel	1.9%	120.00	107.00	160.0	165.0	121.2	108.5	121.3	108.7		39.2	49.0	--
J-HCT2-03	J-HCT2-02	HCT2-03	834	Irregular Channel	2.5%	141.00	120.00	160.0	160.0	142.1	121.2	142.2	121.3		35.1	41.7	--
J-HCT3-01	J-HC-06	HCT3-01	1106	Irregular Channel	2.5%	132.64	105.00	165.0	145.0	133.9	111.0	133.9	110.9		80.2	84.9	--
J-HCT3-02	J-HCT3-01	HCT3-02	567	Irregular Channel	2.5%	146.80	132.64	155.0	165.0	147.7	133.9	147.7	133.9		78.2	82.5	--
J-HCT3-03	J-HCT3-02	HCT3-03	570	Irregular Channel	1.4%	155.00	146.80	165.0	155.0	155.7	147.7	155.7	147.7		71.8	73.8	--
J-HCT3-04	J-HCT3-03	HCT3-04	376	Irregular Channel	1.4%	160.40	155.00	165.0	165.0	163.6	155.7	163.6	155.7		65.7	66.9	--
J-HCT3-05	J-HCT3-04	HCT3-05	128	Irregular Channel	1.5%	162.30	160.40	170.0	165.0	165.1	163.6	165.1	163.6		63.7	64.8	--
J-HCT3-06	J-HCT3-05	HCT3-06	146	Irregular Channel	1.4%	164.40	162.30	170.0	170.0	167.2	165.1	167.2	165.1		63.0	64.1	--
J-HCT3-07	J-HCT3-06	STGM734	45	36'' DIA	0.4%	164.60	164.40	173.0	170.0	167.6	167.2	167.6	167.2	44.5	60.6	61.5	--
J-HCT3-08	J-HCT3-07	HCT3-07	271	Irregular Channel	2.1%	170.20	164.60	175.0	173.0	171.6	167.6	171.7	167.6		60.6	61.5	--
J-HCT3-09	J-HCT3-08	STGM658	49	24'' DIA	0.6%	170.50	170.20	177.1	175.0	171.8	171.6	171.8	171.7	89.1	60.6	61.5	--
J-HCT4-01	J-HC-27	HCT4_01	359	Irregular Channel	3.2%	163.00	151.50	185.0	170.0	164.4	154.9	164.4	155.1		40.3	40.9	--
J-HCT4-02	J-HCT4-01	HCT4-02	204	Irregular Channel	1.7%	166.40	163.00	188.4	185.0	167.5	164.4	167.5	164.4		35.4	35.9	--
J-HCT4-03	J-HCT4-02	HCT4-03	93	Irregular Channel	1.7%	168.00	166.40	190.0	188.4	169.6	167.5	169.6	167.5		33.8	34.3	--
J-HCT4-04	J-HCT4-03	HCT4-04	310	Irregular Channel	2.5%	175.60	168.00	195.0	190.0	177.0	169.6	177.0	169.6		32.1	32.6	--
J-HCT4-05	J-HCT4-04	STGM1867	69	48'' DIA	1.3%	176.50	175.60	188.8	195.0	177.7	177.0	177.7	177.0	163.6	31.1	31.5	--
J-HCT4-06	J-HCT4-05	HCT4-05	263	Irregular Channel	3.2%	185.00	176.50	195.0	188.8	186.3	177.7	186.4	177.7		31.1	31.5	--
STIG11113	J3872	STGM910	49	12'' DIA	0.2%	185.90	185.80	192.8	193.2	192.7	192.6	192.8	193.2	1.7	3.1	3.2	--
STIG1139	J4068	STGM3599	81	12'' DIA	0.5%	186.50	186.10	191.5	192.4	192.8	192.8	192.9	192.9	2.6	2.9	3.0	Existing 10-yr
STIG1142	STIG1139	STGM712	115	12'' DIA	0.0%	186.50	186.50	192.4	191.5	192.8	192.8	192.9	192.9	0.1	2.9	3.0	Existing 10-yr
STIH081	J5450	STGM1720	46	12'' DIA	12.7%	286.77	280.00	288.5	288.9	287.1	280.3	287.1	280.3	13.1	2.4	2.7	--
STIH0917	STMH0910	STGM2308	190	18'' DIA	0.5%	230.00	229.00	242.0	242.2	242.3	242.2	243.2	243.0	7.6	3.8	6.3	Existing 10-yr
STIH1012	STIH1013	STGM4187	35	12'' DIA	0.3%	201.60	201.50	209.0	209.0	202.1	201.7	202.1	201.7	1.9	1.1	1.1	--
STIH1013	STMH109	STGM3407	184	12'' DIA	9.0%	201.50	185.00	209.0	193.1	201.7	185.1	201.7	185.1	10.8	1.2	1.2	--
STIH1033	STMH1015	STGM285	113	12'' DIA	3.5%	209.00	205.00	215.9	216.2	209.3	205.5	209.3	205.5	6.6	1.2	1.2	--
STIH1035	STIH1036	STGM396	38	27'' DIA	2.3%	190.90	190.00	197.0	197.3	192.6	191.3	192.6	191.3	25.8	22.9	23.3	--
STIH1036	J-HCT4-06	STGM3682	63	27'' DIA	7.9%	190.00	185.00	197.3	195.0	191.3	186.3	191.3	186.4	47.5	29.9	30.3	--
STIH1038	STMH1010	STGM1925	86	12'' DIA	5.5%	197.70	193.00	205.3	206.2	198.0	193.9	198.0	193.9	8.3	1.9	1.9	--
STIH1040	STMH1011	STGM1229	234	12'' DIA	5.1%	211.00	199.00	218.0	207.8	211.3	199.4	211.3	199.4	8.0	1.9	1.9	--
STIH1043	STMH1014	STGM952	82	12'' DIA	8.0%	204.00	197.45	210.2	207.5	204.3	197.8	204.3	197.8	10.2	1.9	1.9	--
STIH107	STMH1018	STGM218	127	12'' DIA	17.6%	185.07	163.00	192.2	189.4	185.3	167.0	185.3	167.1	15.2	1.8	1.9	--
STIH118	J-HC-24	STGM1768	72	18'' DIA	36.1%	163.50	139.00	170.0	149.0	164.1	143.6	164.1	144.2	62.2	19.9	20.2	--
STIH12125	STMH125	STGM937	90	15'' DIA	0.6%	178.25	177.69	181.7	185.8	179.0	178.2	179.0	178.2	5.1	3.1	3.1	--
STIH12139	STMH1224	STGM2459	90	15'' DIA	0.3%	173.26	172.96	178.7	180.0	178.7	180.0	178.7	180.0	3.7	7.5	7.5	--
STIH12182	STIH12125	STGM2874	196	15'' DIA	0.5%	179.31	178.25	187.1	181.7	180.1	179.0	180.1	179.0	4.6	3.1	3.1	--
STIH144	J3504	STGM139	63	18'' DIA	1.2%	160.75	160.00	165.5	164.3	161.3	160.4	161.3	160.4	11.5	3.4	3.4	--
STIH145	STIH146	STGM3809	105	12'' DIA	-0.3%	163.35	163.62	167.1	166.2	165.5	164.2	165.6	164.2	1.8	3.4	3.4	--
STIH146	STIH144	STGM128	126	12'' DIA	2.3%	163.62	160.75	166.2	165.5	164.2	161.3	164.2	161.3	5.4	3.4	3.4	--
STII093	J5084	STGM2830	172	12'' DIA	0.3%	233.50	233.00	240.0	238.3	236.0	233.6	236.4	233.6	1.9	6.2	6.3	--
STII0940	STII0941	STGM2704	78	12'' DIA	0.9%	252.88	252.00	259.1	258.1	253.8	252.6	259.1	256.6	3.5	3.8	6.8	--
STII0941	STII0945	STGM2680	192	12'' DIA	2.7%	252.00	246.63	258.1	252.5	252.6	247.7	256.6	249.2	6.1	3.8	6.8	--
STII0942	STII0943	STGM3620	51	18'' DIA	0.5%	250.05	249.57	260.6	260.1	250.4	250.0	250.5	250.0	8.2	1.2	1.4	--
STII0943	STII0947	STGM4009	281	18'' DIA	0.5%	249.57	248.11	260.1	252.1	250.0	248.4	250.0	248.4	7.7	1.2	1.4	--
STII0944	J4628	STGM1690	83	12'' DIA	4.8%	246.13	242.10	252.4	252.5	246.6	242.5	246.8	243.2	8.2	3.8	6.9	--
STII0945	STII0944	STGM630	48	12'' DIA	0.6%	246.63	246.13	252.5	252.4	247.7	246.6	249.2	246.8	2.9	3.8	6.8	--
STII0947	J5012	STGM1719	523	Irregular Channel	2.7%	248.11	234.00	252.1	240.5	248.4	236.3	248.4	236.8		1.2	1.4	--
STII0948	STII0942	STGM3225	165	18'' DIA	0.5%	251.09	250.05	259.8	260.6	251.5	250.4	251.5	250.5	7.7	1.2	1.4	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STII0950	STII0952	STGM4036	174	18'' DIA	0.5%	252.77	251.69	260.3	259.1	253.2	252.1	253.2	252.1	7.7	1.2	1.4	--
STII0952	STII0948	STGM3263	79	18'' DIA	0.5%	251.69	251.09	259.1	259.8	252.1	251.5	252.1	251.5	7.7	1.2	1.4	--
STII0953	STII0954	STGM4279	78	18'' DIA	1.3%	260.00	259.00	263.3	261.0	260.2	259.3	260.2	259.3	13.3	0.4	0.6	--
STII0954	J35	STGM761_a	321	Irregular Channel	1.6%	259.00	253.80	261.0	256.7	259.3	254.1	259.3	254.2		3.9	6.8	--
STII0955	STII0956	STGM319	38	15'' DIA	2.0%	257.95	257.19	263.9	263.8	258.6	258.0	258.7	258.2	9.2	4.0	5.7	--
STII0956	STII0957	STGM3183	79	15'' DIA	0.7%	257.19	256.62	263.8	263.3	258.0	257.3	258.2	257.5	5.7	4.0	5.7	--
STII0957	STII0961	STGM1864	216	15'' DIA	1.0%	256.62	254.48	263.3	261.9	257.3	255.1	257.5	255.3	6.4	4.0	5.7	--
STII0961	STII0962	STGM1528	48	18'' DIA	1.0%	254.48	254.00	261.9	261.7	255.1	254.8	255.3	255.0	10.9	4.0	5.7	--
STII0962	J35	STGM1294	46	18'' DIA	0.4%	254.00	253.80	261.7	256.7	254.8	254.1	255.0	254.2	7.2	4.0	5.7	--
STII11135	STMI117	STGM2498	37	24'' DIA	2.7%	198.00	194.00	211.4	208.9	199.1	195.2	199.2	195.2	37.3	22.8	23.4	--
STII11281	STII11135	STGM3389	84	24'' DIA	1.2%	201.50	198.00	211.5	211.4	203.0	199.1	203.1	199.2	24.7	22.8	23.4	--
STII116	STMI113	STGM3056	161	18'' DIA	0.7%	188.91	187.80	198.4	195.2	190.0	188.8	190.0	188.8	8.7	7.5	7.5	--
STII1179	STMI1140	STGM551	50	24'' DIA	0.4%	205.36	205.14	212.9	210.6	207.2	206.9	207.3	206.9	15.0	19.3	19.9	--
STII118	STII116	STGM2730	200	18'' DIA	0.9%	190.63	188.91	202.3	198.4	191.6	190.0	191.6	190.0	9.7	7.5	7.5	--
STII141	OF_J5066	STGM2953	152	18'' DIA	0.2%	167.21	166.90	173.9	174.0	169.1	168.4	170.3	168.4	4.9	7.4	8.1	--
STII142	STII141	STGM3238	197	15'' DIA	0.2%	167.62	167.21	172.1	173.9	171.5	169.1	172.1	170.3	3.1	7.4	8.1	Future 10-yr
STII151	STMI151	STGM3239	314	18'' DIA	0.8%	159.50	156.80	167.6	164.7	160.6	158.0	167.6	160.4	9.4	8.0	14.5	--
STIL085	STMI0911	STGM3610	413	15'' DIA	4.0%	276.09	259.63	280.1	264.5	276.6	260.2	276.7	260.3	13.5	4.1	5.7	--
STMG1010	STMG109	STGM3054	317	18'' DIA	1.4%	189.18	184.62	201.5	199.7	190.2	185.9	190.2	185.9	12.6	10.5	10.8	--
STMG1015	STMG1019	STGM3242	29	24'' DIA	14.1%	181.87	177.80	191.3	190.8	182.4	178.9	182.4	178.9	83.9	14.3	14.5	--
STMG1019	STMH102	STGM461	153	24'' DIA	2.0%	177.80	174.70	190.8	182.3	178.9	175.9	178.9	175.9	32.4	18.1	18.5	--
STMG1035	STMG108	STGM522	111	18'' DIA	0.5%	189.00	188.50	197.3	199.3	189.8	189.0	189.8	189.0	7.1	4.1	4.1	--
STMG106	STMG1035	STGM4085	184	18'' DIA	0.5%	190.00	189.00	200.6	197.3	190.8	189.8	190.8	189.8	7.7	4.1	4.1	--
STMG108	STMG109	STGM3990	128	21'' DIA	3.0%	188.50	184.62	199.3	199.7	189.0	185.9	189.0	185.9	27.5	4.2	4.2	--
STMG109	STMG1015	STGM98	220	21'' DIA	1.2%	184.62	181.87	199.7	191.3	185.9	182.4	185.9	182.4	17.6	14.3	14.5	--
STMG112	STMG117	STGM107	297	12'' DIA	0.2%	185.51	185.00	194.4	192.3	192.2	186.1	192.3	186.1	1.5	5.1	5.1	--
STMG114	J4784	STGM2734	79	18'' DIA	1.3%	191.00	190.00	197.1	195.9	193.2	193.0	193.4	193.2	11.9	5.7	5.9	--
STMG115	STIG1142	STGM3704	121	12'' DIA	0.4%	187.00	186.50	192.7	192.4	193.1	192.8	193.0	192.9	2.3	6.7	6.7	Existing 10-yr
STMG117	STMG118	STGM2535	441	18'' DIA	0.3%	185.00	183.75	192.3	188.9	186.1	184.4	186.1	184.4	5.6	5.1	5.1	--
STMG118	J-HC-22	STGM1345	551	12'' DIA	8.1%	183.75	137.00	188.9	147.0	184.4	143.0	184.4	143.6	10.5	7.7	7.7	--
STMG1213	J-HC-16	C1	349	12'' DIA	12.0%	167.50	126.00	174.0	147.0	167.9	129.1	167.9	129.3	12.2	4.8	4.8	--
STMG122	STMG1223	STGM3848	261	12'' DIA	0.5%	171.50	170.31	177.4	176.1	185.2	180.2	185.2	180.2	2.4	5.2	5.2	Existing 10-yr
STMG1223	STMG1213	STGM3539	526	12'' DIA	0.5%	170.31	167.50	176.1	174.0	180.2	167.9	180.2	167.9	2.6	5.0	5.0	Existing 10-yr
STMG1228	STMG125	STGM3927	449	12'' DIA	1.1%	172.00	166.96	183.2	177.0	195.4	177.9	195.4	177.9	3.8	8.1	8.1	Existing 10-yr
STMG125	STMG126	STGM3759	306	12'' DIA	1.3%	166.96	163.00	177.0	172.1	177.9	163.5	177.9	163.5	4.1	7.1	7.1	Existing 10-yr
STMG126	J-HC-18	STGM143	212	12'' DIA	16.5%	163.00	128.00	172.1	154.7	163.5	133.2	163.5	133.7	14.4	7.8	7.8	--
STMH091	STMH106	STGM1150	385	15'' DIA	0.6%	199.87	197.65	209.1	208.4	200.6	198.2	200.6	198.2	4.9	3.1	3.1	--
STMH0910	J5480	STGM129	635	15'' DIA	0.1%	229.00	228.10	242.2	240.3	242.2	241.7	243.0	242.4	2.4	5.6	6.4	Existing 10-yr
STMH0911	STMH0913	STGM2928	319	12'' DIA	1.6%	200.85	195.61	211.6	206.5	222.0	206.0	228.3	208.4	4.8	9.0	10.4	Existing 10-yr
STMH0912	STMH0911	STGM2644	54	12'' DIA	5.9%	204.00	200.85	211.5	211.6	222.0	222.0	228.3	228.3	8.9	1.5	1.7	Existing 10-yr
STMH0913	STMH0916	STGM4198	214	12'' DIA	1.2%	195.61	193.13	206.5	199.8	206.0	193.8	208.4	193.8	4.0	8.3	9.3	Future 10-yr
STMH0916	STMH0923	STGM3278	40	12'' DIA	9.4%	193.13	189.37	199.8	198.7	193.8	189.9	193.8	189.9	11.4	8.3	9.2	--
STMH0918	STMH1027	STGM2096_2	241	18'' DIA	5.1%	203.70	191.50	214.4	205.8	212.4	192.6	213.1	192.6	23.5	28.7	29.3	--
STMH0919	STMH0918	STGM2096_3	109	18'' DIA	5.0%	209.20	203.70	217.9	214.4	220.5	212.4	221.5	213.1	23.5	29.0	29.4	Existing 10-yr
STMH0920	STMH0919	STGM4205	55	18'' DIA	5.1%	212.00	209.20	221.4	217.9	222.8	220.5	223.9	221.5	23.8	21.9	22.2	Existing 10-yr
STMH0923	J4002	STGM1533	159	36'' DIA	4.1%	189.37	182.80	198.7	191.9	189.9	183.6	189.9	183.6	138.7	8.3	9.2	--
STMH093	J4042	STGM194	167	12'' DIA	11.6%	195.22	176.00	204.4	204.0	195.5	176.2	195.5	176.2	12.3	2.2	2.2	--
STMH094	STMH093	STGM3906	78	12'' DIA	0.7%	195.80	195.22	204.5	204.4	196.4	195.5	196.4	195.5	3.0	2.2	2.2	--
STMH095	STMH094	STGM2439	86	12'' DIA	0.7%	196.44	195.80	204.9	204.5	197.1	196.4	197.1	196.4	3.1	2.2	2.2	--
STMH096	STMH097	STGM1312	203	15'' DIA	0.5%	224.00	223.00	237.9	232.9	237.9	232.6	238.4	233.5	4.5	11.5	11.6	Future 10-yr
STMH097	STMH098	STGM1476	388	18'' DIA	2.2%	223.00	214.50	232.9	223.9	232.6	224.6	233.5	225.8	15.6	15.3	15.2	Future 10-yr
STMH098	STMH0920	STGM2205	43	18'' DIA	5.8%	214.50	212.00	223.9	221.4	224.6	222.8	225.8	223.9	25.5	21.9	22.3	Existing 10-yr
STMH101	J3474	STGM2425	68	21'' DIA	0.9%	189.90	189.28	200.2	201.5	190.9	190.4	190.9	190.4	15.2	8.3	8.6	--
STMH1010	STIH1036	STGM2132	163	15'' DIA	1.8%	193.00	190.00	206.2	197.3	193.9	191.3	193.9	191.3	8.8	7.2	7.2	--
STMH1011	STIH1038	STGM383	54	12'' DIA	2.4%	199.00	197.70	207.8	205.3	199.4	198.0	199.4	198.0	5.6	1.9	1.9	--
STMH1013	STMH1014	STGM2732	123	12'' DIA	6.0%	204.80	197.45	214.2	207.5	205.1	197.8	205.1	197.8	8.5	1.2	1.2	--
STMH1014	STMH1010	STGM2516	65	15'' DIA	6.9%	197.45	193.00	207.5	206.2	197.8	193.9	197.8	193.9	16.5	3.1	3.1	--
STMH1015	STMH1013	STGM526	50	12'' DIA	0.4%	205.00	204.80	216.2	214.2	205.5	205.1	205.5	205.1	2.2	1.2	1.2	--
STMH1017	J-HCT4-01	STGM1204	153	12'' DIA	9.5%	192.51	163.00	194.6	185.0	192.9	164.4	192.9	164.4	10.9	3.4	3.4	--
STMH1018	J-HC-30	STGM233	141	12'' DIA	0.7%	163.00	162.00	189.4	180.0	167.0	166.7	167.1	166.8	3.0	1.8	1.9	--
STMH102	STMH103	STGM3771	272	24'' DIA	1.7%	174.70	169.99	182.3	181.1	175.9	170.9	175.9	170.9	29.7	18.1	18.5	--
STMH1021	STMH1022	STGM2326	263	12'' DIA	2.5%	192.77	186.19	200.1	193.1	193.2	186.6	193.2	186.6	5.6	2.1	2.4	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STMH1022	J5266	STGM1685	21	12'' DIA	2.5%	186.19	185.66	193.1	193.0	186.6	185.9	186.6	185.9	5.6	2.1	2.4	--
STMH1024	STMH0912	STGM4334	207	12'' DIA	0.5%	205.02	204.00	212.8	211.5	222.1	222.0	228.4	228.3	2.6	1.0	1.2	Existing 10-yr
STMH1026	J-HC-31	HCT5-01	480	Irregular Channel	1.6%	172.00	164.50	187.5	180.0	173.2	168.1	173.2	168.4		28.7	29.3	--
STMH1027	STMH1026	STGM2096_1	384	24'' DIA	5.1%	191.50	172.00	205.8	187.5	192.6	173.2	192.6	173.2	51.3	28.7	29.3	--
STMH103	J3696	STGM3954	206	21'' DIA	6.5%	169.99	156.53	181.1	166.6	170.9	157.1	170.9	157.1	40.3	18.1	18.5	--
STMH104	STMH101	STGM2515	122	21'' DIA	1.6%	191.80	189.90	199.5	200.2	192.6	190.9	192.6	190.9	19.9	8.3	8.6	--
STMH105	STMH104	STGM2041	76	21'' DIA	2.9%	194.00	191.80	201.1	199.5	194.7	192.6	194.7	192.6	26.9	8.4	8.6	--
STMH106	STMH105	STGM329	266	15'' DIA	1.4%	197.65	194.00	208.4	201.1	198.2	194.7	198.2	194.7	7.6	3.1	3.1	--
STMH107	STMH108	STGM2998	67	12'' DIA	7.0%	191.68	187.00	199.5	196.1	192.0	187.2	192.0	187.2	9.3	1.7	1.7	--
STMH108	J-HCT4-03	STGM1002	61	12'' DIA	33.0%	187.00	168.00	196.1	190.0	187.2	169.6	187.2	169.6	20.9	1.7	1.7	--
STMH109	J-HCT4-04	STGM2577	20	12'' DIA	52.3%	185.00	175.60	193.1	195.0	185.1	177.0	185.1	177.0	27.0	1.1	1.1	--
STMH111	STMH1017	STGM614	416	12'' DIA	1.4%	198.50	192.51	201.8	194.6	199.2	192.9	199.3	192.9	4.3	3.4	3.4	--
STMH1110	STMH1126	STGM1397	363	12'' DIA	0.4%	200.50	199.00	204.3	205.7	204.3	200.0	204.3	200.0	2.3	3.3	3.8	Future 10-yr
STMH1112	J4918	STGM1313	119	21'' DIA	0.6%	202.70	202.00	211.0	207.5	203.3	203.0	203.3	203.0	12.0	3.4	3.4	--
STMH1116	STMH1128	STGM3453	185	12'' DIA	5.1%	213.23	203.80	216.3	216.9	213.7	204.3	213.7	204.3	8.1	3.2	3.4	--
STMH1124	STMH1112	STGM3923	28	21'' DIA	2.1%	203.30	202.70	211.4	211.0	203.8	203.3	203.8	203.3	22.5	3.4	3.4	--
STMH1125	STMH1124	STGM545	106	21'' DIA	3.2%	206.69	203.30	211.6	211.4	207.1	203.8	207.1	203.8	28.1	3.4	3.4	--
STMH1126	STMH1129	STGM3572	386	24'' DIA	1.6%	199.00	193.00	205.7	197.9	200.0	193.9	200.0	193.9	28.2	14.4	14.6	--
STMH1127	STMH1126	STGM4256	268	21'' DIA	0.6%	200.50	199.00	212.7	205.7	201.8	200.0	201.9	200.0	11.8	11.2	11.5	--
STMH1128	STMH1127	STGM2194	153	15'' DIA	2.2%	203.80	200.50	216.9	212.7	204.3	201.8	204.3	201.9	9.5	3.2	3.4	--
STMH1129	J5110	STGM1334	19	24'' DIA	2.7%	193.00	192.50	197.9	197.6	193.9	193.5	193.9	193.5	36.9	14.4	14.6	--
STMH1133	J5510	STGM1068	46	18'' DIA	1.7%	181.30	180.53	188.4	188.5	181.9	181.2	181.9	181.2	13.7	4.9	5.1	--
STMH1135	STMH118	STGM37	320	15'' DIA	0.5%	185.80	184.00	193.2	189.9	186.6	184.6	186.6	184.6	4.4	3.2	3.3	--
STMH1137	J4198	STGM3337	581	18'' DIA	2.9%	177.67	160.00	185.0	165.7	178.4	160.5	178.4	160.5	17.9	8.6	8.8	--
STMH114	STMH115	STGM2985	40	24'' DIA	1.8%	186.75	186.02	200.8	200.7	187.9	187.4	187.9	187.4	30.3	18.2	18.4	--
STMH1144	STMH1110	STGM2173	252	12'' DIA	0.5%	201.70	200.50	207.2	204.3	203.0	204.3	203.0	204.3	2.5	8.2	8.4	--
STMH1144	STMH1127	STGM546	360	21'' DIA	0.3%	201.70	200.50	207.2	212.7	203.0	201.8	203.0	201.9	9.2	8.2	8.4	--
