City of Wilsonville
Stormwater Master Plan

A Commitment to Clean Water and Healthy Watersheds

City of Wilsonville

Prepared by:

URS

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ABBREVIATIONS

BMPs	Best Management Practices
CIP	Capital Improvement Program
CMP	Corrugated Metal Pipe
CN	Curve Number
CREST	Center for Research in Environmental Sciences & Technologies
CWA	Clean Water Act
ESEE	Environmental, Energy, Economic, and Social
FEMA	Federal Emergency Management Agency
FOG	Fats, Oil, and Grease
GIS	Geographic Information Systems
MEP	Maximum Extent Practicable
Metro	Portland Metro Regional Government
MS4	Municipal Separate Storm Sewer System
NFIP	National Flood Insurance Program
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
ODEQ	Oregon Department of Environmental Quality
ODOT	Oregon Department of Transportation
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SROZ	Significant Resource Overlay Zone
SWMP	Stormwater Management Plan
T_c	Time of Concentration
TMDL	Total Maximum Daily Loads
TP	Total Phosphorus
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UGB	Urban Growth Boundary
UIC	Underground Injection Control
U.S. EPA	U.S. Environmental Protection Agency

DEFINITIONS

Benchmark – An estimate of the reduction in pollutant loads for a parameter or surrogate, where applicable, for which a Waste Load Allocation has been established in response to an issued Total Maximum Daily Load. It is used as a goal and a means for measuring the effectiveness of a jurisdiction or facility's stormwater management program.

Catch Basin – A catch basin is a box-shaped receptacle fitted with a grilled inlet and a pipe outlet drain to collect rain water and floating debris from the roadway surface and to retain solid material for periodic removal. Catch basins may be installed horizontally in the roadway surface or imbedded in the curb (curb inlet).

Detention Pond – A detention pond is a facility that is designed to temporarily hold stormwater runoff while slowly draining to an outlet. Detention ponds are a means to reduce downstream flooding by slowing the movement of stormwater to downstream pipes, creeks, and rivers. They have a negligible effect on water quality (compared to dry ponds) because sediments and pollutants do not remain in the ponds long enough to settle out of the stormwater. These facilities are normally dry when it is not raining.

Dry Pond – Dry ponds (also known as dry extended detention basins or ponds) are basins whose outlets are designed to detain the stormwater runoff from a rain event for a minimum duration (e.g., 24 hours) to allow sediment particles and pollutants associated with them to settle out. Water flows more slowly through dry ponds than through detention ponds. Dry ponds do not have a permanent pool of water and are normally dry between storm events.

Fee-In-Lieu – A fee paid by a developer to the City for a collective fund used towards offsite mitigation efforts for managing stormwater, including stormwater management systems and programs, instead of requiring stormwater management onsite.

Green-Ampt Method – The Green-Ampt method is a process used to establish parameters representing stormwater runoff and infiltration for use in hydrologic modeling. Details are discussed in Section 6.3.

Hydraulics – The science and study of the mechanical behavior of water in physical systems and processes; (for example: piped systems, flow control facilities, detention or retention, dams).

Hydrology – The science encompassing the behavior of water as it occurs in the atmosphere, on the surface of the ground, and underground.

Hydrodynamic Separator – Hydrodynamic systems are flow-through treatment devices that treat stormwater through settling or separation, typically targeting sediment and oil and grease. Pollutants are stored in a sump and removed during maintenance.

InfoSWMM - InfoSWMM is a hydrologic, hydraulic, and water quality computer simulation model that is integrated with ArcGIS and used to simulate and predict conditions for existing and future land use to aid in effective management of urban stormwater and wastewater collection systems.

LIDAR (Light Detection and Ranging) – A technology measuring the properties of scattered light off different surfaces to determine information such as distance, impervious surface cover, and topography.

Low Impact Development – A stormwater management approach that focuses on mimicking the natural, predeveloped hydrologic function of healthy ecosystems by managing rainfall at the source, as it hits the ground, using decentralized, small scale controls that provide infiltration, filtration, vegetative uptake, and creation of extended flow paths.