STMH115	STMH116	STGM2366	227	27'' DIA	0.8%	186.02	184.21	200.7	195.5	187.4	185.3	187.4	185.3	27.5	18.2	18.4	--
STMH116	STIH118	STGM3712	310	18'' DIA	6.7%	184.21	163.50	195.5	170.0	185.3	164.1	185.3	164.1	27.2	19.9	20.2	--
STMH117	STMH114	STGM857	443	24'' DIA	0.9%	190.68	186.75	195.9	200.8	192.1	187.9	192.1	187.9	21.3	17.4	17.6	--
STMH118	STMH1133	STGM2240	153	18'' DIA	1.6%	184.00	181.30	189.9	188.4	184.6	181.9	184.6	181.9	13.4	4.9	5.1	--
STMH1211	STMH1212	STGM619	125	12'' DIA	1.0%	169.52	168.22	174.7	173.3	178.0	176.4	178.2	176.6	3.6	5.5	5.0	Existing 10-yr
STMH1212	STMH1213	STGM219	367	12'' DIA	1.9%	168.22	161.30	173.3	169.8	176.4	162.1	176.6	162.1	4.9	7.2	7.3	Existing 10-yr
STMH1213	STMH1214	STGM2180	39	15'' DIA	2.6%	161.30	160.30	169.8	168.3	162.1	161.2	162.1	161.2	10.4	7.0	7.0	--
STMH1214	STMH1215	STGM4297	185	15'' DIA	1.7%	160.30	157.22	168.3	163.5	161.2	158.2	161.2	158.3	8.3	7.0	7.0	--
STMH1215	STMH1216	STGM3431	41	15'' DIA	1.9%	157.22	156.42	163.5	162.7	158.2	156.9	158.3	157.0	8.9	8.9	9.2	--
STMH1216	J4504	STGM748	72	15'' DIA	13.9%	156.42	146.42	162.7	159.2	156.9	147.2	157.0	147.3	23.9	8.9	9.2	--
STMH1220	STMH1221	STGM1763	226	12'' DIA	0.4%	171.26	170.42	176.3	174.9	181.1	179.7	181.2	179.8	2.3	3.5	3.3	Existing 10-yr
STMH1221	STMH1226	STGM3290	228	12'' DIA	0.2%	170.42	169.99	174.9	173.7	179.7	178.3	179.8	178.4	1.6	3.7	3.4	Existing 10-yr
STMH1222	STMH1220	STGM2584	227	12'' DIA	0.4%	172.10	171.26	176.3	176.3	182.5	181.1	182.7	181.2	2.3	3.4	3.4	Existing 10-yr
STMH1223	STMH1230	STGM1018	108	12'' DIA	0.2%	172.94	172.72	177.0	176.7	184.0	183.3	184.2	183.4	1.7	3.9	3.9	Existing 10-yr
STMH1224	STMH1227	STGM3602	430	15'' DIA	0.3%	172.96	171.54	180.0	180.9	180.0	180.9	180.0	180.9	3.7	5.5	5.5	--
STMH1226	STMH1211	STGM1382	48	12'' DIA	1.0%	169.99	169.52	173.7	174.7	178.3	178.0	178.4	178.2	3.7	3.6	3.6	Existing 10-yr
STMH1227	J-HCT3-09	STGM2660	345	15'' DIA	0.3%	171.54	170.50	180.9	177.1	180.9	171.8	180.9	171.8	3.5	5.5	5.5	--
STMH1228	J-HCT3-06	STGM192	72	12'' DIA	1.5%	165.50	164.40	173.4	170.0	167.6	167.2	167.7	167.2	4.4	2.6	2.7	--
STMH1229	STMH1228	STGM674	221	12'' DIA	1.5%	168.72	165.50	176.6	173.4	169.3	167.6	169.3	167.7	4.5	2.6	2.7	--
STMH1230	STMH1222	STGM355	116	12'' DIA	0.5%	172.72	172.10	176.7	176.3	183.3	182.5	183.4	182.7	2.7	3.6	3.6	Existing 10-yr
STMH1231	J-HCT3-09	STGM1793	111	42'' DIA	1.0%	171.56	170.50	179.7	177.1	173.4	171.8	173.5	171.8	98.8	55.3	56.3	--
STMH1233	STMH1211	STGM900	313	15'' DIA	0.4%	170.71	169.52	177.2	174.7	178.1	178.0	178.3	178.2	4.0	2.0	2.0	Existing 10-yr
STMH1238	STMH1239	STGM962	206	15'' DIA	0.5%	165.13	164.09	170.5	170.2	165.8	164.7	165.8	164.7	4.8	2.7	2.7	--
STMH1239	STMH1240	STGM1908	279	18'' DIA	0.6%	164.09	162.29	170.2	167.9	164.7	162.9	164.7	162.9	8.8	2.7	2.7	--
STMH1240	STMH1241	STGM496	57	18'' DIA	0.6%	162.29	161.94	167.9	167.6	162.9	162.3	162.9	162.3	8.5	2.7	2.7	--
STMH1241	J-HCT3-03	STGM428	132	18'' DIA	5.3%	161.94	155.00	167.6	165.0	162.3	155.7	162.3	155.7	24.0	2.7	2.7	--
STMH1242	STMH1243	STGM2587	114	12'' DIA	0.9%	169.93	168.94	174.2	173.5	170.5	169.6	170.5	169.6	3.5	2.0	2.0	--
STMH1243	STMH1244	STGM2313	299	12'' DIA	0.6%	168.94	167.19	173.5	172.6	169.6	167.9	169.6	167.9	2.8	2.0	2.0	--
STMH1244	STMH1245	STGM4325	195	12'' DIA	0.5%	167.19	166.12	172.6	172.5	167.9	166.5	167.9	166.5	2.8	2.0	2.0	--
STMH1245	J-HCT3-04	STGM1060	157	15'' DIA	3.6%	166.12	160.40	172.5	165.0	166.5	163.6	166.5	163.6	12.8	2.0	2.0	--
STMH1248	J-HCT3-03	STGM177	183	15'' DIA	3.2%	160.76	155.00	169.6	165.0	161.2	155.7	161.3	155.7	12.0	3.6	4.3	--
STMH125	J4636	STGM2291	54	18'' DIA	2.2%	177.69	176.50	185.8	183.6	178.2	177.8	178.2	177.8	15.7	3.1	3.1	--
STMH1252	J-HCT3-05	STGM1114	39	12'' DIA	3.9%	163.82	162.30	169.6	170.0	165.2	165.1	165.2	165.1	7.5	0.7	0.7	--
STMH1253	STMH1254	STGM525	74	12'' DIA	1.8%	170.83	169.50	177.3	176.8	210.7	208.0	211.3	208.6	4.8	9.0	9.0	Existing 10-yr
STMH1254	J4668	STGM3810	579	12'' DIA	0.8%	169.50	164.65	176.8	173.3	208.0	190.1	208.6	191.1	3.3	8.2	8.2	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STMH127	STMH1231	STGM4274	81	48'' DIA	1.9%	173.13	171.56	181.8	179.7	174.6	173.4	174.6	173.5	197.6	55.3	56.3	--
STMH128	STMH127	STGM425	415	42'' DIA	0.1%	173.60	173.13	186.6	181.8	176.2	174.6	176.3	174.6	33.8	50.0	50.8	--
STMH129	STMH128	STGM4004	444	36'' DIA	1.6%	180.81	173.60	192.2	186.6	182.0	176.2	182.1	176.3	86.2	30.2	30.8	--
STMH1310	J-HCT3-02	STGM1652	117	12'' DIA	0.3%	147.10	146.80	159.9	155.0	148.3	147.7	148.4	147.7	1.9	2.8	3.0	--
STMH1311	STMH1310	STGM3548	114	12'' DIA	6.6%	154.60	147.10	165.6	159.9	155.0	148.3	155.0	148.4	9.7	2.8	3.0	--
STMH1312	J-HCT3-01	STGM1000	120	12'' DIA	12.6%	147.62	132.64	162.4	165.0	147.9	133.9	147.9	133.9	12.9	2.2	2.7	--
STMH1313	STMH1312	STGM3138	49	12'' DIA	11.7%	153.35	147.62	163.3	162.4	153.6	147.9	153.7	147.9	12.9	2.2	2.7	--
STMH1314	STMH1315	STGM1956	461	10'' DIA	1.1%	163.00	158.10	169.9	169.3	196.6	183.9	200.1	187.7	2.2	4.9	4.8	Existing 10-yr
STMH1315	STMH133	STGM2497	433	10'' DIA	1.1%	158.10	153.50	169.3	163.4	183.9	154.2	187.7	154.2	2.3	6.3	6.9	Existing 10-yr
STMH132	J5640	STGM2226	109	12'' DIA	5.1%	154.52	158.50	164.7	164.0	164.6	159.1	164.7	159.2	8.0	5.8	6.1	--
STMH133	J4098	STGM2979	66	15'' DIA	2.3%	153.50	152.00	163.4	157.4	154.2	152.4	154.2	152.4	9.7	5.6	6.0	--
STMH135	STMH136	STGM2191	40	12'' DIA	20.3%	157.70	149.85	165.3	162.9	157.9	150.1	158.0	150.1	15.4	1.9	2.2	--
STMH136	STMH137	STGM1598	43	12'' DIA	33.9%	149.85	136.08	162.9	148.3	150.1	136.3	150.1	136.3	20.6	1.9	2.2	--
STMH137	STMH138	STGM1260	23	12'' DIA	56.6%	136.08	124.75	148.3	138.8	136.3	125.1	136.3	125.1	26.4	1.9	2.2	--
STMH138	J-HC-12	STGM727	142	12'' DIA	6.6%	124.75	115.43	138.8	140.0	125.1	120.1	125.1	120.3	9.7	1.9	2.2	--
STMI081	STIL085	STGM3060	648	12'' DIA	4.6%	305.96	276.09	310.7	280.1	306.5	276.6	306.6	276.7	7.9	4.1	5.7	--
STMI0911	STII0955	STGM2451	80	15'' DIA	2.1%	259.63	257.95	264.5	263.9	260.2	258.6	260.3	258.7	9.6	4.1	5.7	--
STMI096	J-HC-36	STGM3381	2189	18'' DIA	3.4%	256.00	180.50	258.7	187.0	256.6	184.1	256.7	184.3	19.6	6.3	7.6	--
STMI111	J5444	STGM1358	18	18'' DIA	1.1%	212.62	212.42	219.8	219.8	215.4	215.0	215.7	215.3	11.1	15.2	16.1	--
STMI112	STII118	STGM3558	164	18'' DIA	1.1%	192.35	190.63	203.9	202.3	192.9	191.6	192.9	191.6	10.7	3.2	3.2	--
STMI1122	STMI1141	STGM1418	101	24'' DIA	0.5%	204.90	204.40	212.9	215.1	206.6	205.8	206.6	205.8	15.9	19.3	19.9	--
STMI113	J3762	STGM1860	44	18'' DIA	0.9%	187.80	187.40	195.2	195.6	188.8	188.4	188.8	188.4	10.1	7.5	7.5	--
STMI114	STMH129	STGM2566	334	33'' DIA	1.5%	185.80	180.81	195.9	192.2	187.1	182.0	187.2	182.1	64.2	30.2	30.8	--
STMI1140	STMI1122	STGM1958	39	24'' DIA	0.6%	205.14	204.90	210.6	212.9	206.9	206.6	206.9	206.6	17.7	19.3	19.9	--
STMI1141	J4872	STGM167	36	24'' DIA	1.1%	204.40	204.00	215.1	212.1	205.8	205.4	205.8	205.5	23.8	19.3	19.9	--
STMI117	STMI114	STGM1859	548	33'' DIA	1.1%	194.00	185.80	208.9	195.9	195.2	187.1	195.2	187.2	56.9	22.8	23.4	--
STMI121	STMH128	STGM1226	273	27'' DIA	2.1%	179.45	173.60	189.9	186.6	180.2	176.2	180.2	176.3	46.1	9.7	9.7	--
STMI122	STMI121	STGM3166	491	24'' DIA	0.5%	182.11	179.45	192.6	189.9	183.3	180.2	183.3	180.2	16.7	9.7	9.7	--
STMI131	STMI132	STGM2778	236	18'' DIA	3.6%	151.80	143.41	167.5	162.1	152.4	144.7	152.4	144.9	20.3	5.9	5.9	--
STMI1311	J4160	STGM1173	152	24'' DIA	4.6%	154.39	147.33	162.6	154.4	154.8	148.2	154.9	148.3	48.6	3.9	8.2	--
STMI1312	STMI1311	STGM3072	168	21'' DIA	1.7%	157.19	154.39	167.1	162.6	157.7	154.8	158.0	154.9	20.5	3.9	8.2	--
STMI132	J-HCT2-03	STGM2103	100	33'' DIA	2.1%	143.41	141.00	162.1	160.0	144.7	142.1	144.9	142.2	76.4	35.1	41.7	--
STMI135	STMI131	STGM3445	340	18'' DIA	0.3%	152.82	151.80	166.1	167.5	154.0	152.4	154.0	152.4	6.0	5.9	5.9	--
STMI141	STMI135	STGM286	312	18'' DIA	0.7%	154.90	152.82	167.6	166.1	155.8	154.0	155.8	154.0	8.9	5.9	5.9	--
STMI151	J4974	STGM2534	49	15'' DIA	0.8%	156.80	156.40	164.7	163.4	158.0	156.7	160.4	156.7	5.9	8.0	14.5	--
SPRING BROOK																	
J3522	STMJ104	STGM3285	164	27'' DIA	0.3%	212.00	211.50	221.6	221.3	213.8	213.1	213.9	213.1	17.1	18.3	19.2	--
J3524	STMI1015	STGM1126	178	15'' DIA	1.9%	217.58	213.55	225.1	221.8	223.5	221.8	231.6	227.9	9.0	7.4	9.7	Future 10-yr
J3668	STII0913	STGM1646	55	21'' DIA	0.9%	235.50	235.00	241.6	243.0	237.5	238.1	241.7	241.5	15.0	12.6	16.3	Future 10-yr
J3852	STMI102	STGM2771	247	15'' DIA	2.2%	218.54	213.03	225.6	219.9	219.0	218.6	219.6	219.8	9.8	2.5	2.6	--
J3960	STMI124	STGM2682	180	12'' DIA	0.9%	182.33	180.75	189.0	187.5	182.9	182.8	189.0	184.7	3.3	2.2	3.2	--
J4	STML1232	STGM4517	171	12'' DIA	0.3%	179.71	179.20	184.2	183.3	197.3	197.3	197.3	197.2	2.0	1.0	1.2	Existing 10-yr
J4032	J-SB-02	STGM988	404	Irregular Channel	11.2%	155.00	106.10	160.0	130.0	155.6	109.0	155.6	109.2		15.7	16.4	--
J4092	J4094	STGM4122	929	Irregular Channel	1.4%	202.00	185.00	209.3	190.0	202.6	185.4	202.9	185.5		5.4	9.9	--
J4094	J4284	STGM1948_b	257	Irregular Channel	3.9%	185.00	174.80	190.0	184.9	185.4	179.6	185.5	180.5		42.1	52.9	--
J4114	J5124	STGM973	122	12'' DIA	0.8%	234.00	233.00	239.2	235.4	234.9	233.8	239.2	236.5	3.2	3.7	6.1	--
J4116	J4118	STGM4001	54	24'' DIA	0.9%	242.00	241.50	247.5	246.1	242.4	242.1	242.6	242.2	20.9	1.9	3.3	--
J4118	J4114	STGM4090	433	Irregular Channel	1.7%	241.50	234.00	246.1	239.2	242.1	234.9	242.2	239.2		3.7	6.2	--
J4122	STMI104	STGM4465	37	12'' DIA	0.5%	209.50	209.30	220.1	220.3	217.4	217.2	219.3	219.0	2.6	3.2	3.2	--
J4150	STMI128	STGM757	60	12'' DIA	3.3%	175.00	173.00	180.5	180.2	175.6	174.0	175.7	174.0	6.5	4.2	5.2	--
J4268	J4270	STGM3560	219	Irregular Channel	0.9%	245.00	243.00	251.0	250.6	245.6	243.9	245.7	244.0		9.5	14.4	--
J4270	J3668	STGM2694	872	Irregular Channel	0.8%	243.00	235.50	250.6	241.6	243.9	237.5	244.0	241.7		9.4	14.3	--
J4284	J-SBT7-02	STGM627	143	24'' DIA	0.4%	174.80	173.00	184.9	179.5	179.6	175.0	180.5	175.0	14.6	42.0	51.6	--
J4292	J4150	STGM3521	661	18'' DIA	0.7%	179.90	175.00	185.1	180.5	180.6	175.6	180.7	175.7	9.0	4.2	5.2	--
J4424	J4426	STGM3674	132	42'' DIA	1.1%	202.00	200.50	204.8	207.0	203.1	201.7	203.4	202.0	106.0	24.4	40.6	--
J4426	STMI1019	STGM4335	97	42'' DIA	1.0%	200.50	199.50	207.0	209.3	201.7	200.7	202.0	200.9	101.5	24.4	37.3	--
J4834	STII1194	STGM1289	312	24'' DIA	1.0%	197.00	193.95	209.4	202.5	198.3	195.7	198.3	195.9	22.5	17.3	17.4	--
J4848	STII0913	STGM1593	499	12'' DIA	1.8%	244.00	235.00	250.9	243.0	250.9	238.1	253.4	241.5	4.8	17.2	41.6	Existing 10-yr
J4990	STMJ1236	C52	76	Irregular Channel	2.5%	167.85	165.95	179.0	178.4	168.0	166.6	168.0	166.7		2.0	2.2	--
J5	J4848	C4	282	Irregular Channel	1.3%	247.57	244.00	255.0	250.9	251.0	250.9	255.0	253.4		15.6	45.7	Future 10-yr
J5124	STMI0910	STGM1004	143	12'' DIA	2.8%	233.00	229.00	235.4	235.6	233.8	232.6	236.5	235.3	6.0	3.6	5.6	Future 10-yr
J5176	J5178	STGM3022	186	Irregular Channel	2.2%	209.16	205.00	215.7	210.4	210.3	205.5	210.3	205.5		27.8	28.8	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
J5178	J4094	STGM1948_a	903	Irregular Channel	2.2%	205.00	185.00	210.4	190.0	205.5	185.4	205.5	185.5		37.7	40.9	--
J5216	J4424	STGM1265	585	Irregular Channel	0.7%	206.00	202.00	211.3	204.8	216.6	203.1	218.9	203.4		48.9	52.2	Existing 10-yr
J5236	J4848	STGM2099	331	12'' DIA	2.1%	252.00	244.00	258.6	250.9	252.5	250.9	258.6	253.4	5.1	2.1	3.3	--
J5382	J5178	STGM1359	136	Irregular Channel	7.1%	214.65	205.00	219.1	210.4	214.9	205.5	214.9	205.5		5.3	5.3	--
J-SB-02	OF_J-SB-01	SB-00	16	Irregular Channel	6.8%	106.10	105.00	130.0	165.0	109.0	108.2	109.2	108.4		616.3	671.8	--
J-SB-03	J-SB-02	SB-01	1345	Irregular Channel	0.2%	108.60	106.10	140.0	130.0	114.6	109.0	114.8	109.2		520.4	566.4	--
J-SB-04	J-SB-03	SB-02	4551	Irregular Channel	0.2%	115.90	108.60	125.0	140.0	121.4	114.6	121.4	114.8		409.2	437.7	--
J-SB-05	J-SB-04	STGM3824	141	84'' DIA	0.9%	117.10	115.90	125.0	125.0	122.1	121.4	122.2	121.4	585.8	405.9	434.2	--
J-SB-06	J-SB-05	SB-03	437	Irregular Channel	0.4%	119.00	117.10	125.0	125.0	122.5	122.1	122.7	122.2		425.7	454.9	--
J-SB-07	J-SB-06	SB-04	2465	Irregular Channel	0.3%	126.60	119.00	150.0	125.0	131.9	122.5	131.9	122.7		372.3	403.6	--
J-SB-08	J-SB-07	SB-05	2409	Irregular Channel	0.3%	134.00	126.60	160.0	150.0	139.5	131.9	139.6	131.9		347.1	369.5	--
J-SB-09	J-SB-08	SB-06	1627	Irregular Channel	0.3%	139.00	134.00	165.0	160.0	142.9	139.5	143.0	139.6		341.8	367.6	--
J-SB-10	J-SB-09	SB-07	1031	Irregular Channel	1.1%	150.00	139.00	155.0	165.0	152.9	142.9	153.2	143.0		240.1	269.4	--
J-SB-11	J-SB-10	SB-08	537	Irregular Channel	0.2%	151.00	150.00	153.2	155.0	154.9	152.9	155.0	153.2		198.5	221.0	Existing 10-yr
J-SB-12	J-SB-11	STGM1241	185	48'' DIA	0.9%	152.70	151.00	156.3	153.2	157.9	154.9	158.6	155.0	137.3	204.3	231.2	Existing 10-yr
J-SB-13	J-SB-12	SB-09	2247	Irregular Channel	1.1%	177.00	152.70	185.0	156.3	179.4	157.9	179.5	158.6		177.3	210.0	--
J-SB-14	J-SB-13	SB-10	2491	Irregular Channel	1.9%	224.00	177.00	235.0	185.0	225.5	179.4	225.7	179.5		98.2	132.2	--
J-SB-15	J-SB-14	SB-11	1149	Irregular Channel	3.2%	260.20	224.00	270.0	235.0	261.4	225.5	261.5	225.7		64.0	94.0	--
J-SB-16	J-SB-15	SPRINGBROOK_CULVERT	113	36'' DIA	6.0%	267.00	260.20	272.2	270.0	268.3	261.4	268.7	261.5	164.2	64.0	94.0	--
J-SBT1-01	J-SB-03	SBT1-01	2512	Irregular Channel	1.2%	137.80	108.60	150.0	140.0	140.3	114.6	140.4	114.8		147.8	165.4	--
J-SBT1-02	J-SBT1-01	STGM3459	132	36'' DIA	0.8%	138.80	137.80	152.6	150.0	145.9	140.3	146.8	140.4	58.2	159.1	174.1	--
J-SBT1-03	J-SBT1-02	SBT1-02	1576	Irregular Channel	0.9%	152.20	138.80	175.0	152.6	155.2	145.9	155.3	146.8		118.1	128.9	--
J-SBT1-04	J-SBT1-03	SBT1-03	284	Irregular Channel	0.8%	154.61	152.20	180.0	175.0	157.6	155.2	157.7	155.3		113.2	123.4	--
J-SBT1-05	J-SBT1-04	HAYES_CULVERT	105	72'' DIA	2.7%	157.40	154.61	180.0	180.0	159.6	157.6	159.7	157.7	379.1	106.2	112.5	--
J-SBT1-06	J-SBT1-05	SBT1-04	645	Irregular Channel	2.9%	176.00	157.40	185.0	180.0	178.2	159.6	178.2	159.7		89.0	92.2	--
J-SBT1-07	J-SBT1-06	STGM6	107	60'' DIA	3.8%	180.00	176.00	197.0	185.0	181.4	178.2	181.4	178.2	514.9	82.4	85.6	--
J-SBT1-08	J-SBT1-07	SBT1-05	139	Irregular Channel	1.4%	182.00	180.00	199.2	197.0	182.7	181.4	182.7	181.4		81.4	84.4	--
J-SBT1-09	J-SBT1-08	SBT1-06	68	Irregular Channel	4.3%	188.95	182.00	196.5	199.2	189.2	182.7	189.2	182.7		15.8	15.8	--
J-SBT3-01	J-SB-06	SBT3-01	874	Irregular Channel	3.3%	147.70	119.00	160.0	125.0	148.5	122.5	148.6	122.7		26.2	36.7	--
J-SBT4-01	J-SB-07	SBT4-01	283	Irregular Channel	4.9%	140.54	126.60	145.0	150.0	141.2	131.9	141.2	131.9		21.4	21.4	--
J-SBT4-02	STMK1113	SBT4-02	198	Irregular Channel	-0.2%	153.60	154.00	157.0	167.8	155.5	155.2	155.7	155.6		18.3	19.5	--
J-SBT4-03	J-SBT4-02	SBT4-03	411	Irregular Channel	1.9%	161.31	153.60	170.0	157.0	161.9	155.5	161.9	155.7		13.0	13.5	--
J-SBT4-04	J-SBT4-03	STGM1739	68	33'' DIA	3.3%	163.59	161.31	171.9	170.0	164.3	161.9	164.3	161.9	100.2	13.1	13.5	--
J-SBT4-05	J-SBT4-02	SBT4-04	329	Irregular Channel	4.3%	167.77	153.60	173.0	157.0	168.0	155.5	168.0	155.7		3.5	3.9	--
J-SBT5-01	J-SB-08	SBT5-01	860	Irregular Channel	4.1%	169.20	134.00	180.0	160.0	169.8	139.5	169.8	139.6		15.2	17.4	--
J-SBT6-01	J-SB-09	SBT6-01	1563	Irregular Channel	0.3%	143.00	139.00	160.0	165.0	144.0	142.9	144.0	143.0		116.3	116.3	--
J-SBT6-02	J-SBT6-01	STGM2828	306	48'' DIA	0.1%	143.40	143.00	170.0	160.0	146.1	144.0	146.1	144.0	36.8	46.1	46.1	--
J-SBT7-01	J-SB-10	SBT7-01	684	Irregular Channel	2.6%	168.00	150.00	170.0	155.0	169.0	152.9	169.0	153.2		43.8	49.7	--
J-SBT7-02	J-SBT7-01	STGM901	590	Irregular Channel	0.8%	173.00	168.00	179.5	170.0	175.0	169.0	175.0	169.0		40.2	43.9	--
J-SBT7-03	J-SBT7-02	SBT7-02	382	Irregular Channel	4.4%	189.88	173.00	193.6	179.5	190.3	175.0	190.3	175.0		3.5	3.5	--
STII081	STII09126	STGM3464	157	12'' DIA	0.8%	249.94	248.74	258.0	255.8	254.4	250.6	260.2	255.8	3.2	5.3	8.0	Future 10-yr
STII09100	STII10109	STGM2905	112	30'' DIA	1.6%	224.82	223.00	233.6	231.7	237.8	237.8	241.3	241.3	54.8	4.7	6.5	Existing 10-yr
STII09101	STII09104	STGM547	106	18'' DIA	0.5%	253.18	252.46	261.0	259.5	254.6	253.3	261.2	259.6	7.6	9.3	15.8	Future 10-yr
STII09103	STII09106	STGM1287	123	18'' DIA	1.1%	250.92	249.39	259.4	257.7	252.0	252.2	259.4	257.8	11.4	9.3	18.1	Future 10-yr
STII09104	STII09103	STGM3260	36	18'' DIA	2.4%	252.46	250.92	259.5	259.4	253.3	252.0	259.6	259.4	17.0	9.3	18.3	Future 10-yr
STII09106	J5	STGM133	144	18'' DIA	1.3%	249.39	247.57	257.7	255.0	252.2	251.0	257.8	255.0	12.3	9.3	17.7	Future 10-yr
STII09111	STII09112	STGM1978	77	18'' DIA	0.5%	247.51	247.12	252.8	253.4	248.4	247.7	248.7	247.8	7.8	5.3	7.9	--
STII09112	J4268	STGM4459	78	21'' DIA	2.7%	247.12	245.00	253.4	251.0	247.7	245.6	247.8	245.7	26.4	5.4	8.5	--
STII09124	STII09111	STGM2715	110	18'' DIA	0.3%	247.94	247.51	253.5	252.8	249.0	248.4	249.3	248.7	6.0	5.3	7.9	--
STII09125	STII09124	STGM1917	140	15'' DIA	0.3%	248.36	247.94	254.3	253.5	249.8	249.0	252.2	249.3	3.7	5.3	7.9	--
STII09126	STII09125	STGM824	128	15'' DIA	0.3%	248.74	248.36	255.8	254.3	250.6	249.8	255.8	252.2	3.7	5.3	7.9	--
STII0913	STII0928	STGM3176	170	21'' DIA	0.8%	235.00	233.70	243.0	240.5	238.1	238.5	241.5	240.5	13.8	14.4	15.2	--
STII0915	STMI0910	STGM1757	87	21'' DIA	0.8%	229.70	229.00	236.6	235.6	233.2	232.6	236.0	235.3	14.3	15.1	15.4	--
STII0916	STII0926	STGM984	51	21'' DIA	0.8%	230.80	230.40	236.9	236.9	234.6	234.0	237.3	236.9	14.0	15.1	15.4	Future 10-yr
STII092	STMI095	STGM2662	217	15'' DIA	0.4%	233.85	232.85	240.6	244.0	238.4	238.6	239.3	236.9	4.2	4.0	4.1	--
STII0926	STII0915	STGM3951	98	21'' DIA	0.7%	230.40	229.70	236.9	236.6	234.0	233.2	236.9	236.0	13.4	15.1	15.4	--
STII0928	STII0983	STGM4081	186	21'' DIA	0.8%	233.70	232.30	240.5	238.3	238.5	237.1	240.5	238.8	14.3	14.5	15.0	--
STII0965	STII0966	STGM72	36	12'' DIA	0.7%	256.31	255.84	262.6	261.7	256.7	256.3	256.8	256.4	3.1	1.1	1.4	--
STII0966	STII0967	STGM3624	54	12'' DIA	0.5%	255.84	255.36	261.7	261.6	256.3	255.6	256.4	255.7	2.7	1.1	1.4	--
STII0967	STII0968	STGM1099	33	12'' DIA	2.9%	255.36	254.20	261.6	260.1	255.6	254.5	255.7	254.5	6.3	1.1	1.4	--
STII0968	STII0970	STGM773	113	12'' DIA	3.9%	254.20	249.55	260.1	256.0	254.5	249.8	254.5	249.9	7.1	1.1	1.4	--
STII0970	STII0972	STGM943	210	12'' DIA	2.4%	249.55	243.16	256.0	251.4	249.8	243.5	249.9	243.5	5.6	1.1	1.4	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STII0972	STII0975	STGM4253	63	15'' DIA	1.3%	243.16	242.11	251.4	251.0	243.5	242.6	243.5	242.7	7.1	1.1	1.4	--
STII0975	STII0977	STGM283	122	18'' DIA	1.0%	242.11	240.65	251.0	247.7	242.6	241.0	242.7	241.4	10.9	3.0	3.8	--
STII0977	STII0980	STGM297	99	18'' DIA	3.4%	240.65	236.84	247.7	244.0	241.0	237.8	241.4	241.4	19.7	3.0	3.8	--
STII0980	STII0982	STGM528	188	24'' DIA	2.2%	236.84	232.49	244.0	240.2	237.8	237.8	241.4	241.4	36.9	3.0	3.8	--
STII0982	STII0985	STGM2936	199	24'' DIA	1.1%	232.49	230.09	240.2	237.4	237.8	237.8	241.4	241.3	25.2	3.0	4.0	Future 10-yr
STII0983	STII0916	STGM1040	198	21'' DIA	0.8%	232.30	230.80	238.3	236.9	237.1	234.6	238.8	237.3	13.9	14.6	15.0	Future 10-yr
STII0985	STII0986	STGM746	52	24'' DIA	0.5%	230.09	229.64	237.4	238.5	237.8	237.8	241.3	241.3	16.3	3.3	4.2	Existing 10-yr
STII0986	STII0988	STGM2399	78	24'' DIA	0.5%	229.64	228.75	238.5	239.6	237.8	237.8	241.3	241.3	16.2	3.3	4.2	Future 10-yr
STII0988	STMI099	STGM1231	66	30'' DIA	0.5%	228.75	228.23	239.6	241.7	237.8	237.8	241.3	241.4	29.4	3.2	4.2	Future 10-yr
STII0990	STII0991	STGM1504	106	30'' DIA	0.5%	227.59	226.87	238.2	235.7	237.8	237.8	241.3	241.3	30.5	4.6	5.8	Future 10-yr
STII0991	STII0992	STGM554	98	30'' DIA	0.5%	226.87	226.18	235.7	235.1	237.8	237.8	241.3	241.3	30.5	4.6	5.9	Existing 10-yr
STII0992	STII09100	STGM3490	234	30'' DIA	0.5%	226.18	224.82	235.1	233.6	237.8	237.8	241.3	241.3	29.6	4.6	6.0	Existing 10-yr
STII10109	STII1030	STGM1130	119	12'' DIA	1.9%	223.00	220.80	231.7	229.4	237.8	237.1	241.3	240.7	4.8	4.4	5.5	Existing 10-yr
STII102	STMI1121	STGM2880	66	18'' DIA	0.5%	204.20	203.84	212.6	212.6	205.9	204.8	205.9	204.8	7.8	12.3	12.4	--
STII1027	J4122	STGM3159	239	12'' DIA	0.6%	211.00	209.50	220.4	220.1	218.4	217.4	221.0	219.3	2.8	3.2	3.2	Future 10-yr
STII1028	STII1027	STGM2622	118	12'' DIA	1.9%	213.20	211.00	223.1	220.4	219.1	218.4	221.9	221.0	4.9	3.2	3.2	--
STII1029	STII1050	STGM2729	119	8'' DIA	1.9%	217.94	215.72	225.7	223.6	227.1	220.0	230.5	222.9	1.6	3.3	3.4	Existing 10-yr
STII1030	STII1029	STGM2906	150	8'' DIA	1.9%	220.80	217.94	229.4	225.7	237.1	227.1	240.7	230.5	1.7	3.9	4.3	Existing 10-yr
STII1033	STII1034	STGM1083	141	12'' DIA	1.1%	224.79	223.24	227.9	226.1	239.9	233.7	260.3	249.2	3.7	8.4	11.1	Existing 10-yr
STII1034	J3524	STGM3352	242	12'' DIA	2.3%	223.24	217.58	226.1	225.1	233.7	223.5	249.2	231.6	5.4	7.7	10.4	Existing 10-yr
STII104	STMI1010	STGM1994	59	15'' DIA	0.8%	233.15	232.65	239.5	240.0	233.9	233.4	233.9	233.4	5.9	4.0	4.1	--
STII1050	STII1028	STGM3365	133	12'' DIA	1.9%	215.72	213.20	223.6	223.1	220.0	219.1	222.9	221.9	4.9	3.2	3.2	--
STII1055	STII1056	STGM314	64	12'' DIA	0.8%	213.50	213.00	221.1	220.4	216.9	216.9	219.7	219.7	3.2	1.5	1.6	--
STII1056	STMI108	STGM1213	206	12'' DIA	1.6%	213.00	209.79	220.4	221.0	216.9	216.9	219.7	219.7	4.5	1.6	1.6	--
STII1078	STMI1019	STGM392	20	12'' DIA	3.9%	204.07	199.50	210.1	209.3	205.8	200.7	205.8	200.9	7.1	8.5	8.6	--
STII1080	STII1078	STGM334	163	12'' DIA	1.9%	207.16	204.07	213.2	210.1	211.7	205.8	211.8	205.8	4.9	5.0	5.0	--
STII1149	STML1146	STGM3779	422	12'' DIA	1.3%	203.31	197.83	211.4	206.0	226.2	202.5	226.2	202.6	4.1	8.9	8.9	Existing 10-yr
STII1194	STMI1113	STGM3172	66	24'' DIA	1.0%	193.95	193.31	202.5	203.0	195.7	195.5	195.9	195.5	22.1	17.3	17.4	--
STII1245	STMI1226	STGM352	77	24'' DIA	1.3%	160.00	159.00	167.7	169.0	161.1	159.5	161.2	159.6	26.9	16.1	17.2	--
STII135	STMI143	STGM3344	182	18'' DIA	0.2%	159.82	159.08	172.7	173.0	173.7	171.4	175.0	172.8	5.2	12.5	12.7	Existing 10-yr
STII1359	STMI1310	STGM321	184	18'' DIA	0.2%	160.75	160.30	173.2	172.6	178.0	176.3	179.3	177.7	5.2	10.1	10.3	Existing 10-yr
STII137	STII1359	STGM4556	138	18'' DIA	0.3%	161.23	160.75	173.1	173.2	179.2	178.0	180.6	179.3	6.2	9.9	10.0	Existing 10-yr
STIJ081	STII081	STGM3546	220	12'' DIA	1.3%	253.03	249.94	261.1	258.0	259.5	254.4	270.4	260.2	4.3	5.3	8.1	Future 10-yr
STIJ0911	STMJ092	STGM876	400	12'' DIA	2.5%	232.75	222.67	239.7	232.5	258.6	252.2	279.1	267.8	5.7	5.4	8.5	Existing 10-yr
STIJ0915	STIJ10111	STGM4406	124	15'' DIA	0.7%	216.42	215.60	225.1	221.9	217.4	216.6	217.4	216.6	5.5	5.3	5.3	--
STIJ0916	STIJ0917	STGM4372	44	15'' DIA	0.5%	226.92	226.69	235.6	236.0	227.9	227.6	227.9	227.6	4.8	5.3	5.3	--
STIJ0917	STIJ0919	STGM4376	193	15'' DIA	0.7%	226.69	225.32	236.0	235.2	227.6	226.1	227.6	226.1	5.7	5.3	5.3	--
STIJ0919	STIJ0923	STGM4395	80	15'' DIA	1.3%	225.32	224.31	235.2	232.9	226.1	224.9	226.1	224.9	7.5	5.3	5.3	--
STIJ0923	STIJ0924	STGM4396	106	15'' DIA	2.8%	224.31	221.30	232.9	230.6	224.9	221.9	224.9	221.9	11.2	5.3	5.3	--
STIJ0924	STIJ0927	STGM4400	90	15'' DIA	2.3%	221.30	219.25	230.6	228.3	221.9	219.9	221.9	219.9	10.1	5.3	5.3	--
STIJ0927	STIJ0915	STGM4405	120	15'' DIA	2.4%	219.25	216.42	228.3	225.1	219.9	217.4	219.9	217.4	10.3	5.3	5.3	--
STIJ10111	STIJ10112	STGM4407	38	15'' DIA	0.8%	215.60	215.31	221.9	221.9	216.6	216.3	216.6	216.3	5.6	5.3	5.3	--
STIJ10112	J5382	STGM4408	111	15'' DIA	0.6%	215.31	214.65	221.9	219.1	216.3	214.9	216.3	214.9	5.1	5.3	5.3	--
STIJ102	STMJ108	STGM3131	32	18'' DIA	20.6%	216.00	209.51	223.9	224.4	216.3	211.6	216.3	211.6	46.3	3.2	3.2	--
STIJ1021	STMJ105	STGM304	483	15'' DIA	0.8%	215.79	212.09	223.2	221.3	223.5	216.1	227.0	216.4	5.6	8.5	10.0	Existing 10-yr
STIJ1060	STIJ1061	STGM2861	30	12'' DIA	2.3%	223.73	222.82	229.6	231.0	224.3	223.5	224.3	223.5	5.7	3.5	3.5	--
STIJ1061	STIJ1062	STGM493	180	12'' DIA	1.5%	222.82	220.00	231.0	228.4	223.5	220.7	223.5	220.7	4.5	3.5	3.5	--
STIJ1062	STIJ1063	STGM4021	74	12'' DIA	1.2%	220.00	218.91	228.4	227.3	220.7	219.5	220.7	219.5	4.1	3.5	3.5	--
STIJ1063	STIJ1064	STGM3134	251	12'' DIA	2.4%	218.91	212.68	227.3	221.3	219.5	213.3	219.5	213.3	5.8	3.5	3.5	--
STIJ1064	STIJ1065	STGM3804	199	12'' DIA	2.3%	212.68	207.91	221.3	216.5	213.3	208.5	213.3	208.5	5.6	3.5	3.5	--
STIJ1065	STIJ1066	STGM646	369	12'' DIA	2.6%	207.91	198.06	216.5	206.5	208.5	198.7	208.5	198.7	6.0	3.5	3.5	--
STIJ1066	STIJ1069	STGM281	175	12'' DIA	2.0%	198.06	194.56	206.5	202.2	198.7	195.1	198.7	195.1	5.3	3.5	3.5	--
STIJ1069	STIJ1070	STGM3714	160	12'' DIA	2.4%	194.56	190.71	202.2	198.4	195.1	191.4	195.1	191.4	5.8	3.5	3.5	--
STIJ1070	J-SBT7-03	STGM527	83	15'' DIA	1.0%	190.71	189.88	198.4	193.6	191.4	190.3	191.4	190.3	6.7	3.5	3.5	--
STIJ1234	STMJ1224	STGM2977	28	10'' DIA	15.7%	160.31	155.98	164.6	163.9	160.5	156.6	160.5	156.6	9.1	1.5	1.5	--
STIK116	J-SBT4-04	STGM2113	29	33'' DIA	3.3%	164.54	163.59	173.0	171.9	164.9	164.3	164.9	164.3	108.0	3.2	3.4	--
STIK117	J-SBT4-05	STGM2844	62	15'' DIA	0.3%	167.96	167.77	175.0	173.0	168.7	168.0	168.8	168.0	3.7	3.2	3.5	--
STIL11185	J-SBT1-05	STGM3287	38	12'' DIA	29.5%	171.70	157.40	179.0	180.0	171.9	159.6	171.9	159.7	20.9	1.7	2.2	--
STIL11186	STIL11185	STGM4128	36	12'' DIA	2.2%	172.50	171.70	179.0	179.0	172.9	171.9	173.0	171.9	5.6	1.7	2.2	--
STMI091	STMI1014	STGM1080	252	21'' DIA	1.1%	220.03	217.26	229.9	225.1	223.4	218.9	226.9	223.1	16.6	21.1	21.6	--
STMI0910	STMI094	STGM408	43	21'' DIA	6.8%	229.00	226.07	235.6	236.0	232.6	231.8	235.3	234.6	41.3	21.1	21.6	--
STMI092	STMI091	STGM4123	69	27'' DIA	1.0%	220.75	220.03	229.0	229.9	224.5	223.4	227.9	226.9	17.1	21.1	21.6	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STMI093	STMI092	STGM3192	113	24'' DIA	2.0%	223.04	220.75	232.8	229.0	227.6	224.5	230.7	227.9	17.4	21.1	21.6	--
STMI094	STMI093	STGM1701	256	21'' DIA	1.2%	226.07	223.04	236.0	232.8	231.8	227.6	234.6	230.7	18.0	21.1	21.6	--
STMI095	STII104	STGM1064	249	15'' DIA	-0.1%	232.85	233.15	244.0	239.5	238.6	233.9	236.9	233.9	2.2	4.0	4.1	--
STMI099	STII0990	STGM1784	90	30'' DIA	0.5%	228.23	227.59	241.7	238.2	237.8	237.8	241.4	241.3	29.5	3.2	4.5	--
STMI101	STMI107	STGM523	468	15'' DIA	0.9%	230.23	226.24	234.6	230.9	231.0	227.4	231.0	227.4	6.0	4.0	4.1	--
STMI1010	STMI101	STGM692	283	15'' DIA	0.9%	232.65	230.23	240.0	234.6	233.4	231.0	233.4	231.0	6.0	4.0	4.1	--
STMI1012	STMI103	STGM1965	93	27'' DIA	0.4%	211.40	210.80	219.9	220.7	218.5	217.6	219.8	219.2	20.3	29.5	30.0	--
STMI1013	STMI109	STGM1206	362	21'' DIA	1.6%	222.05	216.25	230.4	223.3	222.5	218.4	222.5	222.7	10.8	1.5	1.5	--
STMI1014	STMI109	STGM3669	288	33'' DIA	0.4%	217.26	216.25	225.1	223.3	218.9	218.4	223.1	222.7	31.2	24.0	24.5	--
STMI1015	STMI108	STGM866	340	15'' DIA	1.0%	213.55	209.79	221.8	221.0	221.8	216.9	227.9	219.7	6.6	9.5	11.5	Future 10-yr
STMI1017	J5216	STGM1949	86	24'' DIA	0.6%	206.55	206.00	215.3	211.3	216.6	216.6	219.0	218.9	18.1	13.9	15.6	Existing 10-yr
STMI1018	STMI1017	STGM825	130	24'' DIA	1.3%	208.30	206.55	219.3	215.3	216.7	216.6	219.2	219.0	25.8	10.8	12.6	--
STMI1019	STMI1114	STGM3926	351	42'' DIA	1.6%	199.50	194.00	209.3	203.0	200.7	195.7	200.9	195.8	128.5	30.9	40.3	--
STMI102	STMI1012	STGM3792	50	15'' DIA	1.7%	213.03	211.40	219.9	219.9	218.6	218.5	219.8	219.8	8.4	2.5	2.6	--
STMI1020	STMI106	STGM3563	115	18'' DIA	0.9%	223.16	222.18	227.0	225.8	224.3	222.9	224.3	222.9	9.7	9.0	9.1	--
STMI1021	STII102	STGM2839	332	21'' DIA	2.2%	211.58	204.20	215.2	212.6	212.5	205.9	212.5	205.9	23.7	12.3	12.4	--
STMI1022	STMI1012	STGM3882	271	27'' DIA	0.7%	214.00	211.40	223.0	219.9	221.7	218.5	221.7	219.8	25.3	27.1	27.4	--
STMI1023	STMI1014	STGM2235	127	12'' DIA	1.9%	219.69	217.26	226.2	225.1	220.0	218.9	223.2	223.1	5.0	1.0	1.0	--
STMI103	STMI104	STGM822	72	36'' DIA	0.8%	210.80	209.30	220.7	220.3	217.6	217.2	219.2	219.0	61.4	29.5	29.8	--
STMI104	J5216	STGM3924	352	60'' DIA	0.8%	209.30	206.00	220.3	211.3	217.2	216.6	219.0	218.9	231.4	32.6	32.7	--
STMI105	STMI1022	STGM3651	162	27'' DIA	0.7%	215.20	214.00	223.5	223.0	223.5	221.7	223.5	221.7	26.6	30.0	26.8	--
STMI106	STMI1021	STGM1211	401	21'' DIA	2.6%	222.18	211.58	225.8	215.2	222.9	212.5	222.9	212.5	25.6	9.0	9.1	--
STMI107	STMI1020	STGM223	361	18'' DIA	0.9%	226.24	223.16	230.9	227.0	227.4	224.3	227.4	224.3	9.8	9.0	9.1	--
STMI108	STMI1018	STGM3717	221	21'' DIA	0.6%	209.79	208.30	221.0	219.3	216.9	216.7	219.7	219.2	12.0	10.8	12.6	--
STMI109	STMI105	STGM210	34	33'' DIA	3.1%	216.25	215.20	223.3	223.5	218.4	223.5	222.7	223.5	93.8	25.5	26.0	--
STMI1110	STMI1121	STGM346	250	15'' DIA	1.2%	206.93	203.84	213.9	212.6	207.5	204.8	207.5	204.8	7.2	2.8	2.8	--
STMI1113	STMI1123	STGM201	445	36'' DIA	0.8%	193.31	189.65	203.0	206.2	195.5	191.5	195.5	191.6	60.5	52.0	54.1	--
STMI1114	STMI1113	STGM391	84	42'' DIA	0.8%	194.00	193.31	203.0	203.0	195.7	195.5	195.8	195.5	91.6	34.8	41.8	--
STMI1115	STMI1177	STGM4067	89	36'' DIA	2.0%	186.78	185.02	204.2	201.0	188.4	186.6	188.4	186.6	94.4	52.9	55.1	--
STMI1121	J4834	STGM3457	345	24'' DIA	2.0%	203.84	197.00	212.6	209.4	204.8	198.3	204.8	198.3	32.1	15.1	15.2	--
STMI1123	STMI1124	STGM2866	92	36'' DIA	1.3%	189.65	188.46	206.2	204.7	191.5	190.3	191.6	190.4	75.6	52.9	55.1	--
STMI1124	STMI1115	STGM777	130	36'' DIA	1.3%	188.46	186.78	204.7	204.2	190.3	188.4	190.4	188.4	75.6	52.9	55.1	--
STMI1144	STMI1220	STGM2834	427	15'' DIA	1.4%	187.23	181.41	193.5	186.3	187.8	182.0	187.8	182.0	7.9	3.1	3.2	--
STMI1160	STMI1144	STGM2072	101	15'' DIA	0.6%	187.86	187.23	195.0	193.5	188.5	187.8	188.6	187.8	5.3	3.1	3.2	--
STMI1161	STMI1160	STGM2380	48	12'' DIA	1.1%	188.40	187.86	195.6	195.0	188.6	188.5	188.6	188.6	4.1	0.5	0.5	--
STMI1162	STMI1160	STGM3512	62	12'' DIA	1.9%	189.01	187.86	193.9	195.0	189.4	188.5	189.4	188.6	5.0	1.3	1.3	--
STMI1163	STMI1161	STGM856	187	12'' DIA	0.8%	189.92	188.40	196.2	195.6	190.2	188.6	190.2	188.6	3.3	0.5	0.5	--
STMI1164	STMI1163	STGM2889	49	12'' DIA	1.1%	190.45	189.92	194.9	196.2	190.7	190.2	190.7	190.2	3.8	0.5	0.5	--
STMI1165	STMI1225	STGM2707	159	12'' DIA	0.6%	183.22	182.19	188.7	187.1	183.7	182.7	183.7	182.7	3.0	1.4	1.4	--
STMI1167	STMI1174	STGM2230	51	18'' DIA	1.2%	193.54	192.91	199.4	198.4	194.2	194.3	194.5	194.5	12.3	3.4	3.7	--
STMI1168	STMI1167	STGM1627	98	15'' DIA	1.2%	194.76	193.54	202.0	199.4	195.4	194.2	195.4	194.5	7.4	3.4	3.7	--
STMI1169	STMI1168	STGM3678	126	15'' DIA	1.3%	196.34	194.76	203.3	202.0	196.9	195.4	197.0	195.4	7.4	3.4	3.7	--
STMI1170	STMI1169	STGM323	59	15'' DIA	0.9%	196.84	196.34	202.7	203.3	197.4	196.9	197.4	197.0	6.2	2.1	2.3	--
STMI1171	STMI1170	STGM1667	62	12'' DIA	1.1%	197.53	196.84	203.5	202.7	198.1	197.4	198.1	197.4	3.9	2.1	2.3	--
STMI1172	STMI1171	STGM2755	54	12'' DIA	1.2%	198.19	197.53	204.6	203.5	198.7	198.1	198.7	198.1	4.1	2.1	2.3	--
STMI1173	STMI1172	STGM3243	117	12'' DIA	1.0%	199.33	198.19	206.7	204.6	199.9	198.7	199.9	198.7	3.6	2.1	2.3	--
STMI1174	STMI1175	STGM3850	350	21'' DIA	1.2%	192.91	188.72	198.4	194.8	194.3	189.5	194.5	189.5	18.0	15.7	18.9	--
STMI1175	STMI1176	STGM2412	162	21'' DIA	6.5%	188.72	178.28	194.8	184.9	189.5	179.2	189.5	179.3	42.4	15.7	18.1	--
STMI1176	J-SBT1-05	STGM3931	183	21'' DIA	3.4%	178.28	157.40	184.9	180.0	179.2	159.6	179.3	159.7	30.1	15.7	18.1	--