Media Filtration System – A filter medium that readily takes up substances through adsorption is used to remove a wide range of pollutants, including sediment, oil and grease, metals, nutrients, and organics. The choice of medium depends on the pollutants of concern. Pollutants are stored within the filter media, or in a sump or pre-treatment bay, until removed during maintenance. The size of media filtration systems can be determined either by the flow or the volume of stormwater runoff.

Retention Pond – See Wet Pond.

Swale – Vegetated swales (also known as grassed channels or biofilters) are constructed facilities that are open-channel drainageways used to convey and treat stormwater runoff. Vegetated swales are often used instead of traditional storm sewer pipes or to provide treatment for discharges from stormwater pipes. Swales encourage infiltration, and water does not pond in them for very long. Vegetated swales generally have a relatively flat slope to provide sufficient time for treatment of pollutants, including sediment.

Time of Concentration (T_c) – The time in minutes that it takes a drop of water to travel from the farthest point in a drainage area to the point of discharge.

Total Maximum Daily Load (TMDL) – The Total Maximum Daily Load process determines how much of a pollutant a water body can receive without violating water quality standards.

Underground Injection Control (UIC) – Underground injection control facilities are drainage systems that allow stormwater to infiltrate into the ground. The Safe Drinking Water Act regulates UICs to protect groundwater quality for current or potential beneficial uses such as drinking water.

Urban Growth Boundary (UGB) –A boundary set to control urban sprawl by allowing the area inside the boundary to be used for higher-density urban development while preserving farm and forest land outside. An urban growth boundary circumscribes an entire urbanized area and is used by local governments as a guide to zoning and land use decisions.

Water Quality Design Storm – The water quality design storm is defined as the storm that produces the runoff that requires water quality treatment prior to discharge, defined as 80 percent of the annual runoff for the City. Treatment of the design storm runoff is intended to treat the first-flush pollutant-generating impervious surface runoff.

Wet Pond – Wet ponds (also known as stormwater ponds, retention ponds, and wet extended detention ponds) are facilities designed to contain a permanent pool of water throughout the year, particularly in the wet season. Ponds provide treatment of incoming stormwater runoff by capturing and holding the water for a long time, allowing solids and associated pollutants to settle. Nutrient removal also occurs as a result of plant activity and activity of aquatic organisms.

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EXECUTIVE SUMMARY

INTRODUCTION

This Stormwater Master Plan combines planning, engineering, and public involvement to provide the City with the tools to implement the proposed capital improvement program (CIP) along with the policies necessary to establish a fully integrated stormwater program that combines water quality, water quantity, habitat and wildlife, and regulatory requirements. Low Impact Development, a major aspect of this plan, is a stormwater treatment method that combines several different goals by providing water quality, enhancing natural features, providing aesthetic value, and providing wildlife habitat.

The City identified goals for this Master Plan and the objectives for meeting these goals in order to effectively manage stormwater runoff. These objectives include: improving the environment and protecting water quality, developing an efficient and effective CIP, maintaining continual capacity in the storm system, meeting regulatory requirements, and gaining public support for the Master Plan document.

BACKGROUND INFORMATION

Located in both Clackamas and Washington Counties, the City of Wilsonville is approximately 20 miles south of Portland, Oregon, in the Willamette River Valley. The majority of the City is situated north of the Willamette River which runs east-west near Wilsonville. The Charbonneau District is located south of the river. The Interstate 5 (I-5) freeway corridor runs north–south through the City, dividing it into two nearly equal parts on the east and west sides. The City of Wilsonville has a population of 19,525 (Portland State University, 2011) and has experienced significant recent growth.

Topography in Wilsonville is relatively flat, with the exception of steep canyons surrounding Boeckman Creek. Elevations in the City range from 376 feet above sea level in the upper reaches of the Basalt Creek subbasin to 61 feet above sea level at the Willamette River near the I-5 bridge. The majority of the City generally drains south to the Willamette River, with except for the Charbonneau District, with a large part of the City draining to Boeckman Creek and Coffee Lake Creek before discharging to the Willamette River.