STMI1177	J-SBT1-08	STGM1611	153	42'' DIA	2.0%	185.02	182.00	201.0	199.2	186.6	182.7	186.6	182.7	142.9	52.9	55.1	--
STMI1210	STMI1211	STGM4076	97	18'' DIA	3.8%	168.81	165.11	175.7	175.9	169.2	166.1	169.2	166.2	20.9	3.4	3.4	--
STMI1211	STMI1214	STGM3370	138	24'' DIA	5.8%	165.11	157.09	175.9	166.7	166.1	157.8	166.2	157.9	56.5	26.6	28.6	--
STMI1212	STMI1211	STGM487	56	33'' DIA	1.1%	165.74	165.11	175.9	175.9	166.9	166.1	167.0	166.2	58.0	23.2	25.2	--
STMI1214	J-SBT1-02	STGM2060	124	24'' DIA	15.0%	157.09	138.80	166.7	152.6	157.8	145.9	157.9	146.8	91.6	26.6	28.6	--
STMI1215	STMI1210	STGM2002	123	18'' DIA	1.2%	170.24	168.81	177.1	175.7	170.8	169.2	170.8	169.2	12.0	3.4	3.4	--
STMI1216	STMI1215	STGM2785	312	15'' DIA	1.6%	175.24	170.24	180.9	177.1	175.8	170.8	175.8	170.8	8.6	3.4	3.4	--
STMI1217	STMI1216	STGM91	431	15'' DIA	0.8%	178.84	175.24	185.2	180.9	179.5	175.8	179.5	175.8	6.1	3.4	3.4	--
STMI1218	STMI1217	STGM1026	124	12'' DIA	1.6%	180.87	178.84	187.2	185.2	181.2	179.5	181.2	179.5	4.7	1.4	1.4	--
STMI1219	STMI1221	STGM2965	220	18'' DIA	1.2%	176.01	173.35	181.1	179.0	176.7	174.0	176.8	174.0	12.0	5.6	5.8	--
STMI1220	STMI1219	STGM3283	379	15'' DIA	1.4%	181.41	176.01	186.3	181.1	182.0	176.7	182.0	176.8	8.1	3.1	3.2	--
STMI1221	STMI1222	STGM886	45	18'' DIA	1.7%	173.35	172.59	179.0	178.7	174.0	173.2	174.0	173.2	14.1	5.6	5.8	--
STMI1222	STMI1212	STGM1954	231	18'' DIA	3.0%	172.59	165.74	178.7	175.9	173.2	166.9	173.2	167.0	18.8	5.6	5.8	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STMI1223	STMI1218	STGM623	27	12'' DIA	1.2%	181.20	180.87	187.9	187.2	181.6	181.2	181.6	181.2	4.0	1.4	1.4	--
STMI1224	STMI1223	STGM3943	63	12'' DIA	0.7%	181.67	181.20	186.6	187.9	182.1	181.6	182.1	181.6	3.2	1.4	1.4	--
STMI1225	STMI1224	STGM2295	82	12'' DIA	0.6%	182.19	181.67	187.1	186.6	182.7	182.1	182.7	182.1	2.9	1.4	1.4	--
STMI1226	J-SBT1-02	STGM4243	108	24'' DIA	19.1%	159.00	138.80	169.0	152.6	159.5	145.9	159.6	146.8	100.8	16.1	17.2	--
STMI1227	STMI127	STGM4509	12	18'' DIA	0.9%	174.40	174.30	180.5	180.1	175.2	175.1	175.2	175.1	9.8	3.8	3.8	--
STMI1228	STMI1234	STGM4512	293	18'' DIA	0.5%	176.50	175.00	183.0	181.6	177.2	175.8	177.2	175.8	7.8	3.8	3.8	--
STMI1229	STMI1228	STGM4514	646	18'' DIA	0.5%	179.71	176.50	185.4	183.0	180.5	177.2	180.5	177.2	7.6	3.8	3.8	--
STMI123	STMI139	STGM3149	437	12'' DIA	0.2%	166.55	165.23	177.3	177.1	202.9	197.9	204.3	199.4	1.8	4.9	5.0	Existing 10-yr
STMI1233	STMI126	STGM4525	383	12'' DIA	0.8%	178.00	175.00	182.9	181.6	191.7	176.2	191.7	176.2	3.3	7.9	7.9	Existing 10-yr
STMI1234	STMI1227	STGM4510	138	18'' DIA	0.4%	175.00	174.40	181.6	180.5	175.8	175.2	175.8	175.2	6.9	3.8	3.8	--
STMI124	J4292	STGM356	104	12'' DIA	0.8%	180.75	179.90	187.5	185.1	182.8	180.6	184.7	180.7	3.2	4.2	5.2	--
STMI125	STMI1229	STGM55	203	15'' DIA	0.3%	180.40	179.71	186.3	185.4	181.4	180.5	181.4	180.5	3.8	3.8	3.8	--
STMI126	STMI127	STGM3595	24	12'' DIA	2.9%	175.00	174.30	181.6	180.1	176.2	175.1	176.2	175.1	6.1	7.5	7.5	--
STMI127	STMI128	STGM767	64	24'' DIA	2.0%	174.30	173.00	180.1	180.2	175.1	174.0	175.1	174.0	32.1	11.2	11.2	--
STMI128	STII1245	STGM2032	602	24'' DIA	2.2%	173.00	160.00	180.2	167.7	174.0	161.1	174.0	161.2	34.3	16.1	17.2	--
STMI129	J-SBT1-03	STGM3345	501	12'' DIA	4.0%	185.00	152.20	194.2	175.0	185.6	155.2	185.7	155.3	7.2	5.0	5.6	--
STMI1310	STII135	STGM3689	191	18'' DIA	0.2%	160.30	159.82	172.6	172.7	176.3	173.7	177.7	175.0	5.1	12.3	12.5	Existing 10-yr
STMI137	STII137	STGM2664	342	18'' DIA	0.3%	162.42	161.23	174.0	173.1	182.2	179.2	183.7	180.6	6.2	10.1	10.1	Existing 10-yr
STMI138	STMI137	STGM4542	500	15'' DIA	0.3%	163.98	162.42	175.6	174.0	190.1	182.2	191.5	183.7	3.2	8.8	8.8	Existing 10-yr
STMI139	STMI138	STGM3997	487	15'' DIA	0.3%	165.23	163.98	177.1	175.6	197.9	190.1	199.4	191.5	3.3	10.2	10.2	Existing 10-yr
STMI142	STMI148	STGM3469	86	21'' DIA	0.2%	158.20	157.99	173.6	174.8	167.7	167.4	168.8	167.9	7.8	15.7	16.4	--
STMI143	STMI149	STGM760	83	21'' DIA	0.3%	159.08	158.85	173.0	172.2	171.4	170.5	172.8	171.9	8.3	15.7	16.4	--
STMI144	J4032	STGM3339	517	21'' DIA	0.4%	156.95	155.00	174.6	160.0	167.7	155.6	170.9	155.6	9.7	15.7	16.4	--
STMI148	STMI144	STGM2832	427	21'' DIA	0.2%	157.99	156.95	174.8	174.6	167.4	167.7	167.9	170.9	7.8	15.7	16.4	--
STMI149	STMI142	STGM2709	287	21'' DIA	0.2%	158.85	158.20	172.2	173.6	170.5	167.7	171.9	168.8	7.5	15.7	16.4	--
STMJ091	STMJ1022	STGM3296	261	12'' DIA	1.1%	222.46	219.49	232.9	227.5	250.2	241.8	264.8	252.0	3.8	6.5	8.4	Existing 10-yr
STMJ092	STMJ091	STGM1034	61	12'' DIA	0.3%	222.67	222.46	232.5	232.9	252.2	250.2	267.8	264.8	2.1	7.2	9.9	Existing 10-yr
STMJ1010	STMJ1012	STGM1360	157	12'' DIA	2.5%	185.18	181.23	193.3	191.5	185.4	181.6	185.4	181.7	5.9	0.7	0.7	--
STMJ1011	STMJ1013	STGM3914	220	12'' DIA	0.5%	220.37	219.30	229.5	228.0	221.8	220.0	221.8	220.0	2.6	3.2	3.2	--
STMJ1012	J-SBT5-01	STGM3147	293	18'' DIA	4.1%	181.23	169.20	191.5	180.0	181.6	169.8	181.7	169.8	21.6	3.7	5.0	--
STMJ1013	STMJ1015	STGM3598	121	15'' DIA	0.5%	219.30	218.73	228.0	223.7	220.0	219.3	220.0	219.3	4.6	3.2	3.2	--
STMJ1015	STIJ102	STGM4314	135	12'' DIA	2.0%	218.73	216.00	223.7	223.9	219.3	216.3	219.3	216.3	5.1	3.2	3.2	--
STMJ102	STMJ103	STGM4063	259	18'' DIA	0.3%	213.81	213.12	221.6	221.6	221.5	217.8	221.0	219.0	5.4	6.5	6.5	--
STMJ1022	STIJ1021	STGM2731	321	12'' DIA	1.1%	219.49	215.79	227.5	223.2	241.8	223.5	252.0	227.0	3.8	8.7	10.4	Existing 10-yr
STMJ103	STMJ106	STGM2081	121	21'' DIA	0.3%	213.12	212.77	221.6	222.2	217.8	217.1	219.0	218.2	8.5	8.8	8.8	--
STMJ104	STMJ107	STGM2171	332	36'' DIA	0.4%	211.50	210.16	221.3	224.1	213.1	212.0	213.1	212.1	41.5	22.0	23.0	--
STMJ105	J3522	STGM1824	28	15'' DIA	0.3%	212.09	212.00	221.3	221.6	216.1	213.8	216.4	213.9	3.7	18.3	19.2	--
STMJ106	STMJ105	STGM2476	253	24'' DIA	0.3%	212.77	212.09	222.2	221.3	217.1	216.1	218.2	216.4	11.7	10.4	10.5	--
STMJ107	STMJ108	STGM3145	192	36'' DIA	0.3%	210.16	209.51	224.1	224.4	212.0	211.6	212.1	211.6	35.6	24.6	25.6	--
STMJ108	J5176	STGM4222	336	36'' DIA	0.1%	209.51	209.16	224.4	215.7	211.6	210.3	211.6	210.3	23.0	27.8	28.8	--
STMJ1110	STMJ119	STGM4173	90	15'' DIA	2.8%	210.16	207.67	216.1	214.5	210.5	208.0	210.5	208.0	11.0	1.3	1.4	--
STMJ1111	STMI1173	STGM4181	212	12'' DIA	1.8%	203.20	199.33	210.5	206.7	203.7	199.9	203.7	199.9	5.0	2.1	2.3	--
STMJ1113	STMJ1114	STGM3550	290	15'' DIA	3.5%	207.14	196.97	211.5	204.9	207.4	198.0	207.4	198.1	12.9	1.4	1.5	--
STMJ1114	STMI1174	STGM4022	548	21'' DIA	0.7%	196.97	192.91	204.9	198.4	198.0	194.3	198.1	194.5	14.3	9.9	10.7	--
STMJ1119	STMJ1012	STGM4020	268	15'' DIA	0.9%	183.51	181.23	193.4	191.5	184.2	181.6	184.3	181.7	6.2	3.0	4.3	--
STMJ1120	STMJ1119	STGM56	162	15'' DIA	0.7%	184.60	183.51	193.0	193.4	185.3	184.2	185.4	184.3	5.5	3.0	4.3	--
STMJ1121	STMJ1120	STGM1305	211	12'' DIA	0.7%	186.07	184.60	195.3	193.0	186.9	185.3	189.3	185.4	3.1	3.0	4.3	--
STMJ1126	STMJ1128	STGM1460	241	12'' DIA	2.0%	219.30	214.51	223.5	218.8	219.7	214.9	219.7	214.9	5.3	1.4	1.5	--
STMJ1127	STMJ1113	STGM1306	74	15'' DIA	2.3%	208.87	207.14	213.0	211.5	209.2	207.4	209.2	207.4	10.1	1.4	1.5	--
STMJ1128	STMJ1127	STGM3656	254	12'' DIA	2.2%	214.51	208.87	218.8	213.0	214.9	209.2	214.9	209.2	5.5	1.4	1.5	--
STMJ1132	STMJ1133	STGM794	149	24'' DIA	0.5%	175.66	174.87	181.2	180.8	176.3	175.4	176.4	175.5	17.1	4.3	5.3	--
STMJ1133	STMJ1135	STGM4327	216	24'' DIA	1.3%	174.87	172.13	180.8	184.2	175.4	173.3	175.5	173.5	26.7	4.3	5.3	--
STMJ1134	STMJ1135	STGM1074	247	15'' DIA	5.1%	184.75	172.13	193.7	184.2	185.1	173.3	185.2	173.5	15.4	3.1	3.8	--
STMJ1135	STMJ1138	STGM3324	317	24'' DIA	0.2%	172.13	171.55	184.2	178.2	173.3	172.4	173.5	172.5	10.0	7.3	9.1	--
STMJ1136	STMJ1132	STGM1013	488	18'' DIA	0.6%	178.62	175.66	191.8	181.2	179.4	176.3	179.5	176.4	8.6	4.3	5.3	--
STMJ1138	STMJ1235	STGM953	85	24'' DIA	1.4%	171.55	170.33	178.2	176.9	172.4	171.1	172.5	171.2	28.1	10.4	13.1	--
STMJ1141	STMJ1142	STGM885	95	24'' DIA	2.3%	184.00	181.80	198.1	196.2	184.4	182.2	184.5	182.3	35.1	2.8	3.9	--
STMJ1142	STMJ1143	STGM4239	264	24'' DIA	2.2%	181.80	176.00	196.2	184.3	182.2	176.4	182.3	176.5	35.0	2.8	3.9	--
STMJ1143	STMJ1238	STGM2043	499	24'' DIA	1.4%	176.00	168.99	184.3	178.5	176.4	169.4	176.5	169.5	28.0	2.8	3.9	--
STMJ115	STMI1162	STGM693	339	12'' DIA	0.6%	190.96	189.01	195.5	193.9	191.5	189.4	191.5	189.4	2.8	1.3	1.3	--
STMJ116	STMI1169	STGM413	235	15'' DIA	1.1%	198.86	196.34	205.8	203.3	199.2	196.9	199.2	197.0	6.9	1.3	1.4	--
STMJ117	STMJ116	STGM2885	53	15'' DIA	2.1%	199.99	198.86	206.8	205.8	200.3	199.2	200.3	199.2	10.1	1.3	1.4	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STMJ118	STMJ117	STGM3212	176	15'' DIA	2.0%	203.56	199.99	210.4	206.8	203.9	200.3	203.9	200.3	9.4	1.3	1.4	--
STMJ119	STMJ118	STGM2864	214	15'' DIA	1.9%	207.67	203.56	214.5	210.4	208.0	203.9	208.0	203.9	9.4	1.3	1.4	--
STMJ121	STMJ1212	STGM3031	310	12'' DIA	0.9%	179.24	176.56	184.6	181.1	179.8	177.0	179.8	177.0	3.4	1.9	1.9	--
STMJ1210	STMJ128	STGM1943	156	21'' DIA	0.6%	168.84	167.85	174.5	175.6	170.1	169.1	170.2	169.2	13.1	11.0	12.7	--
STMJ1211	STMJ1210	STGM2621	112	15'' DIA	0.4%	169.30	168.84	173.6	174.5	170.2	170.1	170.4	170.2	4.3	2.2	3.2	--
STMJ1212	STMJ126	STGM946	217	12'' DIA	1.3%	176.56	173.71	181.1	178.9	177.0	174.4	177.0	174.4	4.2	1.9	1.9	--
STMJ1213	STMJ1214	STGM203	166	12'' DIA	1.1%	180.53	178.72	185.1	183.1	181.4	181.2	185.1	183.1	3.8	2.1	2.3	--
STMJ1214	STMJ123	STGM3955	210	15'' DIA	0.9%	178.72	176.80	183.1	182.2	181.2	181.1	183.1	182.2	6.5	2.2	2.4	--
STMJ1215	STMJ1216	STGM2429	73	15'' DIA	0.9%	172.85	172.18	178.9	179.1	173.3	172.5	173.4	172.5	6.5	2.0	2.2	--
STMJ1216	J4990	STGM1637	84	18'' DIA	5.1%	172.18	167.85	179.1	179.0	172.5	168.0	172.5	168.0	25.0	2.0	2.2	--
STMJ1217	STMJ1215	STGM2811	189	15'' DIA	0.6%	173.99	172.85	182.2	178.9	174.5	173.3	174.6	173.4	5.3	2.0	2.2	--
STMJ1218	STMJ1219	STGM835	253	12'' DIA	3.1%	135.56	127.73	144.3	133.3	136.0	128.2	136.1	128.2	6.6	2.5	3.2	--
STMJ1219	STMJ1220	STGM1194	59	12'' DIA	3.0%	127.73	125.95	133.3	134.1	128.2	126.6	128.2	126.6	6.4	2.5	3.2	--
STMJ122	STMJ123	STGM2217	421	12'' DIA	1.6%	183.38	176.80	188.7	182.2	183.9	181.1	184.1	182.2	4.6	2.7	2.7	--
STMJ1220	J-SB-04	STGM796	36	21'' DIA	7.1%	125.95	115.90	134.1	125.0	126.6	121.4	126.6	121.4	42.4	11.5	12.1	--
STMJ1222	STMJ1220	STGM1348	110	18'' DIA	6.8%	133.40	125.95	138.2	134.1	134.0	126.6	134.0	126.6	28.0	9.0	9.0	--
STMJ1223	STMJ1222	STGM608	95	18'' DIA	6.4%	139.50	133.40	145.0	138.2	140.1	134.0	140.1	134.0	28.0	9.0	9.0	--
STMJ1224	STMJ1223	STGM3637	237	18'' DIA	7.0%	155.98	139.50	163.9	145.0	156.6	140.1	156.6	140.1	28.9	9.0	9.0	--
STMJ1225	STMJ1224	STGM736	175	21'' DIA	1.4%	158.36	155.98	166.7	163.9	159.1	156.6	159.1	156.6	19.3	7.5	7.5	--
STMJ1226	STMJ1227	STGM2863	268	15'' DIA	5.0%	159.59	146.32	170.0	156.3	160.4	147.1	160.4	147.1	14.9	10.7	11.2	--
STMJ1227	STMJ1228	STGM3346	80	15'' DIA	4.9%	146.32	142.40	156.3	152.3	147.1	143.2	147.1	143.2	14.9	10.7	11.2	--
STMJ1228	STMJ1229	STGM1043	80	15'' DIA	5.3%	142.40	138.19	152.3	150.4	143.2	139.0	143.2	139.0	15.5	10.7	11.2	--
STMJ1229	STMJ1242	STGM1444	39	15'' DIA	5.3%	138.19	136.14	150.4	145.0	139.0	136.5	139.0	136.5	15.5	10.7	11.2	--
STMJ123	STMJ124	STGM3193	178	15'' DIA	1.1%	176.80	174.83	182.2	180.0	181.1	180.0	182.2	180.0	7.1	8.8	9.6	--
STMJ1230	STIJ1234	STGM274	40	12'' DIA	0.6%	160.57	160.31	162.7	164.6	161.1	160.5	161.1	160.5	3.0	1.5	1.5	--
STMJ1231	STMJ1232	STGM3442	65	33'' DIA	0.7%	165.26	164.80	172.5	173.1	166.2	165.4	166.3	165.4	45.2	10.4	13.1	--
STMJ1232	STMJ1233	STGM735	111	33'' DIA	4.8%	164.80	159.41	173.1	172.3	165.4	160.5	165.4	160.7	115.4	10.4	13.1	--
STMJ1233	J-SBT3-01	STGM737	355	36'' DIA	3.3%	159.41	147.70	172.3	160.0	160.5	148.5	160.7	148.6	66.7	18.0	23.4	--
STMJ1234	STMJ1231	STGM501	117	33'' DIA	1.0%	166.39	165.26	173.8	172.5	167.2	166.2	167.3	166.3	52.0	10.4	13.1	--
STMJ1235	STMJ1234	STGM1822	228	24'' DIA	1.7%	170.33	166.39	176.9	173.8	171.1	167.2	171.2	167.3	30.6	10.4	13.1	--
STMJ1236	STMJ1237	STGM4360	122	24'' DIA	2.3%	165.95	163.11	178.4	175.8	166.6	163.7	166.7	163.8	34.7	7.7	10.3	--
STMJ1237	STMJ1239	STGM2654	64	24'' DIA	3.7%	163.11	160.72	175.8	175.8	163.7	161.7	163.8	161.9	42.4	7.6	10.3	--
STMJ1238	STMJ1236	STGM580	55	24'' DIA	5.5%	168.99	165.95	178.5	178.4	169.4	166.6	169.5	166.7	51.5	5.7	8.1	--
STMJ1239	STMJ1233	STGM1647	158	36'' DIA	0.8%	160.72	159.41	175.8	172.3	161.7	160.5	161.9	160.7	33.2	7.6	10.3	--
STMJ124	STMJ129	STGM3039	260	15'' DIA	1.1%	174.83	171.98	180.0	177.0	180.0	172.9	180.0	173.0	7.0	8.8	9.6	--
STMJ1242	J-SB-06	SBT2-01	236	Irregular Channel	7.3%	136.14	119.00	145.0	125.0	136.5	122.5	136.5	122.7		10.7	11.2	--
STMJ1244	STMJ1210	STGM2304-B	113	18'' DIA	1.0%	170.00	168.84	175.9	174.5	171.0	170.1	171.1	170.2	11.1	8.8	9.6	--
STMJ125	STMJ126	STGM2225	496	12'' DIA	1.5%	181.17	173.71	186.0	178.9	181.4	174.4	181.5	174.4	4.6	0.7	0.8	--
STMJ126	STMJ127	STGM921	220	15'' DIA	1.6%	173.71	170.29	178.9	176.7	174.4	171.0	174.4	171.0	8.4	4.9	5.1	--
STMJ127	STMJ128	STGM3631	263	18'' DIA	0.9%	170.29	167.85	176.7	175.6	171.0	169.1	171.0	169.2	10.5	4.9	5.1	--
STMJ128	STMI1212	STGM17	450	33'' DIA	0.5%	167.85	165.74	175.6	175.9	169.1	166.9	169.2	167.0	37.9	15.9	17.8	--
STMJ129	STMJ1244	STGM2304-A	147	18'' DIA	1.3%	171.98	170.00	177.0	175.9	172.9	171.0	173.0	171.1	12.7	8.8	9.6	--
STMK111	J-SBT4-04	STGM3873	7	15'' DIA	16.6%	164.77	163.59	172.0	171.9	165.1	164.3	165.1	164.3	26.8	3.2	3.3	--
STMK1110	STMK117	STGM1277	115	12'' DIA	3.7%	177.71	173.50	187.2	180.8	178.2	174.0	178.2	174.0	7.2	3.2	3.4	--
STMK1111	STMK1110	STGM3851	134	12'' DIA	9.9%	190.91	177.71	200.0	187.2	191.3	178.2	191.3	178.2	11.7	3.2	3.4	--
STMK1112	STMK1111	STGM2971	155	12'' DIA	12.4%	210.00	190.91	218.6	200.0	210.3	191.3	210.4	191.3	13.1	3.2	3.4	--
STMK1113	STMK1114	STGM3617	73	15'' DIA	13.4%	154.00	144.32	167.8	160.0	155.2	148.9	155.6	148.9	24.5	21.7	22.0	--
STMK1114	J-SBT4-01	STGM3110	62	15'' DIA	6.2%	144.32	140.54	160.0	145.0	148.9	141.2	148.9	141.2	16.7	21.4	21.4	--
STMK1115	STMK1113	STGM585	215	15'' DIA	0.8%	155.74	154.00	169.2	167.8	156.4	155.2	156.4	155.6	6.1	2.9	3.6	--
STMK1116	STMK1113	STGM3827	320	15'' DIA	2.7%	162.55	154.00	171.6	167.8	163.0	155.2	163.0	155.6	10.9	2.8	3.0	--
STMK1117	STMK1116	STGM197	135	15'' DIA	1.3%	164.26	162.55	173.2	171.6	164.8	163.0	164.8	163.0	7.6	2.8	3.0	--
STMK1118	STMK1117	STGM2666	83	15'' DIA	1.4%	165.41	164.26	174.1	173.2	165.9	164.8	166.0	164.8	7.9	2.8	3.0	--
STMK1119	STMK1118	STGM1422	113	12'' DIA	1.7%	167.33	165.41	175.6	174.1	167.9	165.9	167.9	166.0	4.6	2.8	3.0	--
STMK1120	STMK1119	STGM1144	91	12'' DIA	5.8%	172.58	167.33	180.2	175.6	173.0	167.9	173.0	167.9	8.9	2.8	3.0	--
STMK1121	STMK116	STGM2036	208	12'' DIA	5.1%	190.20	179.68	198.3	190.1	190.9	180.3	190.9	180.4	8.4	6.6	6.8	--
STMK1122	STMK1121	STGM504	204	12'' DIA	3.2%	196.81	190.20	204.2	198.3	197.7	190.9	197.7	190.9	6.7	6.6	6.8	--
STMK113	J-SBT4-04	STGM3752	142	18'' DIA	0.6%	164.46	163.59	171.4	171.9	165.5	164.3	165.5	164.3	8.3	6.6	6.8	--
STMK114	STMK113	STGM2593	51	18'' DIA	1.5%	165.22	164.46	172.5	171.4	166.0	165.5	166.0	165.5	12.7	6.6	6.8	--
STMK115	STMK114	STGM2050	111	12'' DIA	7.6%	173.64	165.22	181.5	172.5	174.2	166.0	174.2	166.0	10.2	6.6	6.8	--
STMK116	STMK115	STGM14	109	12'' DIA	5.6%	179.68	173.64	190.1	181.5	180.3	174.2	180.4	174.2	8.7	6.6	6.8	--
STMK117	STMK118	STGM1105	144	12'' DIA	2.6%	173.50	169.71	180.8	178.2	174.0	170.3	174.0	170.3	6.1	3.2	3.4	--
STMK118	STMK119	STGM3282	73	12'' DIA	1.8%	169.71	168.40	178.2	177.3	170.3	169.3	170.3	169.3	5.0	3.2	3.4	--

Table B-2. Hydraulic Model Parameters and Results

Up and Downstream Model Node		Conduit ID	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Slope (%)	Invert Elevation (ft)		Ground Elevation (ft)		Exst 10 yr Max Water Surface		Fut 10 yr Max Water Surface		Capacity (cfs)	Exst 10 yr Max Flow (cfs)	Fut 10 yr Max Flow (cfs)	When Flooding (Max WSE > Ground Elevation)
US	DS					US	DS	US	DS	US	DS	US	DS				
STMK119	STIK117	STGM1581	141	15'' DIA	0.3%	168.40	167.96	177.3	175.0	169.3	168.7	169.3	168.8	3.8	3.1	3.4	--
STMK121	STMJ1225	STGM2899	199	21'' DIA	1.3%	160.93	158.36	166.7	166.7	161.7	159.1	161.7	159.1	18.8	7.5	7.5	--
STMK1210	STMK129	STGM3371	108	12'' DIA	6.3%	169.93	163.14	178.4	171.9	170.4	166.1	170.4	166.8	9.3	3.4	3.5	--
STMK1211	STMK1210	STGM2234	229	12'' DIA	8.4%	188.97	169.93	197.2	178.4	189.4	170.4	189.4	170.4	10.7	3.4	3.5	--
STMK1212	STMK126	STGM3829	156	12'' DIA	4.9%	183.98	176.34	198.0	185.7	184.5	176.8	184.5	176.8	8.1	4.0	4.0	--
STMK1213	STMK1214	STGM3216	135	12'' DIA	8.1%	180.96	170.13	190.3	179.9	181.2	170.6	181.2	170.6	10.2	0.9	0.9	--
STMK1214	STMK111	STGM2871	169	15'' DIA	3.2%	170.13	164.77	179.9	172.0	170.6	165.1	170.6	165.1	11.9	3.2	3.3	--
STMK1215	STMK1214	STGM2543	82	12'' DIA	5.4%	174.52	170.13	185.0	179.9	174.9	170.6	174.9	170.6	8.5	2.3	2.3	--
STMK1216	STMK1215	STGM1031	237	12'' DIA	12.7%	204.42	174.52	215.4	185.0	204.7	174.9	204.7	174.9	13.5	2.3	2.3	--
STMK1217	STMK1216	STGM3452	141	12'' DIA	12.1%	221.37	204.42	232.0	215.4	221.5	204.7	221.5	204.7	12.3	0.7	0.7	--
STMK1218	STMK1217	STGM3989	177	12'' DIA	15.0%	247.63	221.37	257.8	232.0	247.8	221.5	247.8	221.5	14.8	0.7	0.7	--
STMK1219	STMK1216	STGM440	126	12'' DIA	4.5%	210.12	204.42	227.5	215.4	210.4	204.7	210.4	204.7	7.6	0.9	1.0	--
STMK122	STMK121	STGM3638	208	21'' DIA	1.1%	163.17	160.93	171.4	166.7	164.0	161.7	164.0	161.7	17.1	7.5	7.6	--
STMK1220	STMK1219	STGM239	240	12'' DIA	13.6%	242.37	210.12	254.9	227.5	242.6	210.4	242.6	210.4	13.0	0.9	1.0	--
STMK1221	STMK1220	STGM3551	66	12'' DIA	3.6%	244.72	242.37	256.0	254.9	245.0	242.6	245.0	242.6	7.0	0.9	1.0	--
STMK1222	STMK1221	STGM2823	169	12'' DIA	8.6%	259.18	244.72	269.4	256.0	259.4	245.0	259.4	245.0	11.4	0.9	1.0	--
STMK1223	STMK1224	STGM1405	353	12'' DIA	5.4%	263.91	244.69	272.9	253.2	264.3	245.0	264.3	245.0	8.5	2.3	2.3	--
STMK1224	STMK1225	STGM1893	64	12'' DIA	8.2%	244.69	239.49	253.2	249.0	245.0	239.8	245.0	239.8	10.4	2.3	2.3	--
STMK1225	STMK1226	STGM3668	174	12'' DIA	18.3%	239.49	208.13	249.0	221.2	239.8	208.4	239.8	208.4	16.4	2.3	2.3	--
STMK1226	STMK1227	STGM3728	92	12'' DIA	15.8%	208.13	193.74	221.2	207.5	208.4	194.1	208.4	194.1	14.3	2.3	2.3	--
STMK1227	STMK1212	STGM448	180	12'' DIA	5.4%	193.74	183.98	207.5	198.0	194.1	184.5	194.1	184.5	8.5	2.3	2.3	--
STMK1228	STMK124	STGM2106	54	18'' DIA	3.7%	166.09	164.12	170.3	169.3	166.5	164.9	166.5	164.9	20.7	3.7	3.8	--
STMK1229	STMK1228	STGM621	210	15'' DIA	10.8%	188.72	166.09	195.1	170.3	189.1	166.5	189.1	166.5	21.9	3.7	3.8	--
STMK123	STMK122	STGM1742	248	12'' DIA	6.2%	178.61	163.17	184.0	171.4	178.8	164.0	178.8	164.0	9.5	1.1	1.1	--
STMK1230	STMK1229	STGM3819	205	12'' DIA	10.0%	209.01	188.72	216.0	195.1	209.3	189.1	209.3	189.1	11.8	2.6	2.6	--
STMK1231	STMK1230	STGM3915	124	12'' DIA	8.7%	219.71	209.01	228.0	216.0	220.0	209.3	220.0	209.3	10.8	2.6	2.6	--
STMK1232	STMK1231	STGM1946	271	12'' DIA	10.7%	248.53	219.71	252.9	228.0	248.8	220.0	248.8	220.0	12.3	2.6	2.6	--
STMK1233	STMK1229	STGM578	116	12'' DIA	0.8%	189.66	188.72	196.5	195.1	190.1	189.1	190.1	189.1	3.4	1.1	1.2	--
STMK1235	STMK1115	STGM3189	181	15'' DIA	0.5%	156.63	155.74	167.2	169.2	157.3	156.4	157.4	156.4	4.7	2.9	3.6	--
STMK124	STMK122	STGM1650	179	18'' DIA	0.5%	164.12	163.17	169.3	171.4	164.9	164.0	164.9	164.0	8.0	4.5	4.5	--
STMK125	STMK124	STGM2255	244	12'' DIA	2.2%	169.53	164.12	176.2	169.3	169.8	164.9	169.8	164.9	5.4	0.8	0.8	--
STMK126	STMJ1226	STGM3715	356	12'' DIA	4.7%	176.34	159.59	185.7	170.0	176.8	160.4	176.8	160.4	8.0	4.0	4.0	--
STMK127	STMJ1226	STGM434	168	12'' DIA	0.6%	160.59	159.59	170.3	170.0	162.4	160.4	162.8	160.4	2.9	3.4	3.5	--
STMK128	STMK127	STGM3789	202	12'' DIA	0.7%	162.01	160.59	171.6	170.3	164.7	162.4	165.1	162.8	3.1	3.4	3.5	--
STMK129	STMK128	STGM3068	184	12'' DIA	0.6%	163.14	162.01	171.9	171.6	166.1	164.7	166.8	165.1	2.9	3.4	3.5	--
STML1131	STML1132	STGM1321	245	27'' DIA	1.8%	194.81	190.42	207.4	202.9	195.8	191.4	195.8	191.4	41.6	15.8	15.8	--
STML1132	J-SBT1-09	STGM452	90	30'' DIA	1.6%	190.42	188.95	202.9	196.5	191.4	189.2	191.4	189.2	52.6	15.8	15.8	--
STML1146	STML1131	STGM3690	109	12'' DIA	2.8%	197.83	194.81	206.0	207.4	202.5	195.8	202.6	195.8	5.9	8.5	8.5	--
STML1232	STMI1233	STGM4524	417	12'' DIA	0.3%	179.20	178.00	183.3	182.9	197.3	191.7	197.2	191.7	2.0	5.1	5.1	Existing 10-yr

Appendix C: Channel Vulnerability Data

Use of contents on this sheet is subject to the limitations specified on the title page of this document.

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

Chehalem Creek Tributary, Upstream of Sunnycrest Road

Stream
Chehalem Creek Newberg Tributary

Reach
Lower Reach (upstream of Sunnycrest)

General Characteristics

Gradient:	≈ 0.006 ft/ft
Valley Width:	100 – 150 feet
Planform:	Meandering
Average BFW:	≈ 6 ft
Average BFD:	≈ 4 ft
Substrate:	Silt
Vegetation:	Blackberries, ferns, mixed forest.
Beaver Activity:	Upstream of Sheridan Road culvert.

Issues
Some bank erosion and slumps.

Aerial view of Chehalem Creek Tributary, Sunnycrest (W 1st St) Reach

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

Typical stream section above Highway 240

Stream
Chehalem Creek Newberg Tributary

Reach
Upper Reach (upstream of Hwy 240)

General Characteristics

Gradient:	≈ 0.016 ft/ft
Valley Width:	50 – 100 feet
Planform:	Relatively straight
Average BFW:	≈ 8 ft
Average BFD:	≈ 4 ft
Substrate:	Silt
Vegetation:	Blackberries, ferns, narrow mixed forest.
Beaver Activity:	None

Issues
Bank slumps, erosion and hillslope failures.

Aerial view of Chehalem Creek Tributary, upstream Hwy 240 reach

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

Photo of Corrine Drive Tributary channel upstream of detention pond/lake (bottom photo).

Stream
Hess Creek

Reach
East Tributary (Corrine Drive)

General Characteristics

Gradient:	≈ 0.01 ft/ft
Valley Width:	<100 feet
Planform:	Relatively straight
Average BFW:	≈ 5 ft (City data)
Average BFD:	≈ 2.7 ft (City data)
Substrate:	Silt above detention pond, and downstream at confluence
Vegetation:	Mixed
Beaver Activity:	None

Issues
Erosion at detention pond outlet. Channel incision downstream (City data).

Aerial view of Hess Creek, Corrine Drive Tributary

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

Hess Creek channel about WWTP

Stream
Hess Creek

Reach
Lower Reach (WWTP)

General Characteristics

Gradient:	≈ 0.002 ft/ft
Valley Width:	250 – 300 feet
Planform:	Meandering
Average BFW:	≈ 9 ft
Average BFD:	≈ 4 ft
Substrate:	Silt
Vegetation:	Reed canary grass, blackberries
Beaver Activity:	No recent activity observed.

Issues
Invasive vegetation. Very long piped section downstream of WWTP.

Aerial view of Hess Creek, WWTP reach.

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

Example photos of stream reach above Crestview. Significant bank erosion in this reach.

Stream
Hess Creek

Reach
Upper Reach (Above Crestview)

General Characteristics

Gradient:	≈ 0.008 ft/ft
Valley Width:	100 – 150 feet
Planform:	Meandering
Average BFW:	≈ 9 feet
Average BFD:	≈ 3 feet
Substrate:	Silt (loose and thick in places)
Vegetation:	Residential pasture, blackberries, reed canary grass
Beaver Activity:	Moderate

Issues
Bank erosion (exposed sewer manhole)
Culvert of unknown purpose

Aerial view of Hess Creek, Crestview Reach

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

Photo of mainstem Hess Creek at confluence with Corrine Drive Tributary

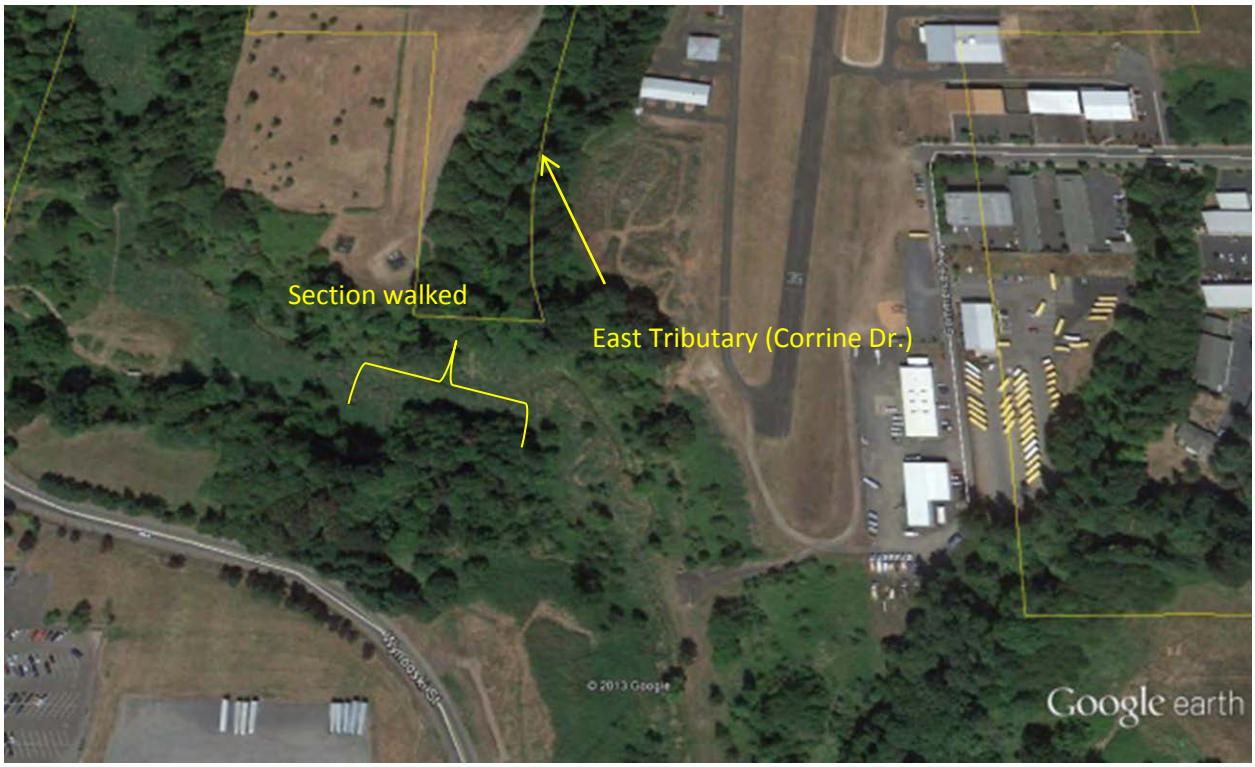
Stream
Hess Creek

Reach
Lower Reach (Near Confluence with East Trib)

General Characteristics

Gradient:	≈ 0.002 ft/ft
Valley Width:	200 – 300 feet
Planform:	Meandering
Average BFW:	≈ 11 feet
Average BFD:	≈ 2.5 feet
Substrate:	Silt
Vegetation:	Reed canary grass, blackberries, mixed vegetation along slopes at forest edge.
Beaver Activity:	None

Issues
Fair amount of bank slumping in this reach



Aerial view of Hess Creek, East Tributary Confluence Reach

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

Typical stream section upstream of NE Benjamin Road

Stream
Spring Brook Mainstem

Reach
Upper Reach (Upstream of Benjamin Road)

General Characteristics

Gradient:	≈ 0.008 ft/ft
Valley Width:	100 – 150 feet
Planform:	Meandering
Average BFW:	≈ 8 ft
Average BFD:	≈ 3 ft
Substrate:	Silt
Vegetation:	Shrubs, lawn (residential areas)
Beaver Activity:	None

Issues
Flooding at Benjamin Road during larger events

Aerial view of Spring Brook in the vicinity of NE Benjamin Road

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

Example photos of Hess Creek through Hoover Park (downstream of Hwy 99), and flooding during January 2011.

Stream
Hess Creek

Reach
Lower Reach (Hoover Park)

General Characteristics

Gradient:	≈ 0.006 ft/ft
Valley Width:	200 – 300 feet
Planform:	Channelized
Average BFW:	≈ 8 feet
Average BFD:	≈ 3 feet
Substrate:	Silt
Vegetation:	Lawn, blackberries and reed canary grass in undeveloped areas.
Beaver Activity:	None

Issues
Park flooding during larger storms.

Aerial view of Hess Creek, Hoover Park reach

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

Example photos of stream reach below Mountainview Drive. Residential drainage pipes enter channel on west side.

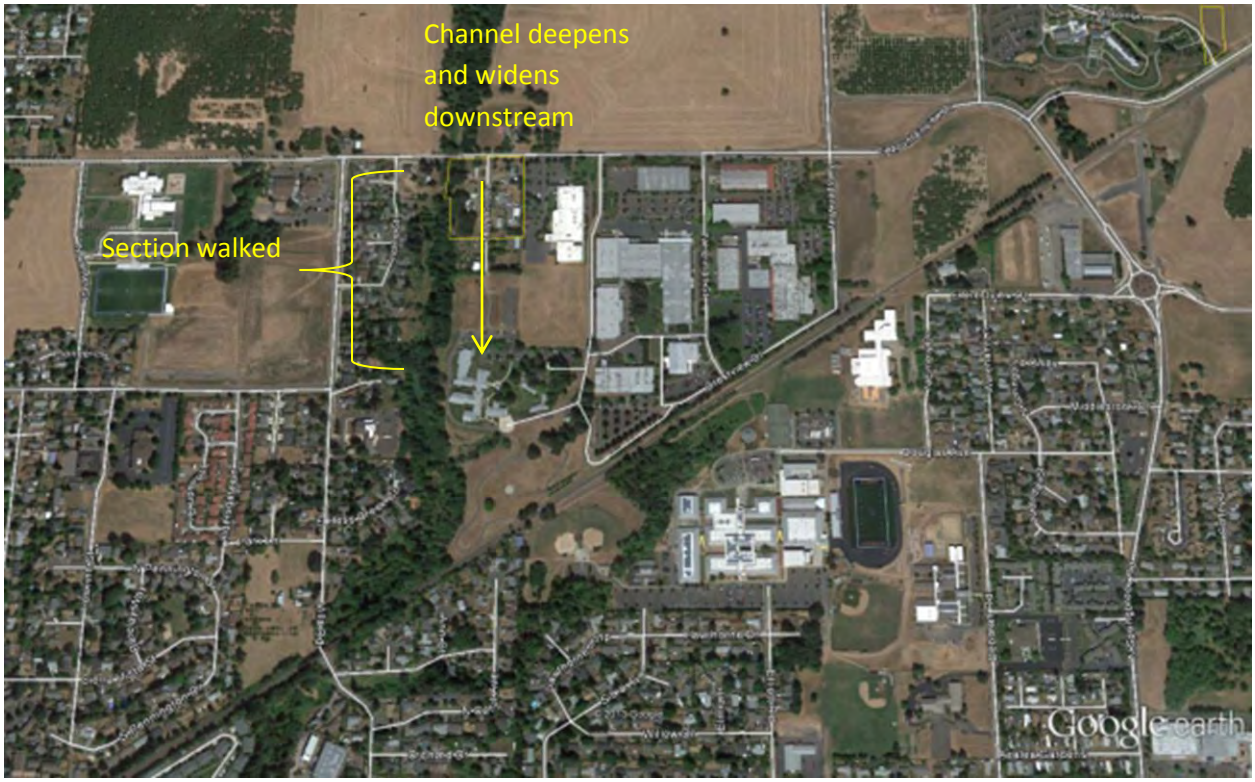
Stream
Hess Creek

Reach
Upper Reach (Below Mtn. View Dr.)

General Characteristics

Gradient:	≈ 0.008 ft/ft
Valley Width:	100 -150 feet
Planform:	Meandering
Average BFW:	≈ 7 feet (3 – 12)
Average BFD:	≈ 3 feet (2 - 10
Substrate:	Primarily silt, some gravel
Vegetation:	Residential landscaping, lawn, trees adjacent to channel
Beaver Activity:	None

Issues
Downcutting. Some bank erosion.



Aerial view of Hess Creek, Mountainview downstream

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

One of many beaver dams in the Hess Creek reach above Mountainview Drive

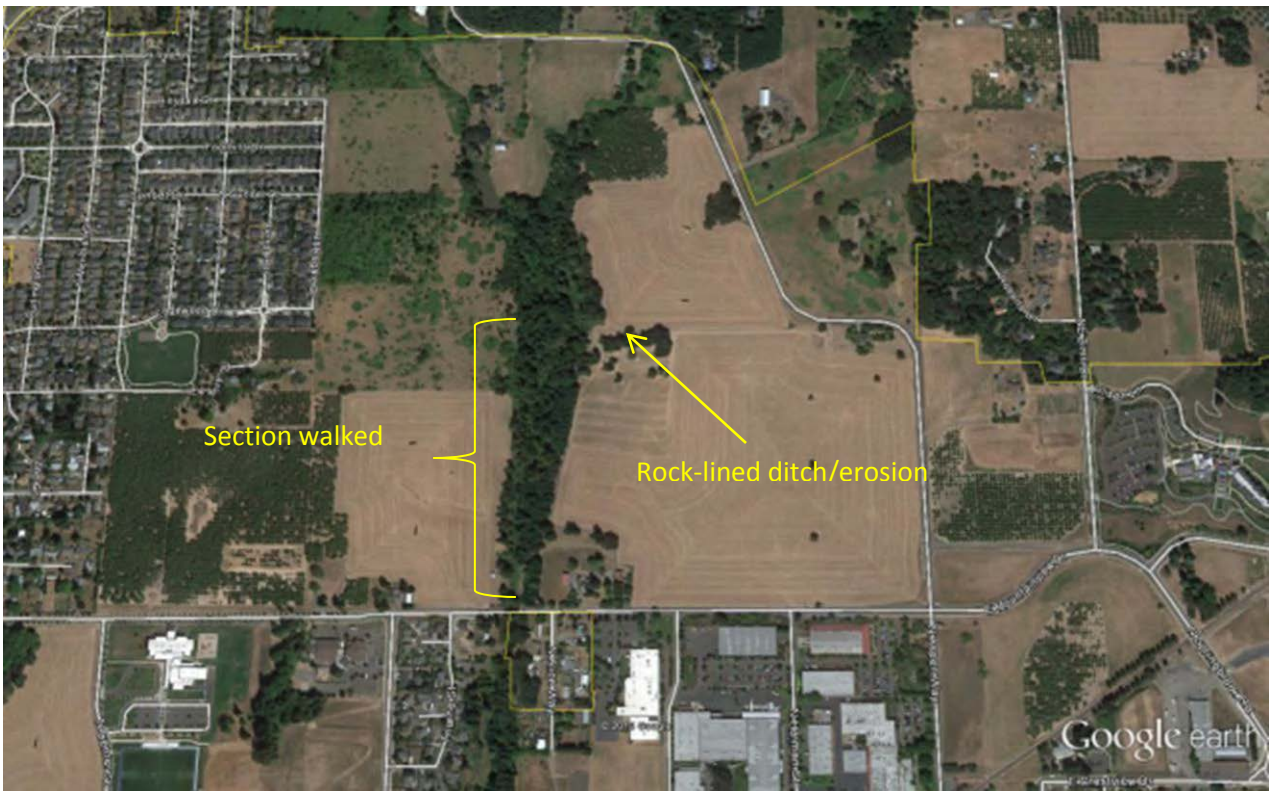
Stream
Hess Creek

Reach
Upper Reach (Above Mtn. View Dr.)

General Characteristics

Gradient:	≈ 0.008 ft/ft
Valley Width:	100 – 150 feet
Planform:	Meandering
Average BFW:	≈ 9 feet
Average BFD:	≈ 3 feet
Substrate:	Primarily silt, some gravel, bedrock above Mountainview Dr
Vegetation:	Narrow forested riparian area, reed canary grass
Beaver Activity:	Significant

Issues
Significant erosion at ditch outfall



Aerial view of Hess Creek, Mountainview Drive Reach

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

Typical stream section between Fernwood Rd and Hayes St

Stream
Spring Brook West Tributary

Reach
Upper Reach (Upstream of Fernwood)

General Characteristics

Gradient:	≈ 0.012 ft/ft
Valley Width:	50 – 100 feet
Planform:	Relatively straight
Average BFW:	≈ 7 ft
Average BFD:	≈ 3 ft
Substrate:	Silt
Vegetation:	Mixed forest. Fairly nice riparian area.
Beaver Activity:	None

Issues
Many groundwater seeps, especially on west bank.

Aerial view of Spring Brook West Tributary in the vicinity of E Fernwood Rd

CITY OF NEWBERG
STREAM VULNERABILITY ASSESSMENT STREAM REACH DESCRIPTIONS

Example photo of Hess Creek through GFU campus

Stream
Hess Creek

Reach
Middle Reach (George Fox University)

General Characteristics

Gradient:	≈ 0.005 ft/ft
Valley Width:	150 – 200 feet
Planform:	Meandering
Average BFW:	≈ 10 feet
Average BFD:	≈ 3 feet
Substrate:	Silt
Vegetation:	Native plants (significant restoration activity)
Beaver Activity:	None

Issues
No significant issues. GFU has and continues to restore reach.

Aerial view of Hess Creek, George Fox University Reach

Appendix D: CIP Fact Sheets and Cost Estimate

Use of contents on this sheet is subject to the limitations specified on the title page of this document.