A moderate climate of cool, wet winters and warm, dry summers is typical for the City. The average annual rainfall in the City is approximately 42 inches, with over 90-percent of the annual rainfall occurring from October through June.

Most soils in Wilsonville have moderate to slow infiltration rates. There are approximately 254 acres of identified wetlands throughout the City, with the largest being the Coffee Lake Creek wetland complex.

A majority of the existing land use in the City is residential and industrial, followed by public open space and commercial land use. Large commercial and industrial facilities are located along the I-5 corridor.

EXISTING DRAINAGE SYSTEM

The City of Wilsonville's conveyance system is comprised of pipes, culverts, natural channels, and constructed channels. Pipe diameters range from 8 to 48 inches in diameter, with typical pipe materials consisting of polyvinyl chloride (PVC), reinforced concrete (RCP), and corrugated metal (CMP). Many open channels are part of the drainage system; channel widths range from 4 feet up to 20 feet, with wetland areas up to 50 feet wide. As part of the overall drainage system, there are numerous private and public stormwater detention facilities, including large regional facilities, as well as structural water quality facilities.

Existing problem areas were identified by City staff. Seventeen areas were identified to have problems associated with flooding, undersized or deteriorated pipe, water quality, and erosion.

WATER QUANTITY ANALYSIS AND RESULTS

The water quantity analysis was conducted through hydrologic and hydraulic modeling of the City of Wilsonville's stormwater system. The modeling effort simulated the condition and function of the storm drainage system for various storm events during current and future development conditions and the flow-reduction benefits of future Low Impact Development implementation. Results of the modeling effort were used to develop the CIP for future stormwater system needs. The InfoSWMM model was selected by the City to provide a uniform platform for modeling efforts within the City.

Model input parameters were provided by various sources including as-built plans, City GIS data, limited field reconnaissance, discussions with City staff, and information from the City's previous stormwater model. Drainage subbasins were delineated based on topography. The model was calibrated using flow monitoring data collected at specific outfalls. Results of the calibration were validated using anecdotal evidence of flooding and comparing those locations with the calibrated model results for specific storm events. Upon completion of the model calibration, scenarios were run for existing and future development conditions for the 2-, 5-, 10-, 25-, 50-, and 100-year, 24-hour storm events.

Results of the existing condition simulations were compared with problem areas identified by City staff associated with flooding and drainage issues. Based on model results, four general areas were predicted to experience flooding. These areas include:

- Commerce Circle – A business park development in the northwestern area of the City, predicted to overtop its banks and flood nodes (a point connecting two or more linear segments) along the channel, beginning at the 2-year, 24-hour storm event, at the northwest boundary of the Commerce Circle business development.

- SW Boberg Road north of SW Barber Street – The section of pipe along Boberg Road running south to the south tributary of Coffee Lake Creek is predicted to flood, beginning at the 2-year, 24-hour storm event.

- Hillman Court and 95th Avenue – Flooding was identified along SW 95th Avenue, just north of SW Freeman Road to SW Hillman Road, beginning at the 2-year, 24-hour storm event.

- Charbonneau District – The Charbonneau District is an older development (approximately 40 years old) with some portions of the District on the south side of the Willamette River. Flooding along the northern portion of SW French Prairie Road is predicted to begin at the 2-year, 24-hour storm event.

LOW IMPACT DEVELOPMENT MODELING

Model simulations were conducted to determine the potential benefits of reducing stormwater runoff through implementation of Low Impact Development projects. Low Impact Development was modeled using two methods; one method that provides a site specific analysis but is time consuming to implement, the other provides a broader, more generalized analysis. A scenario for each analysis assumed 10- and 25-percent of Low Impact Development implementation (i.e., 10- and 25-percent of total land area is treated by Low Impact Development practices). Results for both methods show that 25-percent implementation of Low Impact Development provides significantly more flow-reduction benefits than 10-percent implementation. Benefits are also more pronounced for land use associated with higher percentages of impervious areas, such as commercial versus residential. Due to limited flow reduction during the 25-year storm, Low Impact Development implementation will not reduce pipe sizes for future storm drainage flows. However, benefits will be realized in reduction of stormwater runoff for typical annual flows and pollutant load reduction due to minimizing these flows.