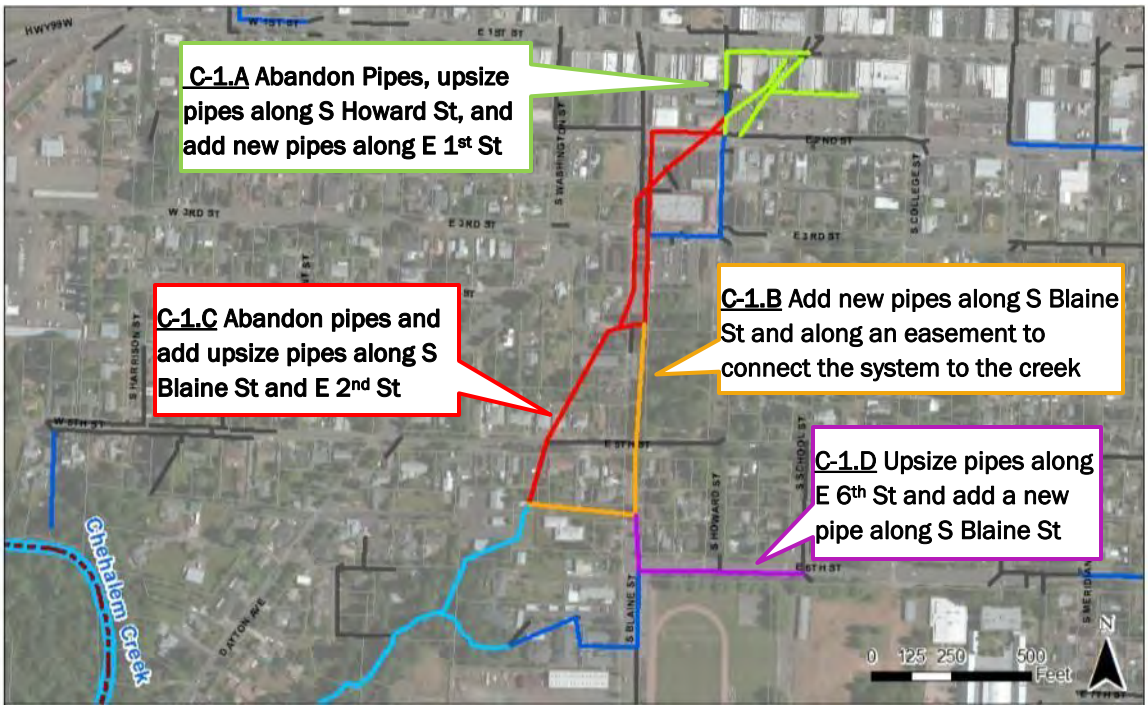
City of Newberg
Stormwater Master Plan
Prioritized Capital Improvement Projects

		Prioritization Criteria Scores							TOTAL SCORE	Implementation Timeline		
		COST	SAFETY LIABILITY	COMPLEXITY	IMPACT	ENVIRON. BENEFIT	REDUCE MAINT. COST	SUSTAIN/ LIVABILITY		Short Term (0-5 Year)	Mid Term (6-10 Year)	Long Term (>10 Year)
CIP No.	**Project Name**		***1.0***	***0.5***	***0.5***	***0.5***	***1.0***	***0.5***				
C-1	Blaine St Improvements - Design	$180,000	Design prior to all C-1 Projects						n/a	X		
C-1A	S Blaine St Improvements - 99W to 2nd St Parking Lot Decommissioning/Replacement	$131,100	3	2	2	1	3	3	10.0	X		
C-1B	S Blaine St Improvements - S Blaine St Pipe Replacement	$383,600	3	1	3	1	2	3	9.0	X		
C-1C	S Blaine St Improvements - E 2nd St to E 5th St Pipe Decommissioning/Replacement	$290,600	3	1	3	1	3	3	10.0	X		
C-1D	S Blaine St Improvements - E 6th Street Pipe Replacement	$175,800	1	2	2	1	2	2	6.5			X
C-2	S Center St Improvements - Design	$180,000	Design prior to all C-2 Projects						n/a	X		
C-2A	S Center St Improvements - E 9th St to S Center Pipe Decommissioning	$293,600	3	2	3	1	3	3	10.5	X		
C-2B	S Center St Improvements - Center, 7th and 8th Street Pipe Replacement	$930,500	1	2	3	1	2	2	7.0			X
C-3	E Columbia Dr Improvements	$79,300	1	3	2	1	3	2	8.0		X	
C-4	Oxford St Improvements	$1,092,100	1	2	2	1	3	2	7.5		X	
C-5	N College St Improvements	$259,500	1	2	2	1	2	2	6.5			X
C-6	S River St Improvements	$159,900	2	3	2	1	3	2	9.0	X		
C-7	S College St at Andrew St Improvements	$196,200	1	1	3	2	2	2	7.0			X
C-8	Dayton Avenue Green Streets	$124,900	2	3	1	2	1	3	7.5		X	
H-1	N Elliot Rd Improvements*	$239,400	1	2	1	1	1	3	5.5			X
H-2	N Edwards St Improvements	$1,217,000	1	1	3	1	1	3	6.0			X
H-3	E 3rd St Improvements - Design	$142,000	Design prior to all H-3 Projects						n/a			X
H-3A	E 3rd St Improvements - S Church and E 1st Street	$403,600	1	2	2	2	1	2	6.0			X
H-3B	E 3rd St Improvements - E 3rd Street	$341,100	1	2	2	1	1	2	5.5			X
H-4	Villa Rd Improvements*	$103,900	2	1	2	3	2	2	8.0		X	
S-1	N Springbrook Rd Improvements**	$776,600	1	2	2	1	2	2	6.5			X
S-2	Libra St Improvements	$246,500	1	2	1	1	3	2	7.0			X
A-1	Streambank Protection Projects	$190,000	2	2	1	3	2	2	8.0		X	
	Totals	$8,137,200								$ 1,618,800	$ 1,590,200	$ 4,928,200

*Project to be installed with roadway improvement project. Schedule dependent on transportation priorities.
**Project to be designed and installed with water and sewer utilities. Schedule based on joint priorities.

CIP Rating Criteria					
Criteria		Weight	Score Definition		
			3	2	1
1	SAFETY/LIABILITY	1.0	Significant Hazard; Threat to life and limb and or property	Moderate safety hazard	No safety hazard
2	COMPLEXITY	0.5	May be done by small crew in less than a month's time	Typical moderate level of difficulty project.	Requires significant design, contract SP's, complex construction, and/or permitting
3	IMPACT	0.5	Problem affects region-wide area with significant downstream and/or upstream impacts	Problem affects a small sub-basin.	Problem affects only a few individual properties
4	ENVIRONMENTAL BENEFIT	0.5	Significantly improves water quality and wildlife habitat	Moderately improves water quality and wildlife habitat	No water quality or wildlife benefit
5	LONG-TERM MAINTENANCE	1.0	Project will reduce or eliminate ongoing maintenance requirements	No change in maintenance	Project could increase City's needed maintenance activities
6	SUSTAINABILITY / LIVABILITY	0.5	Project is a long term solution that will be sustained for multiple generations. Or project adds infrastructure in deficient areas	Project is adequate to address needs in master plan timeline (10-15 years)	Short term solution that may require additional projects down the road

	Criteria Definition	
1	SAFETY/LIABILITY	What potential safety and/or liability issues are involved?
2	COMPLEXITY	How quickly can the solution be implemented and with what level of effort?
3	IMPACT	How large an area and/or how many people does the problem impact?
4	ENVIRONMENTAL BENEFIT	Are there direct environmental benefits associated with the projects?
5	LONG-TERM MAINTENANCE	Will this cause a long-term maintenance burden?
6	SUSTAINABILITY / LIVABILITY	Will the project improve the quality of life? Is this what our grandchildren would want?



Project Name	C-1: S Blaine St Improvements
Drainage	Chehalem Creek
Contributing Drainage Area	62.0 acres
Associated Modeled Pipes/Conduits	STGM3838 and STGM685 to STMF135
Objective(s) Addressed	Pipe Replacement - Location; Structural Integrity; Flood Control

Project Description

Currently a reach of 10"-18" stormwater pipe runs through private property and under several houses. Flooding along E 6th St and S Blaine St occurs during the current and future conditions 10-year storm events.

Due to project size, this CIP has been sub-divided into several projects.

Survey and Design **$ 180,000**

C-1.A 99W to 2nd St Parking Lot Pipe Decommissioning/Replacement **$ 131,100**

A. Decommission the stormwater pipes which are in private property and add a 12" stormwater pipe along E 1st St. Upsize the stormwater pipe along S Howard St to convey existing and future flows.

C-1.B S Blaine St Pipe Replacement **$ 383,600**

B. Add new 30" stormwater pipes along S Blaine St to convey existing and future flows.

C-1.C E 2nd St to E 5th St Pipe Decommissioning/Replacement **$ 290,600**

C. Decommission the stormwater pipes which are in private property and add/upsize pipes to 18" and 24" to convey existing and future flows and connect to the new stormwater system along S Blaine St.

C-1.D E 6th St and S Blaine St Pipe Replacement **$ 175,800**

D. Upsize existing stormwater pipes to 18"to convey existing and future flows. Connect the stormwater system from E 6th St to S Blaine St to provide conveyance and storage.

See the detailed cost estimate in tables: Survey and Design Cost, C-1.A, C-1.B, C-1.C, and C-1.D.

Capital Project Implementation Cost Total	$ 1,161,100
Existing to Future % Flow Increase[1]	5%

Design Assumptions

Existing pipes on private property must be properly abandoned to maintain long term structural integrity.

Obtain an easement west of S Blaine St to connect to the existing stormwater system.

City preference is to have stormwater line run in the planter strip on the west side of S Blaine St.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*

MEMORANDUM

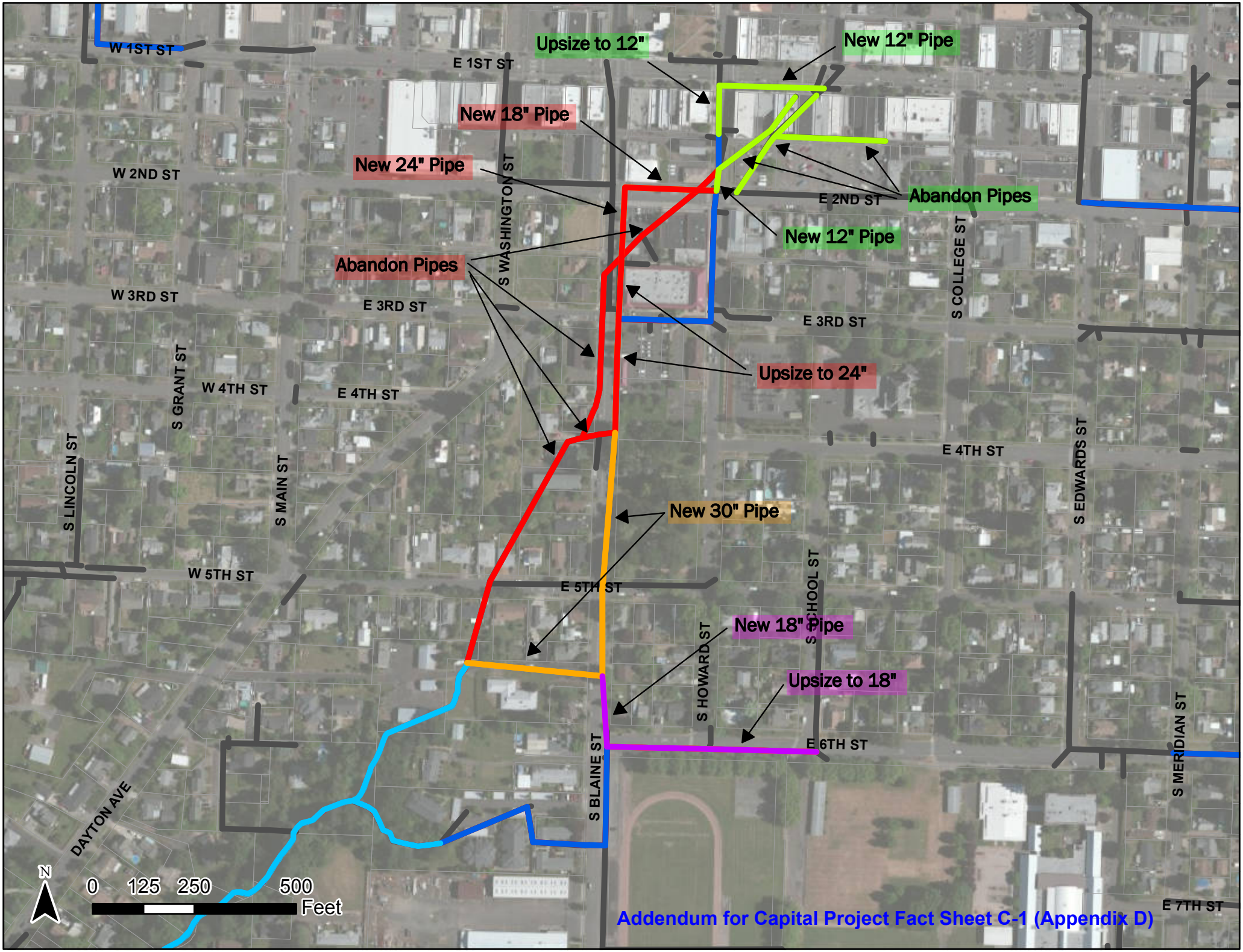
ENGINEERING SERVICES DEPARTMENT
P.O. Box 970 • 414 E. First Street • Newberg, Oregon 97132 • Tel 503.537.1240

SUBJECT: **Addendum for the Stormwater Master Plan 2014**
DATE: February 2, 2015

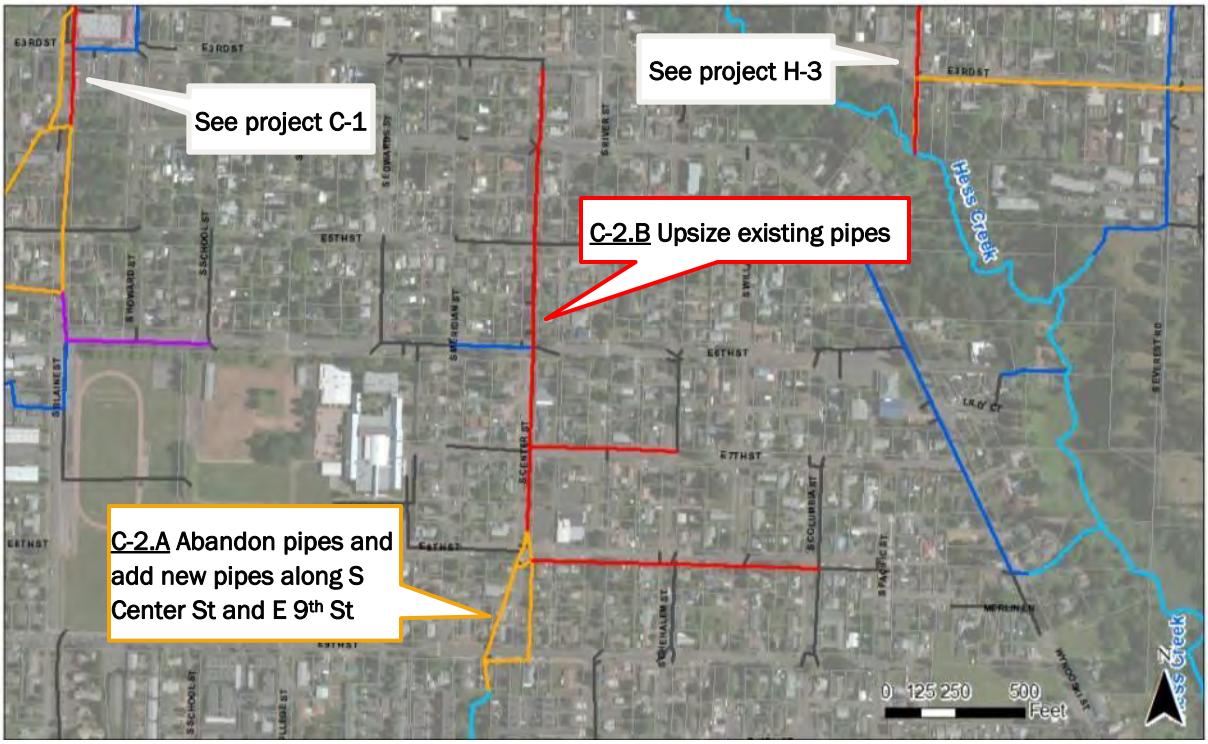
To make the adopted Stormwater Master Plan (2014 edition) more user friendly, the following attachments are added:

- Table B-2, sorted by the Upstream Node names. Note that the table is still arranged into 3 sections – Chehalem starting on Page 1, Hess on Page 8, and Spring Brook on Page 13. (Note: Table B-2 in the original master plan was sorted by the Conduit ID.) Please insert to Appendix B.
- Supplemental map for CIP C-1, showing the proposed pipe sizes. Please insert to the fact sheets in Appendix D.

Thank you.



Addendum for Capital Project Fact Sheet C-1 (Appendix D)



Project Name	C-2: S Center St Improvements
Drainage	Chehalem Creek
Contributing Drainage Area	100.1 acres
Associated Modeled Pipes/Conduits	STGM1039, STGM1093, and STGM1333 to J4572
Objective(s) Addressed	Pipe Replacement - Location; Structural Integrity; Flood Control

Project Description

Currently a reach of 21" stormwater pipe runs through private property and under several houses. Flooding along E 8th St, E 7th St, and S Center St occurs during the current and future conditions 10-year storm events.

Decommission the stormwater pipes which are on private property and add a 30" stormwater pipe along S Center St. Upsize existing stormwater pipes to 30", 24" and 18"to convey existing and future flows.

Due to project size, this CIP has been sub-divided into several projects.

Survey and Design	**$ 180,000**
C-1.A E 9th St to S Center St Pipe Decommissioning	**$ 293,600**
E. Decommission the stormwater pipes which are on private property and add a 30" stormwater pipe along S Center St and E 9th St.	
C-1.B S Center St, E 8th St, and E 7th St Pipe Replacement	**$ 930,500**
F. Upsize existing stormwater pipes to 30", 24" and 18"to convey existing and future flows.	

See the detailed cost estimate in tables: Survey and Design Cost, C-2.A, and C-2.B.

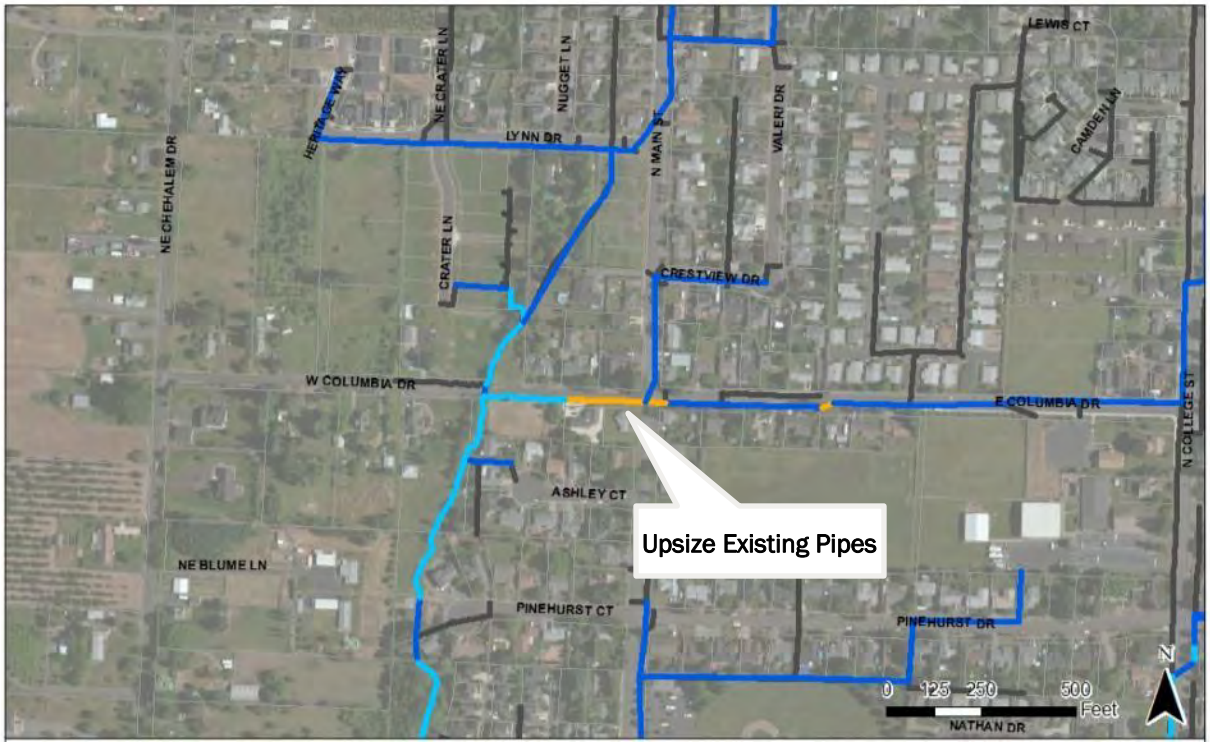
Capital Project Implementation Cost Total	$ 1,404,100
Existing to Future % Flow Increase[1]	5%

Design Assumptions

Existing pipes on private property must be property abandon to maintain long term structural integrity.

Obtain an easement in the location of the existing pipe, which runs under a driveway on a flag lot.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*



Project Name	C-3: E Columbia Dr Improvements
Drainage	Chehalem Creek
Contributing Drainage Area	56.7 acres
Associated Modeled Pipes/Conduits	STGM4199 to J4362
Objective(s) Addressed	Flood Control

Project Description

Flow is currently limited by three undersized 18" pipes which restrict flow from larger-diameter upstream pipes. This has been a maintenance concern for some time. Hydraulic modeling shows overflow from manholes during the 10-year existing/future flow event. Downstream pipe segments are 24" diameter and have capacity for current and future 10-year flow events.

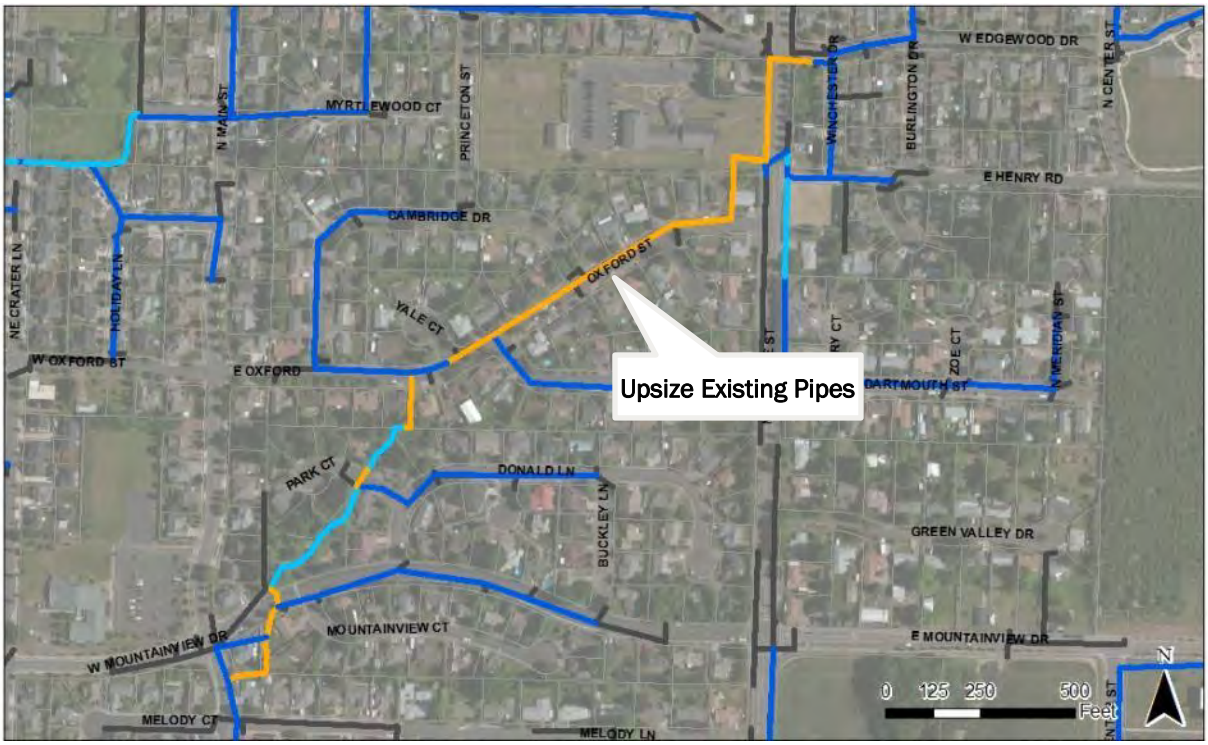
Upsize existing stormwater pipes to 24" to convey existing and future flows.

Estimated Planning Cost (2014 dollars, rounded to the thousand)

Capital Expense Sub-total (See Appendix E for details)	$ 38,600
Mobilization/Demobilization (10%)	$ 3,900
Traffic Control/Utility Relocation (5%)	$ 1,900
Erosion Control (2%)	$ 800
Construction Cost Sub-total	$ 45,200
Construction Contingency (30%)	$ 13,500
Capital Expense Total	$ 58,700
Engineering and Permitting (30%)	$ 17,600
Construction Administration (5%)	$ 2,900
Capital Project Implementation Cost Total	**$ 79,300**
Existing to Future % Flow Increase[1]	**15%**

Design Assumptions

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*



Project Name	C-4: Oxford St Improvements
Drainage	Chehalem Creek
Contributing Drainage Area	167.4 acres
Associated Modeled Pipes/Conduits	STGM276 to J4162
Objective(s) Addressed	Flood Control

Project Description

Flow is currently restricted by fourteen undersized pipes. Flooding from manholes is shown to occur during the 10-year existing/future flow event. Pipe diameters increase and decrease in numerous places throughout this alignment. The City has installed an orifice plate which forces flows into a detention basin at Winchester and Edgewood. This project provides a wider solution to provide long term capacity.

Upsize existing stormwater pipes to 36" to provide capacity for future flows. Utilize existing structures where possible.

Estimated Planning Cost (2014 dollars, rounded to the thousand)

Capital Expense Sub-total (See Appendix E for details)	$ 574,400
Mobilization/Demobilization (10%)	$ 57,400
Traffic Control/Utility Relocation (5%)	$ 28,700
Erosion Control (2%)	$ 11,500
Construction Cost Sub-total	$ 672,100
Construction Contingency (30%)	$ 201,600
Capital Expense Total	$ 873,700
Engineering and Permitting (20%)	$ 174,700
Construction Administration (5%)	$ 43,700
Capital Project Implementation Cost Total	**$ 1,092,100**
Existing to Future % Flow Increase[1]	5%

Design Assumptions

The culvert at E Mountainview Drive has limited pipe cover – alternate pipe materials or roadway surfacing may need to be considered during project design.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*

Project Name	C-5: N College St Improvements
Drainage	Chehalem Creek
Contributing Drainage Area	102.8 acres
Associated Modeled Pipes/Conduits	STGM4127 to STMG0727
Objective(s) Addressed	Flood Control

Project Description

Flow is currently restricted by four undersized pipes during the current and future conditions 10-year storm events.

Upsize existing stormwater pipes to 24" to convey existing and future flows.

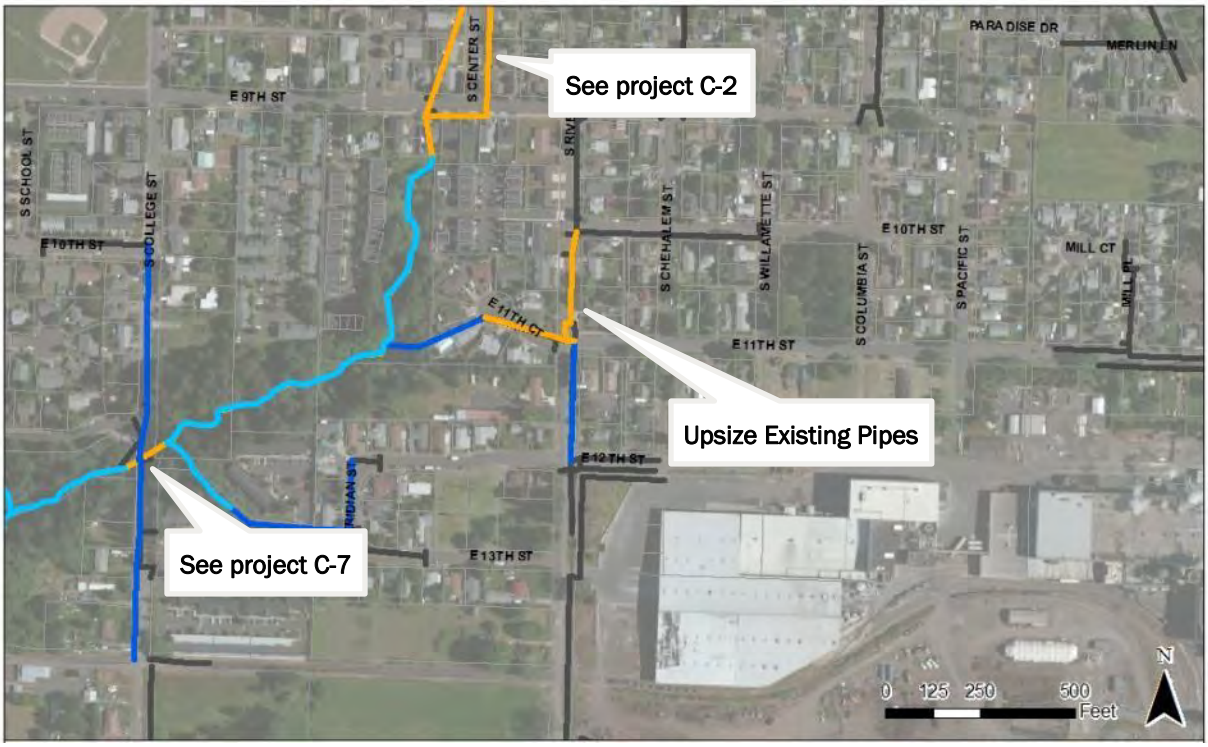
Estimated Planning Cost (2014 dollars, rounded to the thousand)

Capital Expense Sub-total (See Appendix E for details)	$ 136,500
Mobilization/Demobilization (10%)	$ 13,700
Traffic Control/Utility Relocation (5%)	$ 6,800
Erosion Control (2%)	$ 2,700
Construction Cost Sub-total	$ 159,700
Construction Contingency (30%)	$ 47,900
Capital Expense Total	$ 207,600
Engineering and Permitting (20%)	$ 41,500
Construction Administration (5%)	$ 10,400
Capital Project Implementation Cost Total	**$ 259,500**
Existing to Future % Flow Increase[1]	**10%**

Design Assumptions

Utilize existing structures wherever possible.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*



Project Name	C-6: S River St Improvements
Drainage	Chehalem Creek
Contributing Drainage Area	27.0 acres
Associated Modeled Pipes/Conduits	CIP_C-7_01 to STMG136
Objective(s) Addressed	Pipe Replacement - Material

Project Description

Carry-over project from the 2001 Stormwater Master Plan.

Two clay sewer tile pipe segments will be replaced with 18" pipe to convey existing and future flows.

Estimated Planning Cost (2014 dollars, rounded to the thousand)

Capital Expense Sub-total (See Appendix E for details)	$ 77,900
Mobilization/Demobilization (10%)	$ 7,800
Traffic Control/Utility Relocation (5%)	$ 3,900
Erosion Control (2%)	$ 1,600
Construction Cost Sub-total	$ 91,100
Construction Contingency (30%)	$ 27,300
Capital Expense Total	$ 118,500
Engineering and Permitting (20%)	$ 35,500
Construction Administration (5%)	$ 5,900
Capital Project Implementation Cost Total	**$ 159,900**
Existing to Future % Flow Increase[1]	**5%**

Design Assumptions

Utilize existing structures wherever possible.

Project is adjacent to the Hwy 99 Bypass alignment. This project could be addressed during the bypass construction.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*

Project Name	C-7: S College St at Andrew St Improvements
Drainage	Chehalem Creek
Contributing Drainage Area	171.5 acres
Associated Modeled Pipes/Conduits	STGM2909 to J-CCT1-04
Objective(s) Addressed	Pipe Replacement - Material

Project Description

Existing pipe system under S College Street is composed of multiple pipe materials, causing maintenance problems and concerns over long term stability.

Replace two existing culverts with 130 LF of 48" culvert.

Estimated Planning Cost (2014 dollars, rounded to the thousand)

Capital Expense Sub-total (See Appendix E for details)	$ 99,000
Mobilization/Demobilization (10%)	$ 9,900
Traffic Control/Utility Relocation (10%)	$ 9,900
Erosion Control (2%)	$ 2,000
Construction Cost Sub-total	$ 120,700
Construction Contingency (30%)	$ 36,200
Capital Expense Total	$ 157,000
Engineering and Permitting (20%)	$ 31,400
Construction Administration (5%)	$ 7,800
Capital Project Implementation Cost Total	**$ 196,200**
Existing to Future % Flow Increase[1]	5%

Design Assumptions

Culvert replacement has the potential for significant roadway impacts during construction. A well-designed traffic control plan will be required.

Additional engineering costs have been added to allow design to consider additional alternatives (e.g. pipe busting, open bottom culvert, etc)

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*

Project Name	C-8: Dayton Ave Green Street Conveyance
Drainage	Chehalem Creek
Contributing Drainage Area	13.4 acres
Associated Modeled Pipes/Conduits	N/A
Objective(s) Addressed	Water Quality; Flood Control

Project Description

The City has reported drainage problems along Dayton Ave near W Johanna Ct. The resident at 606 NE Dayton Ave has reported frequent flooding of their driveway.

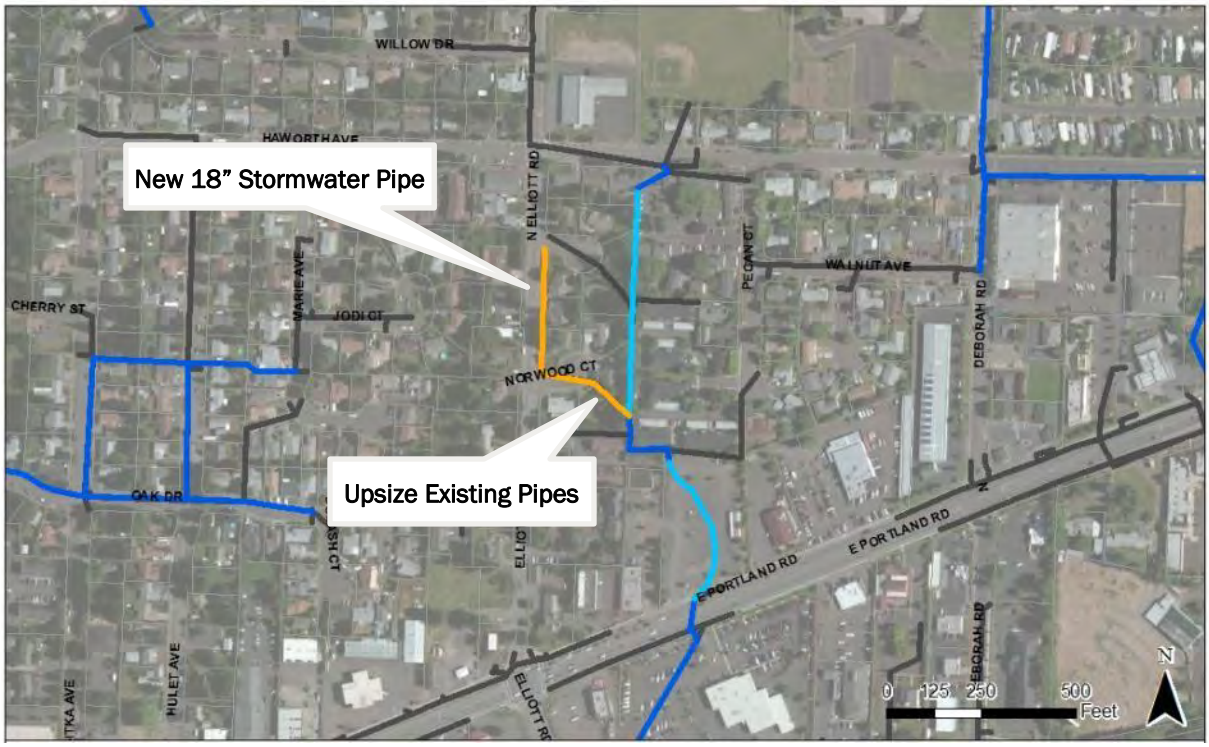
Add six stormwater planters (Low Impact Development/Green Stormwater Infrastructure Design) along Dayton Ave to provide storage capacity and water quality improvements.

Estimated Planning Cost (2014 dollars, rounded to the thousand)

Capital Expense Sub-total (See Appendix E for details)	$ 65,700
Mobilization/Demobilization (10%)	$ 6,600
Traffic Control/Utility Relocation (10%)	$ 3,300
Erosion Control (2%)	$ 1,300
Construction Cost Sub-total	$ 76,900
Construction Contingency (30%)	$ 23,100
Capital Expense Total	$ 99,900
Engineering and Permitting (20%)	$ 20,000
Construction Administration (5%)	$ 5,000
Capital Project Implementation Cost Total	**$ 124,900**
Existing to Future % Flow Increase[1]	**0%**

Design Assumptions

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*



Project Name	H-1: N Elliot Rd Improvements
Drainage	Hess Creek
Contributing Drainage Area	17.8 acres
Associated Modeled Pipes/Conduits	Drains to STMI1140
Objective(s) Addressed	Improve Drainage Infrastructure Network

Project Description

The City has reported drainage problems along N Elliot Rd as the area does not have a public drainage system, resulting in frequent ponding during storm events.

Add a drainage system to convey flows from N Elliot Rd to the existing system to the east. The proposed pipe system is sized to convey both current and future flows.

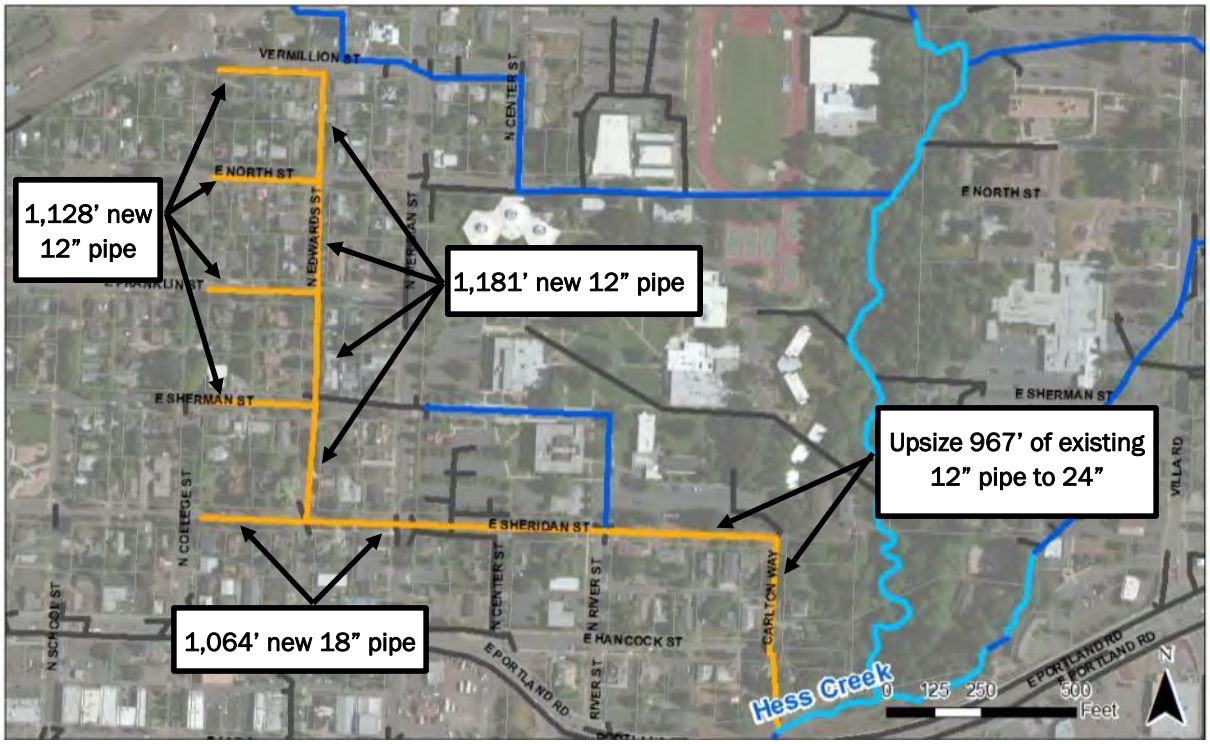
Estimated Planning Cost (2014 dollars, rounded to the hundred)

Capital Expense Sub-total (See Appendix F for details)	$ 125,900
Mobilization/Demobilization (10%)	$ 12,600
Traffic Control/Utility Relocation (5%)	$ 6,300
Erosion Control (2%)	$ 2,500
Construction Cost Sub-total	$ 147,300
Construction Contingency (30%)	$ 44,200
Capital Expense Total	$ 191,500
Engineering and Permitting (20%)	$ 38,300
Construction Administration (5%)	$ 9,600
Capital Project Implementation Cost Total	**$ 239,400**
Existing to Future % Flow Increase[1]	**5%**

Design Assumptions

Utilize the easement south of Norwood Ct to connect to the existing stormwater system.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*



Project Name	H-2: N Edwards St Improvements
Drainage	Hess Creek
Contributing Drainage Area	38.0 acres
Associated Modeled Pipes/Conduits	Drains to STMG1228
Objective(s) Addressed	Flood control; Improve Drainage Infrastructure Network

Project Description

The City has reported drainage problems along Vermillion St between N College St and the railroad. Currently a flat and undersized pipe discharges stormwater along the railroad tracks. This neighborhood has some bubblers at intersections, but does not have a defined connection to the public stormwater system.

Add a drainage system to convey flows from Vermillion St to the existing drainage system at E Sheridan St. Proposed pipes are sized to convey both current and future flows.

Estimated Planning Cost (2014 dollars, rounded to the hundred)

Capital Expense Sub-total (See Appendix F for details)	$ 640,100
Mobilization/Demobilization (10%)	$ 64,000
Traffic Control/Utility Relocation (5%)	$ 32,000
Erosion Control (2%)	$ 12,800
Construction Cost Sub-total	$ 748,900
Construction Contingency (30%)	$ 224,700
Capital Expense Total	$ 973,600
Engineering and Permitting (20%)	$ 194,700
Construction Administration (5%)	$ 48,700
Capital Project Implementation Cost Total	**$ 1,217,000**
Existing to Future % Flow Increase[1]	0%

Design Assumptions

The City has an additional maintenance project to address local drainage and pave gravel areas on Vermillion Street, west of College Street. Flow through planters could be added as a water quality retrofit to the area.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*

Project Name	H-3: E 3rd St Improvements
Drainage	Hess Creek
Contributing Drainage Area	40.7 acres
Associated Modeled Pipes/Conduits	STGM3290 and STGM3810 to Hess Creek Confluence
Objective(s) Addressed	Flood Control

Project Description

Modeling shows flooding problems along E 3rd St and S Church St during the current and future conditions 10-year storm events.

Due to project size, this CIP has been sub-divided into several projects.

Survey and Design **$ 142,000**

H-3.A S Church St and E 1st St Improvements **$ 403,600**

G. Upsize existing stormwater pipes to 30" and 18", as determined by modeling. Install stormwater planters (Low Impact Development/Green Stormwater Infrastructure Design) along E 1st St to provide additional storage capacity and water quality improvements.

H-3.B E 3rd St Improvements **$ 341,100**

H. Add a 24" stormwater pipe to connect the stormwater system from E 3rd St to S Church St to provide conveyance and storage. Upsize existing stormwater pipes to 24" and 18", as determined by modeling.

See the detailed cost estimate in tables: Survey and Design Cost, H-3.A, and H-3.B.

Capital Project Implementation Cost Total	$ 886,700
Existing to Future % Flow Increase[1]	5%

Design Assumptions/Notes

E 1st St already has a sewer project that is ready for construction. The City could look at adding stormwater pipe and/or water quality swales at the same time.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*

Project Name	H-4: Villa Rd Improvements
Drainage	Hess Creek
Contributing Drainage Area	1,174.4 acres
Associated Modeled Pipes/Conduits	VILLA_CULVERT_1
Objective(s) Addressed	Pipe Replacement – Material; Flood Control

Project Description

The culvert on Hess Creek at Villa road is a mix of CMP and concrete box culverts. This is an area of maintenance attention during large storm events to prevent flood waters from impeding traffic on Villa Road.

The existing culvert will be upsized from a 30" to a 60" culvert to convey current and future flows.

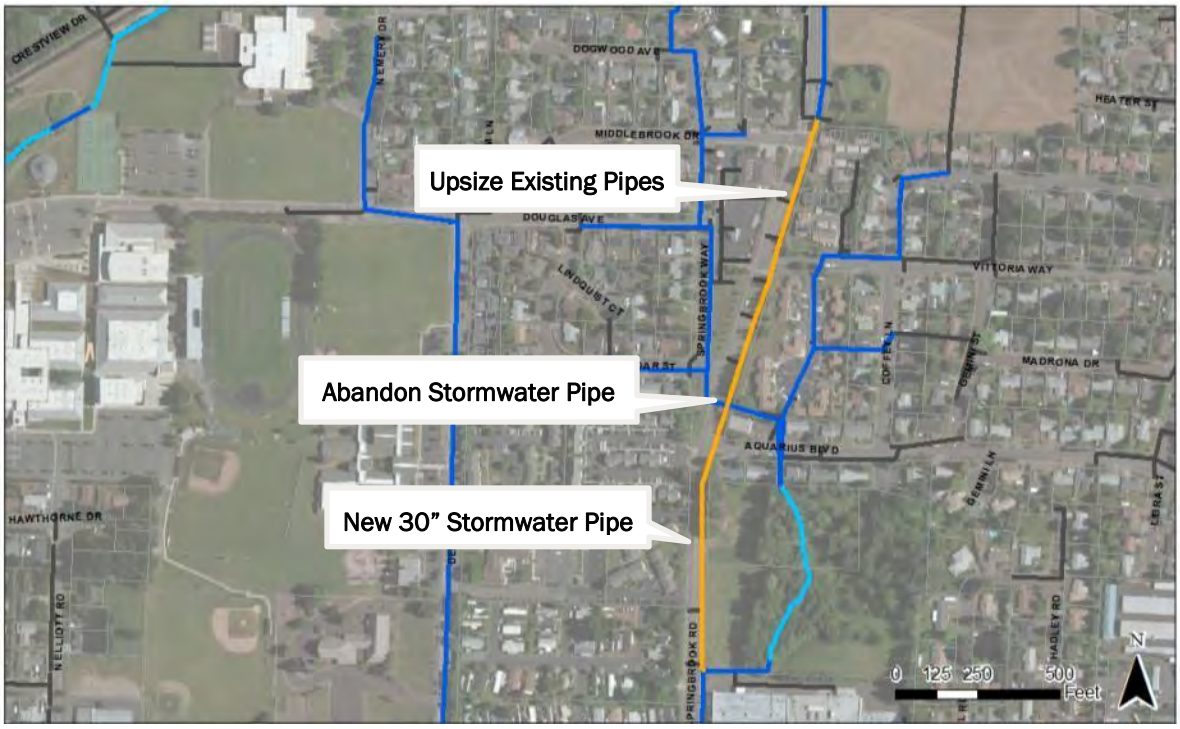
Estimated Planning Cost (2014 dollars, rounded to the thousand)

Capital Expense Sub-total (See Appendix E for details)	$ 51,300
Mobilization/Demobilization (10%)	$ 5,100
Traffic Control/Utility Relocation (5%)	$ 2,600
Erosion Control (2%)	$ 2,600
Construction Cost Sub-total	$ 61,500
Construction Contingency (30%)	$ 18,500
Capital Expense Total	$ 80,000
Engineering and Permitting (30%)	$ 20,000
Construction Administration (5%)	$ 4,000
Capital Project Implementation Cost Total	**$ 103,900**
Existing to Future % Flow Increase[1]	**25%**

Design Assumptions/Notes

This project should be constructed in conjunction with Villa Road widening and roadway improvements.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*



Project Name	S-1: N Springbrook Rd Improvements
Drainage	Spring Brook
Contributing Drainage Area	55.9 acres
Associated Modeled Pipes/Conduits	STGM72 to STMI1019
Objective(s) Addressed	Flood Control

Project Description

Modeling shows flooding problems along N Springbrook Rd during the current and future conditions 10-year storm event. The upstream stormwater system along N Springbrook Rd was upgraded during installation of traffic improvements, but flows are constricted from a 30" pipe down to an 8"-12" section of pipe near Middlebrook Dr.

Upsize the stormwater pipes along N Springbrook Rd to 30" diameter and connect the system to the existing system to the south. The proposed pipe system is sized for both current and future flows.

Estimated Planning Cost (2014 dollars, rounded to the thousand)

Capital Expense Sub-total (See Appendix E for details)	$ 408,500
Mobilization/Demobilization (10%)	$ 40,800
Traffic Control/Utility Relocation (0%)	$ 20,400
Erosion Control (10%)	$ 8,200
Construction Cost Sub-total	$ 477,900
Construction Contingency (30%)	$ 143,400
Capital Expense Total	$ 621,300
Engineering and Permitting (30%)	$ 124,300
Construction Administration (5%)	$ 31,100
Capital Project Implementation Cost Total	**$ 776,600**
Existing to Future % Flow Increase[1]	**10%**

Design Assumptions/Notes

The flow from the undeveloped area east of N Springbrook Rd (N and S of E Crestview Dr) will flow to the stormwater drainage system that runs along N Springbrook Rd. The cost of installing drainage infrastructure through future development areas is not included in this CIP, though the proposed system has been sized with capacity for flows from future development areas.

The Osten property needs to connect to the Springbrook system when it is developed.

The associated 10- and 50-yr maximum flows at STMI1019 are 47.4 and 59.1 cfs, respectively.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*

Project Name	S-2: Libra St Improvements
Drainage	Spring Brook
Contributing Drainage Area	14.4 acres
Associated Modeled Pipes/Conduits	STGM876 to STMJ105
Objective(s) Addressed	Flood Control; Reduce Maintenance Frequency

Project Description

Modeling shows flooding problems along Libra St during the current and future conditions 10-year storm event. This system needs frequent maintenance to address silt accumulation.

Upsize existing stormwater pipes along Libra St to 18" to convey current and future flows.

Estimated Planning Cost (2014 dollars, rounded to the thousand)

Capital Expense Sub-total (See Appendix E for details)	$ 129,700
Mobilization/Demobilization (10%)	$ 13,000
Traffic Control/Utility Relocation (5%)	$ 6,500
Erosion Control (2%)	$ 2,600
Construction Cost Sub-total	$ 151,700
Construction Contingency (30%)	$ 45,500
Capital Expense Total	$ 197,200
Engineering and Permitting (20%)	$ 39,400
Construction Administration (5%)	$ 9,900
Capital Project Implementation Cost Total	**$ 246,500**
Existing to Future % Flow Increase[1]	**20%**

Design Assumptions/Notes

The flow from the undeveloped area east of N Springbrook Rd (N and S of E Crestview Dr) should be directed to the stormwater drainage system that runs along N Springbrook Rd. The cost to install infrastructure in areas to be developed in the future is not included in this CIP, as pipes in those areas will be a developer responsibility.

The associated 10- and 50-yr maximum flows at STMJ105 are 17.0 and 23.3 cfs, respectively.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*

West Bank Chehalem Creek
Streambank Erosion

Hess Creek (DS of Mountainview Drive)
Residential Stormwater Outfall

Corrine Tributary to Hess Creek
Detention Pond Outfall Retrofit

Project Name	A-1: Streambank Protection Improvements
Drainage	Hess Creek, Chehalem Creek, and Spring Brook
Contributing Drainage Area	N/A
Associated Modeled Pipes/Conduits	N/A
Objective(s) Addressed	Water Quality, Stream Restoration

Project Description

The stream channel assessment identified problem areas in the creek where erosion was significant.

A. West Bank Chehalem Creek (Upstream of Hwy 240)
   - This project addresses stream bank protection and riparian restoration and landscaping along the west bank of Chehalem Creek.

B. Hess Creek (Downstream of Mountainview Drive)
   - This project addresses an outfall improvement, stream bank protection, and riparian restoration and landscaping along Hess Creek.

C. Corinne Tributary to Hess Creek
   - This project addresses an outfall improvement, stream bank protection, and riparian restoration and landscaping at the detention pond outfall along Corinne Tributary.

D. Two Additional Outfall Protection and Bank Restoration Projects
   - This cost accounts for two additional outfall protection and bank restoration projects. The locations are to be determined upon City field investigation.

Estimated Planning Cost (2014 dollars, rounded to the thousand)

Capital Expense Sub-total (See Appendix E for details)	$ 100,000
Mobilization/Demobilization (10%)	$ 10,000
Traffic Control/Utility Relocation (5%)	$ 5,000
Erosion Control (2%)	$ 2,000
Construction Cost Sub-total	$ 117,000
Construction Contingency (30%)	$ 35,100
Capital Expense Total	$ 152,100
Engineering and Permitting (20%)	$ 30,400
Construction Administration (5%)	$ 7,600
Capital Project Implementation Cost Total	**$190,100**
Existing to Future % Flow Increase[1]	**N/A**

Design Assumptions/Notes: Additional project locations to be determined through stream channel observations.