WATER QUALITY ANALYSIS

Stormwater quality pollutants in the City include those typical of urban stormwater runoff such as bacteria, heavy metals, oil & grease, sediments, nutrients, and temperature. Recently, attention has been given to toxics (such as pesticides) and chemicals/contaminants of emerging concern such as pharmaceuticals. The sources of these pollutants are varied; some sources are human caused, and require action by both the City and the public to minimize, while others are not directly attributed to human activities, such as bacteria from wildlife droppings, and are therefore more difficult to control.

The City implements many source control BMPs such as public education, maintenance (i.e., catch basin cleaning, street sweeping, structural control facility maintenance), and programmatic actions targeted at pollutant removal through inspection, education, and response.
As documented in the City's Public Works Standards, the City of Wilsonville requires structural controls for stormwater quality (and quantity) on all development of new impervious area over 5,000 square feet. Typical structural controls used in the City of Wilsonville for water quality include bioswales, extended detention ponds, constructed wetlands, retention ponds, and filters. The removal efficiency of structural controls can vary in accordance with design and sizing, maintenance, and influent stormwater characteristics.

Based on previous studies, industrial land use generally shows the highest potential pollutant concentrations, and residential and open space (i.e., undeveloped) land use tend to represent the lowest pollutant concentrations. However, depending on the type of pollutant, this ranking could vary. Based on the BMP effluent data used in the preparation of the City's TMDL benchmarks, structural controls that use infiltration in addition to other unit processes as part of a treatment train achieve the greatest pollutant removal because pollutant loads are reduced as a function of runoff volume reduction and pollutant removal capabilities. Therefore, Low Impact Development practices (i.e., porous pavement, rain gardens), followed by wetlands, bioswales, and ponds generally achieve the highest pollutant removal.

To address water quality, proposed projects for the CIP include wetland and stream restoration as well as Low Impact Development. The potential high source areas, typically industrial land use and areas with the largest impervious surfaces, may represent areas where the City wishes to focus implementation of Low Impact Development practices, including use of rain gardens and pervious pavement. Low Impact Development practices result in the greatest projected pollutant load reduction for all assessed land use and pollutant categories.

RECOMMENDED PROJECTS

The goal of the City in implementing stormwater projects is to maximize the benefit of each project while protecting and enhancing the surface waters in the City and maintaining safe conditions for the public and associated properties. Benefits considered include: flood control, conveyance deficiencies, enhancing water quality, increasing habitat for wildlife, implementing projects with cost efficiency, and combining projects in the CIP with other projects (such as transportation projects). Projects were identified based on model results, City identified problem areas, and locations with good potential for water quality improvements and natural resource enhancements. These and other benefits were used for the prioritization of the list of projects in the CIP. Efforts were made to develop projects and choose locations that provided multiple benefits. The use of Low Impact Development practices is one method that meets multiple objectives for the City, including stormwater flow control, surface water quality enhancement, landscaping, and groundwater recharge, and provides for an integrated method of achieving the City's stormwater management goals.

PROJECT SELECTION AND PRIORITIZATION FOR THE CAPITAL IMPROVEMENT PROGRAM

Based on recommended projects, the CIP was developed to meet the goals and objectives identified by the City for this Master Plan. Recommended projects include detention, pipe upgrades and improvements, outfall rehabilitation, flood control, stream and wetland restoration, and Low Impact Development projects.

The projects in the CIP are sorted into three categories to meet the City's current and future needs: short-term, mid-term, and long-term. Short-term projects are scheduled to be implemented within 5 years; mid-term projects in 5 to 10 years, and long-term projects in 10 to 20 years. One additional category of unfunded projects has been included. These projects were identified to be a low priority and require additional information and study prior to incorporation into the funded CIP.

The prioritization process involved evaluating each project against significance criteria identified by the City to determine the importance and urgency of each project. A numerical value from 0 to 5, or 0 to 10 for selected benefits, was established for each project, based on the value of the benefit; the short-term projects are those with the highest total numerical value. Prioritization criteria fall into the following four categories:

- Site Issues
- Compliance
- Cost Efficiency
- Other (Livability)

Estimated total costs for all projects within the sets of short-, mid-, and long-term priority categories as well as unfunded projects are as follows:

Short-term projects:	$2,771,697
Mid-term projects:	$10,129,961
Long-term projects:	$10,087,602
Subtotal:	$22,989,260
Unfunded projects:	$8,245,926
Total:	$ 31,235,186

Table ES-1 provides the prioritized list of CIP projects and Figure ES-1 displays the locations of the CIP projects.

Table ES-1
Prioritized CIP Projects

Project ID	Location	Land Acquisition Required? (Yes or No)	Total Cost Estimate[1]	Annual Maintenance Cost Estimate
Short-Term Projects – Implementation in 0 to 5 Years				
WD-3	Rivergreen Repair Project	No	$ 285,000	$ 2,200
BC-7	Boeckman Creek Realignment	No	$ 577,296	$ 2,200
ST-5	Low Impact Development Design Standards and Implementation Guide	No	$ 57,000	NA
ST-8	Install Two Permanent Stormwater Flow Monitoring Stations and Two Rain Gauges	No	$ 45,486	NA
ST-9	Purchase InfoSWMM Model	No	$ 18,240	NA
ST-6	Charbonneau Infrastructure Replacement Study	No	$ 142,500	NA
BC-4	Gesellschaft Water Well Channel Restoration	No	$ 135,774	$ 1,800
LID1	Memorial Park Parking Lot Vegetated Swales (3)	No	$ 203,148	$ 6,500
BC-8	Canyon Creek Estates Pipe Removal	No	$ 129,504	$ 1,500
SD4208 & SD4209	Barber Street Pipe Replacement	No	$ 213,196	$ 1,200
LID3	SW Camelot Green Street Mid-Block Curb Extensions (2 extensions)	No	$ 58,482	$ 5,300
CLC-3	Commerce Circle Channel Restoration	No	$ 564,071	$ 5,700
ST-1	Study to analyze area north of Elligsen Rd/East of I-5	No	$ 57,000	NA
FP	Future Project Development and Implementation	No	$285,000	N/A
Short-Term Projects	**Subtotal**	**-**	**$2,771,697**	**$26,400**
Mid-Term Projects – Implementation 5 to 10 Years				
BC-2	Boeckman Creek Outfall Rehabilitation	Maybe	$ 167,580	$ 1,500
BC-6	Multiple Detention Pipe Installation	No	$ 1,366,948	$ 1,100

[1] Total Cost Includes land acquisition costs and is in 2009 dollars.