[1] *Existing to future percent flow increase is based on the 25-year percent peak flow increase from the contributing drainage area between the existing and future land use scenarios for each CIP.*

CIP Cost Summary

CIP Number	CIP Name (Capital Projects)	Total Cost
C-1	Blaine St Improvements - Design	$ 180,000
C-1A	99W to 2nd St Parking Lot Pipe Decommissioning/Replacement	$ 131,000
C-1B	S Blaine St Pipe Replacement	$ 384,000
C-1C	E 2nd St to E 5th St Pipe Decommissioning/Replacement	$ 291,000
C-1D	E 6th St and S Blaine St Pipe Replacement	$ 176,000
C-2	S Center St Improvements - Design	$ 180,000
C-2A	E 9th St to S Center St Pipe Decommissioning	$ 294,000
C-2B	S Center St, E 8th St, and E 7th St Pipe Replacement	$ 930,000
C-3	E Columbia Dr Improvements	$ 79,000
C-4	Oxford St Improvements	$ 1,092,000
C-5	N College St Improvements	$ 260,000
C-6	S River St Improvements	$ 160,000
C-7	S College St at Andrew St Improvements	$ 196,000
H-1	N Elliot Rd Improvements	$ 239,000
H-2	N Edwards St Improvements	$ 1,217,000
H-3	E 3rd St Improvements - Design	$ 142,000
H-3A	S Church St and E 1st St Improvements	$ 404,000
H-3B	E 3rd St Improvements	$ 341,000
H-4	Villa Rd Improvements	$ 104,000
S-1	N Springbrook Rd Improvements	$ 777,000
S-2	Streambank Protection Projects	$ 246,000
A-1	Streambank Protection Projects	$ 190,000
TOTAL		**$ 8,013,000**

CIP Number	CIP Name (Programatic CIP)	Total Cost
P-1	Annual Pipe Replacement Program	$ 100,000
P-2	Water Quality Retrofit Program	$ 50,000
P-3	Water Quality Sensitive O&M Manual	$ 25,000
P-4	SDC Rate Study Revision	$ 15,000
P-5	Master Plan update	$ 250,000
TOTAL		**$ 440,000**

Preliminary Engineering Unit Costs

Storm Drain Pipe Installation Cost (w/ Asphalt) per Linear Foot																
Cover Depth (feet)	Diameter (inches)															
	12	12-RCP	15	18	18-RCP	24	24-RCP	30	30-RCP	36	36-RCP	42	42-RCP	48	48-RCP	54
2-5	$ 63	$ 78	$ 77	$ 96	$ 112	$ 124	$ 152	$ 159	$ 233	$ 194	$ 294	$ 233	$ 317	$ 269	$ 371	$ 343
5-10	$ 87	$ 102	$ 106	$ 130	$ 146	$ 169	$ 197	$ 213	$ 288	$ 259	$ 359	$ 308	$ 392	$ 354	$ 456	$ 438
10-15	$ 111	$ 126	$ 135	$ 164	$ 180	$ 213	$ 241	$ 268	$ 343	$ 324	$ 424	$ 383	$ 467	$ 440	$ 541	$ 534
15-20	$ 134	$ 150	$ 164	$ 198	$ 214	$ 257	$ 285	$ 322	$ 397	$ 388	$ 488	$ 458	$ 542	$ 525	$ 627	$ 629

City of Newberg - Stormwater Master Plan
Capital Improvement Project
Preliminary Engineering Unit Costs

ITEM	UNIT	UNIT COST
Water Quality Facility Installation		
Stormwater Planter	SF	$37
Structure Installation		
Precast Concrete Manhole (48", 0-8' deep)	EA	$3,000
Precast Concrete Manhole (48", 9-12' deep)	EA	$4,400
Precast Concrete Manhole (60", 0-8' deep)	EA	$4,300
Precast Concrete Manhole (60", 9-12' deep)	EA	$7,700
Precast Concrete Manhole (72", 0-8' deep)	EA	$6,000
Precast Concrete Manhole (72", 9-12' deep)	EA	$11,100
Curb Inlet	EA	$1,700
Catch Basin	EA	$2,000
Connection to Existing Structure	EA	$900
Abandon Existing Structure	EA	$400
Abandon Existing Pipe, no excavation (12")	FT	$8.00
Abandon Existing Pipe, no excavation (15-18")	FT	$18.00
Abandon Existing Pipe, no excavation (21"-24")	FT	$23.00
Abandon Existing Pipe, no excavation (27"-36")	FT	$30.00
Outfall Improvements	EA	$5,000
Pipe Unit Cost		
HDPE Inlet Lead (12", 2-5' Deep)	FT	$63
HDPE Pipeline (12", 5-10' Deep)	FT	$87
HDPE Pipeline (12", 10-15' Deep)	FT	$111
HDPE Pipeline (15", 5-10' Deep)	FT	$106
HDPE Pipeline (15", 10-15' Deep)	FT	$135
HDPE Pipeline (18", 5-10' Deep)	FT	$130
HDPE Pipeline (18", 10-15' Deep)	FT	$164
HDPE Pipeline (24", 5-10' Deep)	FT	$169
HDPE Pipeline (24", 10-15' Deep)	FT	$213
HDPE Pipeline (30", 5-10' Deep)	FT	$213
HDPE Pipeline (30", 10-15' Deep)	FT	$268
HDPE Pipeline (36", 5-10' Deep)	FT	$259
HDPE Pipeline (36", 10-15' Deep)	FT	$324
HDPE Pipeline (48", 5-10' Deep)	FT	$354
HDPE Pipeline (60", 5-10' Deep)	FT	$509
RCP Pipeline (84", 5-10' Deep)	FT	$937
RCP Pipeline (96", 5-10' Deep)	FT	$1,115
Project Totals		
Project Sub-Total		
Mobilization/Demobilization (%)	LS	10%
Traffic Control/Utility Relocation (%)	LS	Varies by project (5-10%)
Erosion Control (%)	LS	2%
Construction Contingency (%)	LS	30%
Construction Cost Estimate		
Engineering and Permitting (%) *	LS	Varies by project (20-40%)
Construction Administration (%)	LS	5%
Total Project Engineering and Construction Cost		

* Engineering and permitting costs will be documented in each project's write-up.

Survey and Design Costs				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Projects				
C-1: Blaine St Improvements	1	EA	$ 180,000	$ 180,000
C-2: S Center St Improvements	1	EA	$ 180,000	$ 180,000
H-3: E 3rd St Improvements	1	EA	$ 142,000	$ 142,000
Major Survey and Design Cost				**$ 502,000**

CIP C-1.A: 99W to 2nd St Parking Lot Pipe Decommissioning/Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (12", 5-10' Deep)	443	FT	$ 87	$ 38,437
Abandon Existing Pipe, no excavation (12")	866	FT	$ 8	$ 6,928
Precast Concrete Manhole (48", 9-12' deep)	3	EA	$ 4,400	$ 13,200
HDPE Inlet Lead (12", 2-5' Deep)	120	FT	$ 63	$ 7,548
Catch Basin	8	EA	$ 2,000	$ 16,000
Capital Expense Sub-Total				$ 82,113
Mobilization/Demobilization	10%	LS		$ 8,211
Traffic Control/Utility Relocation	5%	LS		$ 4,106
Erosion Control	2%	LS		$ 1,642
Construction Cost Sub-Total				$ 96,072
Construction Contingency	30%	LS		$ 28,822
Capital Expense Total				$ 124,894
Administrative Expenses				
Engineering and Permitting*	-	LS		-
Construction & General Administration	5%	LS		$ 6,245
Administrative Expense Total				$ 6,245
Capital Implementation Cost Total				**$ 131,138**

CIP C-1.B: S Blaine St Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (30", 5-10' Deep)	931	FT	$ 213	$ 198,438
Precast Concrete Manhole (48", 9-12' deep)	3	EA	$ 4,400	$ 13,200
HDPE Inlet Lead (12", 2-5' Deep)	120	FT	$ 63	$ 7,548
Catch Basin	8	EA	$ 2,000	$ 16,000
Outfall Improvements	1	EA	$ 5,000	$ 5,000
Capital Expense Sub-Total				$ 240,187
Mobilization/Demobilization	10%	LS		$ 24,019
Traffic Control/Utility Relocation	5%	LS		$ 12,009
Erosion Control	2%	LS		$ 4,804
Construction Cost Sub-Total				$ 281,018
Construction Contingency	30%	LS		$ 84,305
Capital Expense Total				$ 365,324
Administrative Expenses				
Engineering and Permitting*	-	LS		-
Construction & General Administration	5%	LS		$ 18,266
Administrative Expense Total				$ 18,266
Capital Implementation Cost Total				**$ 383,590**

CIP C-1.C: E 2nd St to E 5th St Pipe Decommissioning/Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (18", 10-15' Deep)	224	FT	$ 164	$ 36,745
HDPE Pipeline (24", 5-10' Deep)	602	FT	$ 169	$ 101,499
Abandon Existing Pipe, no excavation (12")	792	FT	$ 8	$ 6,336
Abandon Existing Pipe, no excavation (15-18")	717	FT	$ 18	$ 12,906
Abandon Existing Structure	2	EA	$ 400	$ 800
Precast Concrete Manhole (48", 0-8' deep)	2	EA	$ 3,000	$ 6,000
HDPE Inlet Lead (12", 2-5' Deep)	90	FT	$ 63	$ 5,661
Catch Basin	6	EA	$ 2,000	$ 12,000
Capital Expense Sub-Total				$ 181,947
Mobilization/Demobilization	10%	LS		$ 18,195
Traffic Control/Utility Relocation	5%	LS		$ 9,097
Erosion Control	2%	LS		$ 3,639
Construction Cost Sub-Total				$ 212,878
Construction Contingency	30%	LS		$ 63,863
Capital Expense Total				$ 276,741
Administrative Expenses				
Engineering and Permitting*	-	LS		-
Construction & General Administration	5%	LS		$ 13,837
Administrative Expense Total				$ 13,837
Capital Implementation Cost Total				**$ 290,578**

CIP C-1.D: E 6th St and S Blaine St Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (18", 5-10' Deep)	687	FT	$ 130	$ 89,273
Precast Concrete Manhole (48", 0-8' deep)	3	EA	$ 3,000	$ 9,000
HDPE Inlet Lead (12", 2-5' Deep)	60	FT	$ 63	$ 3,774
Catch Basin	4	EA	$ 2,000	$ 8,000
Capital Expense Sub-Total				$ 110,047
Mobilization/Demobilization	10%	LS		$ 11,005
Traffic Control/Utility Relocation	5%	LS		$ 5,502
Erosion Control	2%	LS		$ 2,201
Construction Cost Sub-Total				$ 128,755
Construction Contingency	30%	LS		$ 38,627
Capital Expense Total				$ 167,382
Administrative Expenses				
Engineering and Permitting*	-	LS		-
Construction & General Administration	5%	LS		$ 8,369
Administrative Expense Total				$ 8,369
Capital Implementation Cost Total				**$ 175,751**

CIP C-2.A: E 9th St to S Center St Pipe Decommissioning				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (30", 5-10' Deep)	516	FT	$ 213	$ 109,983
HDPE Pipeline (36", 10-15' Deep)	112	FT	$ 324	$ 36,253
Abandon Existing Pipe, no excavation (12")	143	FT	$ 8	$ 1,144
Abandon Existing Pipe, no excavation (21"-24")	360	FT	$ 23	$ 8,280
Abandon Existing Structure	2	EA	$ 400	$ 800
Precast Concrete Manhole (48", 9-12' deep)	2	EA	$ 4,400	$ 8,800
Precast Concrete Manhole (60", 9-12' deep)	1	EA	$ 7,700	$ 7,700
HDPE Inlet Lead (12", 2-5' Deep)	30	FT	$ 63	$ 1,887
Catch Basin	2	EA	$ 2,000	$ 4,000
Outfall Improvements	1	EA	$ 5,000	$ 5,000
Capital Expense Sub-Total				$ 183,847
Mobilization/Demobilization	10%	LS		$ 18,385
Traffic Control/Utility Relocation	5%	LS		$ 9,192
Erosion Control	2%	LS		$ 3,677
Construction Cost Sub-Total				$ 215,101
Construction Contingency	30%	LS		$ 64,530
Capital Expense Total				$ 279,632
Administrative Expenses				
Engineering and Permitting*	-	LS		-
Construction & General Administration	5%	LS		$ 13,982
Administrative Expense Total				$ 13,982
Capital Implementation Cost Total				**$ 293,613**

CIP C-2.B: S Center St, E 8th St, and E 7th St Pipe Replacement				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (18", 5-10' Deep)	803	FT	$ 130	$ 104,347
HDPE Pipeline (24", 5-10' Deep)	1,759	FT	$ 169	$ 296,571
HDPE Pipeline (30", 5-10' Deep)	670	FT	$ 213	$ 142,807
Precast Concrete Manhole (48", 0-8' deep)	11	EA	$ 3,000	$ 33,000
HDPE Inlet Lead (12", 2-5' Deep)	30	FT	$ 63	$ 1,887
Catch Basin	2	EA	$ 2,000	$ 4,000
Capital Expense Sub-Total				$ 582,612
Mobilization/Demobilization	10%	LS		$ 58,261
Traffic Control/Utility Relocation	5%	LS		$ 29,131
Erosion Control	2%	LS		$ 11,652
Construction Cost Sub-Total				$ 681,657
Construction Contingency	30%	LS		$ 204,497
Capital Expense Total				$ 886,154
Administrative Expenses				
Engineering and Permitting*	-	LS		-
Construction & General Administration	5%	LS		$ 44,308
Administrative Expense Total				$ 44,308
Capital Implementation Cost Total				**$ 930,461**

CIP C-3: E Columbia Dr Improvements				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (24", 5-10' Deep)	81	FT	$ 169	$ 13,657
HDPE Pipeline (24", 10-15' Deep)	11	FT	$ 213	$ 2,342
Precast Concrete Manhole (48", 9-12' deep)	4	EA	$ 4,400	$ 17,600
Outfall Improvements	1	EA	$ 5,000	$ 5,000
Capital Expense Sub-Total				$ 38,599
Mobilization/Demobilization	10%	LS		$ 3,860
Traffic Control/Utility Relocation	5%	LS		$ 1,930
Erosion Control	2%	LS		$ 772
Construction Cost Sub-Total				$ 45,161
Construction Contingency	30%	LS		$ 13,548
Capital Expense Total				$ 58,709
Administrative Expenses				
Engineering and Permitting*	30%	LS		$ 17,613
Construction & General Administration	5%	LS		$ 2,935
Administrative Expense Total				$ 20,548
Capital Implementation Cost Total				**$ 79,257**

CIP C-4: Oxford St Improvements				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (36", 5-10' Deep)	1,860	FT	$ 259	$ 481,555
Precast Concrete Manhole (60", 0-8' deep)	10	EA	$ 4,300	$ 43,000
Precast Concrete Manhole (60", 9-12' deep)	3	EA	$ 7,700	$ 23,100
HDPE Inlet Lead (12", 2-5' Deep)	60	FT	$ 63	$ 3,774
Catch Basin	4	EA	$ 2,000	$ 8,000
Outfall Improvements	3	EA	$ 5,000	$ 15,000
Capital Expense Sub-Total				$ 574,429
Mobilization/Demobilization	10%	LS		$ 57,443
Traffic Control/Utility Relocation	5%	LS		$ 28,721
Erosion Control	2%	LS		$ 11,489
Construction Cost Sub-Total				$ 672,082
Construction Contingency	30%	LS		$ 201,625
Capital Expense Total				$ 873,707
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 174,741
Construction & General Administration	5%	LS		$ 43,685
Administrative Expense Total				$ 218,427
Capital Implementation Cost Total				**$ 1,092,133**

CIP C-5: N College St Improvements				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (24", 5-10' Deep)	691	FT	$ 169	$ 116,504
Precast Concrete Manhole (48", 0-8' deep)	5	EA	$ 3,000	$ 15,000
Outfall Improvements	1	EA	$ 5,000	$ 5,000
Capital Expense Sub-Total				$ 136,504
Mobilization/Demobilization	10%	LS		$ 13,650
Traffic Control/Utility Relocation	5%	LS		$ 6,825
Erosion Control	2%	LS		$ 2,730
Construction Cost Sub-Total				$ 159,710
Construction Contingency	30%	LS		$ 47,913
Capital Expense Total				$ 207,623
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 41,525
Construction & General Administration	5%	LS		$ 10,381
Administrative Expense Total				$ 51,906
Capital Implementation Cost Total				**$ 259,528**

CIP C-6: S River St Improvements				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (18", 5-10' Deep)	507	FT	$ 130	$ 65,883
Precast Concrete Manhole (48", 0-8' deep)	2	EA	$ 3,000	$ 6,000
Precast Concrete Manhole (48", 0-8' deep)	2	EA	$ 3,000	$ 6,000
Capital Expense Sub-Total				$ 77,883
Mobilization/Demobilization	10%	LS		$ 7,788
Traffic Control/Utility Relocation	5%	LS		$ 3,894
Erosion Control	2%	LS		$ 1,558
Construction Cost Sub-Total				$ 91,123
Construction Contingency	30%	LS		$ 27,337
Capital Expense Total				$ 118,460
Administrative Expenses				
Engineering and Permitting	30%	LS		$ 35,538
Construction & General Administration	5%	LS		$ 5,923
Administrative Expense Total				$ 41,461
Capital Implementation Cost Total				**$ 159,920**

CIP C-7: S College St and Andrew St Improvements				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (48", 5-10' Deep)	260	FT	$ 354	$ 92,163
Connection to Existing Structure	2	EA	$ 900	$ 1,800
Outfall Improvements	1	EA	$ 5,000	$ 5,000
Capital Expense Sub-Total				$ 98,963
Mobilization/Demobilization	10%	LS		$ 9,896
Traffic Control/Utility Relocation	10%	LS		$ 9,896
Erosion Control	2%	LS		$ 1,979
Construction Cost Sub-Total				$ 120,735
Construction Contingency	30%	LS		$ 36,220
Capital Expense Total				$ 156,955
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 31,391
Construction & General Administration	5%	LS		$ 7,848
Administrative Expense Total				$ 39,239
Capital Implementation Cost Total				**$ 196,194**

CIP C-8: Dayton Ave Green Street Improvements				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
Stormwater Planter	1,500	SF	$ 37	$ 55,500
Curb Inlet	6	EA	$ 1,700	$ 10,200
Capital Expense Sub-Total				$ 65,700
Mobilization/Demobilization	10%	LS		$ 6,570
Traffic Control/Utility Relocation	5%	LS		$ 3,285
Erosion Control	2%	LS		$ 1,314
Construction Cost Sub-Total				$ 76,869
Construction Contingency	30%	LS		$ 23,061
Capital Expense Total				$ 99,930
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 19,986
Construction & General Administration	5%	LS		$ 4,996
Administrative Expense Total				$ 24,982
Capital Implementation Cost Total				**$ 124,912**

CIP H-1: N Elliot Rd Improvements				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (18", 5-10' Deep)	757	FT	$ 130	$ 98,369
HDPE Inlet Lead (12", 2-5' Deep)	90	FT	$ 63	$ 5,661
Catch Basin	6	EA	$ 2,000	$ 12,000
Precast Concrete Manhole (48", 0-8' deep)	3	EA	$ 3,000	$ 9,000
Connection to Existing Structure	1	EA	$ 900	$ 900
Capital Expense Sub-Total				$ 125,930
Mobilization/Demobilization	10%	LS		$ 12,593
Traffic Control/Utility Relocation	5%	LS		$ 6,297
Erosion Control	2%	LS		$ 2,519
Construction Cost Sub-Total				$ 147,339
Construction Contingency	30%	LS		$ 44,202
Capital Expense Total				$ 191,540
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 38,308
Construction & General Administration	5%	LS		$ 9,577
Administrative Expense Total				$ 47,885
Capital Implementation Cost Total				**$ 239,425**

CIP H-2: N Edwards St Improvements						
Description	Quantity	Unit	Unit Cost (2014)		2014 Cost	
Capital Expenses						
HDPE Pipeline (12", 5-10' Deep)	2,309	FT	$	87	$	200,339
HDPE Pipeline (18", 5-10' Deep)	1,064	FT	$	130	$	138,263
HDPE Pipeline (24", 5-10' Deep)	755	FT	$	169	$	127,295
HDPE Pipeline (24", 10-15' Deep)	212	FT	$	213	$	45,141
HDPE Inlet Lead (12", 2-5' Deep)	360	FT	$	63	$	22,645
Catch Basin	24	EA	$	2,000	$	48,000
Precast Concrete Manhole (48", 0-8' deep)	9	EA	$	3,000	$	27,000
Precast Concrete Manhole (48", 9-12' deep)	6	EA	$	4,400	$	26,400
Outfall Improvements	1	EA	$	5,000	$	5,000
Capital Expense Sub-Total					$	640,082
Mobilization/Demobilization	10%	LS			$	64,008
Traffic Control/Utility Relocation	5%	LS			$	32,004
Erosion Control	2%	LS			$	12,802
Construction Cost Sub-Total					$	748,896
Construction Contingency	30%	LS			$	224,669
Capital Expense Total					$	973,565
Administrative Expenses						
Engineering and Permitting	20%	LS			$	194,713
Construction & General Administration	5%	LS			$	48,678
Administrative Expense Total					$	243,391
Capital Implementation Cost Total					**$**	**1,216,956**

CIP H-3.A: S Church St and E 1st St Improvements				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (18", 5-10' Deep)	1,249	FT	$ 130	$ 162,303
Stormwater Planter	1,791	SF	$ 37	$ 66,267
HDPE Inlet Lead (12", 2-5' Deep)	60	FT	$ 63	$ 3,774
Catch Basin	4	EA	$ 2,000	$ 8,000
Precast Concrete Manhole (48", 0-8' deep)	1	EA	$ 3,000	$ 3,000
Precast Concrete Manhole (48", 9-12' deep)	1	EA	$ 4,400	$ 4,400
Outfall Improvements	1	EA	$ 5,000	$ 5,000
Capital Expense Sub-Total				$ 252,744
Mobilization/Demobilization	10%	LS		$ 25,274
Traffic Control/Utility Relocation	5%	LS		$ 12,637
Erosion Control	2%	LS		$ 5,055
Construction Cost Sub-Total				$ 295,710
Construction Contingency	30%	LS		$ 88,713
Capital Expense Total				$ 384,423
Administrative Expenses				
Engineering and Permitting*	-	LS		-
Construction & General Administration	5%	LS		$ 19,221
Administrative Expense Total				$ 19,221
Capital Implementation Cost Total				**$ 403,644**

CIP H-3.B: E 3rd St Improvements				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (18", 5-10' Deep)	228	FT	$ 130	$ 29,628
HDPE Pipeline (24", 5-10' Deep)	950	FT	$ 169	$ 160,172
HDPE Inlet Lead (12", 2-5' Deep)	60	FT	$ 63	$ 3,774
Catch Basin	4	EA	$ 2,000	$ 8,000
Precast Concrete Manhole (48", 0-8' deep)	4	EA	$ 3,000	$ 12,000
Capital Expense Sub-Total				$ 213,574
Mobilization/Demobilization	10%	LS		$ 21,357
Traffic Control/Utility Relocation	5%	LS		$ 10,679
Erosion Control	2%	LS		$ 4,271
Construction Cost Sub-Total				$ 249,881
Construction Contingency	30%	LS		$ 74,964
Capital Expense Total				$ 324,846
Administrative Expenses				
Engineering and Permitting*	-	LS		-
Construction & General Administration	5%	LS		$ 16,242
Administrative Expense Total				$ 16,242
Capital Implementation Cost Total				**$ 341,088**

CIP H-4: Villa Rd Improvements				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
60" Diameter Culvert (5-10' Deep)	75	LF	$ 550	$ 41,250
Inlet and Outfall Improvements	1	LS	$ 10,000	$ 10,000
Capital Expense Sub-Total				$ 51,250
Mobilization/Demobilization	10%	LS		$ 5,125
Traffic Control/Utility Relocation	5%	LS		$ 2,563
Erosion Control	5%	LS		$ 2,563
Construction Cost Sub-Total				$ 61,500
Construction Contingency	30%	LS		$ 18,450
Capital Expense Total				$ 79,950
Administrative Expenses				
Engineering and Permitting*	25%	LS		$ 19,987.50
Construction & General Administration	5%	LS		$ 3,998
Administrative Expense Total				$ 23,985
Capital Implementation Cost Total				**$ 103,935**

CIP S-1: N Springbrook Rd Improvements				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (30", 5-10' Deep)	1,735	FT	$ 213	$ 369,807
Abandon Existing Pipe, no excavation (12")	37	FT	$ 8	$ 296
Precast Concrete Manhole (48", 0-8' deep)	3	EA	$ 3,000	$ 9,000
Precast Concrete Manhole (48", 9-12' deep)	4	EA	$ 4,400	$ 17,600
HDPE Inlet Lead (12", 2-5' Deep)	60	FT	$ 63	$ 3,774
Catch Basin	4	EA	$ 2,000	$ 8,000
Capital Expense Sub-Total				$ 408,477
Mobilization/Demobilization	10%	LS		$ 40,848
Traffic Control/Utility Relocation	5%	LS		$ 20,424
Erosion Control	2%	LS		$ 8,170
Construction Cost Sub-Total				$ 477,918
Construction Contingency	30%	LS		$ 143,376
Capital Expense Total				$ 621,294
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 124,259
Construction & General Administration	5%	LS		$ 31,065
Administrative Expense Total				$ 155,323
Capital Implementation Cost Total				**$ 776,617**

CIP S-2: Streambank Protection Projects				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
HDPE Pipeline (18", 5-10' Deep)	804	FT	$ 130	$ 104,477
Precast Concrete Manhole (48", 0-8' deep)	3	EA	$ 3,000	$ 9,000
Precast Concrete Manhole (48", 9-12' deep)	1	EA	$ 4,400	$ 4,400
HDPE Inlet Lead (12", 2-5' Deep)	60	FT	$ 63	$ 3,774
Catch Basin	4	EA	$ 2,000	$ 8,000
Capital Expense Sub-Total				$ 129,651
Mobilization/Demobilization	10%	LS		$ 12,965
Traffic Control/Utility Relocation	5%	LS		$ 6,483
Erosion Control	2%	LS		$ 2,593
Construction Cost Sub-Total				$ 151,691
Construction Contingency	30%	LS		$ 45,507
Capital Expense Total				$ 197,199
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 39,440
Construction & General Administration	5%	LS		$ 9,860
Administrative Expense Total				$ 49,300
Capital Implementation Cost Total				**$ 246,499**

CIP A-1: Streambank Protection Projects				
Description	Quantity	Unit	Unit Cost (2014)	2014 Cost
Capital Expenses				
Outfall Improvements	5	EA	$ 5,000	$ 25,000
Streambank Protection	5	LS	$ 10,000	$ 50,000
Riparian Restoration and Landscaping	5	LS	$ 5,000	$ 25,000
Capital Expense Sub-Total				$ 100,000
Mobilization/Demobilization	10%	LS		$ 10,000
Traffic Control/Utility Relocation	5%	LS		$ 5,000
Erosion Control	2%	LS		$ 2,000
Construction Cost Sub-Total				$ 117,000
Construction Contingency	30%	LS		$ 35,100
Capital Expense Total				$ 152,100
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 30,420
Construction & General Administration	5%	LS		$ 7,605
Administrative Expense Total				$ 38,025
Capital Implementation Cost Total				**$ 190,125**