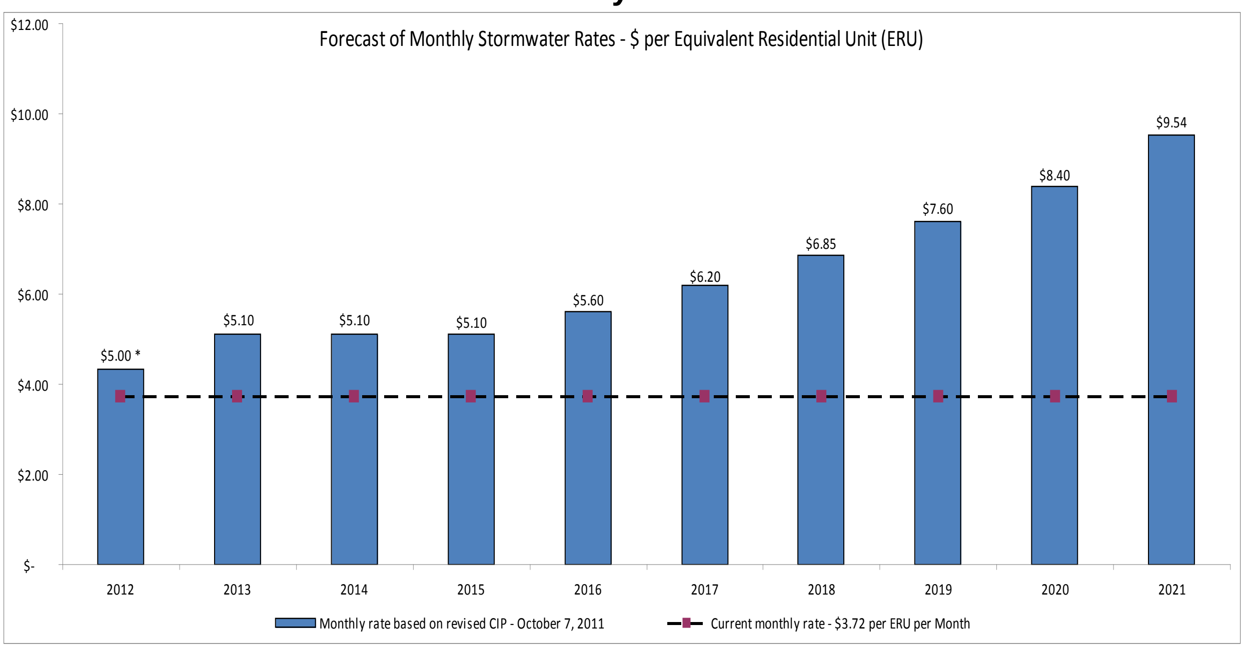
Project ID	Location	Land Acquisition Required? (Yes or No)	Total Cost Estimate[1]	Annual Maintenance Cost Estimate
BC-5	Boeckman Creek Outfall Realignment	No	$ 38,441	$ 1,300
BC-3	Cascade Loop Detention Pipe Installation	No	$ 810,109	$ 1,100
BC-10	Memorial Park Stream and Wetland Enhancement	No	$ 84,360	$ 2,900
BC-9	Memorial Drive Pathway and Storm Drain Repair	No	$ 111,720	NA
LID3	SW Camelot Green Street Mid-Block Curb Extensions (18 extensions)	No	$ 526,338	$ 47,700
LID7	SW Wilsonville Road Stormwater Planters	No	$ 362,794	$ 6,700
CLC-2	SW Parkway Avenue Stream Restoration	Yes	$ 279,420	$ 4,900
CLC-9	Jobsey Lane Culvert Replacement	No	$ 115,028	$ 2,200
SD5707, 5709, 5714, 5719	SW Parkway Pipes Replacement	No	$ 497,405	$ 2,200
ST-2	Advance Road School Site Study	No	$ 57,000	NA
CLC-1	Detention/Wetland Facility near Tributary to Basalt Creek	Yes	$ 3,516,900	$ 4,900
SD9038; 9045; 9046; 9054-9058	French Prairie Road in NW Charbonneau Pipe Replacement	No	$ 867,417	$ 1,500
SD9052; 9053; 9059; 9061-9069	Curry Drive and French Prairie Road in NW Charbonneau Pipe Replacement	No	$ 1,043,501	$ 2,100
FP	Future Project Development and Implementation	No	$285,000	N/A
Mid-Term Projects	**Subtotal**	**-**	**$10,129,961**	**$80,100**
Long-Term Projects – Implementation in 10 to 20 Years				
ST-4	Master Plan and Model Update	No	$ 342,000	NA
ST-3	Survey of Open Channel Conveyance	No	$ 57,000	NA
BC-1	Wiedeman Road Regional Stormwater Detention/ Stream Enhancement	Yes	$ 5,446,350	$ 4,900
CLC-4	Ridder Road Wetland Restoration	Yes	$ 283,778	$ 2,900
LID2	SW Hillman Green Street Stormwater Curb Extensions	No	$ 236,938	$ 4,000
CLC-5	Coffee Lake Creek Stream and Riparian Enhancement	Yes	$ 339,844	$ 2,900

Project ID	Location	Land Acquisition Required? (Yes or No)	Total Cost Estimate[1]	Annual Maintenance Cost Estimate
CLC-6	Coffee Lake Creek South Tributary Wetland Enlargement	Yes	$ 490,286	$ 2,900
CLC-7	Coffee Lake Creek South Tributary Stream Restoration	Yes	$ 496,114	$ 2,900
SD4021 & SD4022	Boberg Road Culvert Replacement	No	$ 65,393	$ 2,200
CLC-8	Coffee Lake Creek Restoration	Yes	$ 486,877	$ 4,300
ST-7	Boeckman Creek at Boeckman Road Stormwater Study	No	$ 57,000	NA
SD4025 - SD4028	Boberg Road Pipe Replacement	No	$ 733,590	$ 2,200
BC-6	Multiple Detention Pipe Installation – Bridge Creek Apartments	No	$1,052,432	1,100
Long-Term Projects	**Subtotal**	**-**	**$10,087,602**	**$29,200**
	Unfunded Projects			
SD9000-9012	Miley Road in S Charbonneau Pipe Replacement	No	$ 3,198,175	$ 3,900
SD9013-9021; 9060	French Prairie Road in NE Charbonneau Pipe Replacement	No	$ 1,680,563	$ 2,800
SD9022-9029	Old Farm Road in NE Charbonneau Pipe Replacement	No	$ 1,015,021	$ 1,600
SD9030-9037	Edgewater Drive E and French Prairie Road in NE Charbonneau Pipe Replacement	No	$ 996,254	$ 1,700
SD9039; 9044; 9047; 9051	Boones Bend Road in NW Charbonneau Pipe Replacement	No	$ 855,395	$ 1,600
LID4	SW Costa Circle Vegetated Swale and Stormwater Curb Extension	No	$ 70,817	$ 6,300
LID5	Wood Middle School Parking Lot Green Street	No	$ 203,148	NA
LID6	Boones Ferry Primary School Parking Lot Green Gutters and Pervious Paving	No	$ 130,945	NA
WD-1	Montgomery Way Culvert Replacement	No	$ 44,354	$ 600
WD-2	Rose Lane Culvert Replacement	No	$ 51,254	$ 1,100
Unfunded Projects	**Subtotal**	**-**	**$8,245,926**	**$19,600**
All CIP Projects	**Total CIPs**	**-**	**$31,235,186**	**$155,300**

FINANCIAL ANALYSIS

The financial study addresses the revenues required from stormwater fees and system development charges (SDC) to support the construction, operation and maintenance of the City's stormwater system. A key work product in this analysis has been development of a financial model for future use by City Staff. This model - constructed with input from City Staff - is the tool for quantifying the rate and SDC impacts of the capital, operations and maintenance programs under consideration by the City through the current master planning process. Historical and current budget data figures were obtained from the City and provide the foundation for the model framework and for developing forecasts. In addition, capital facilities identified in this Master Plan have been summarized in the model and are fully funded via the rate and SDC analyses contained in this report. Based on these factors, the rate analysis resulted in the following profile of percentage changes in the rate per equivalent residential unit (ERU) required to fund the utility and costs identified in this Master Plan:

Figure ES-2
Forecast of Monthly Stormwater Rates



While the City's current rate of $3.72 per ERU provides the rate revenue necessary to fund the current program, the results of the master planning have identified significant capital requirements of $23 million over the 20-year planning period. Coupled with these capital expenses are the increased operating costs related to maintaining these new facilities and costs related to additional and more stringent regulatory requirements. The combination of these factors results in the rate forecast shown in Figure ES-2. This forecast assumes the City will also use available resources within its Stormwater SDC and Operating Funds to support immediate capital needs and issue revenue bonds to pay for future stormwater capital needs. These projections and specifically the rate effects related to capital funding are also based on increasing the City's current

Stormwater SDC of $492 per ERU to $1,356 per ERU. The proposed SDC is shown in Table ES-2.

Table ES-2
Proposed Stormwater SDC

City of Wilsonville
Stormwater - System Development Charge Analysis
Summary of Fee Components

Reimbursement fee		$ 480
Improvement fee:		
Water quantity	827	
Water quality	49	
Total improvement fee	876	876
Total System Development Fee		$ 1,356

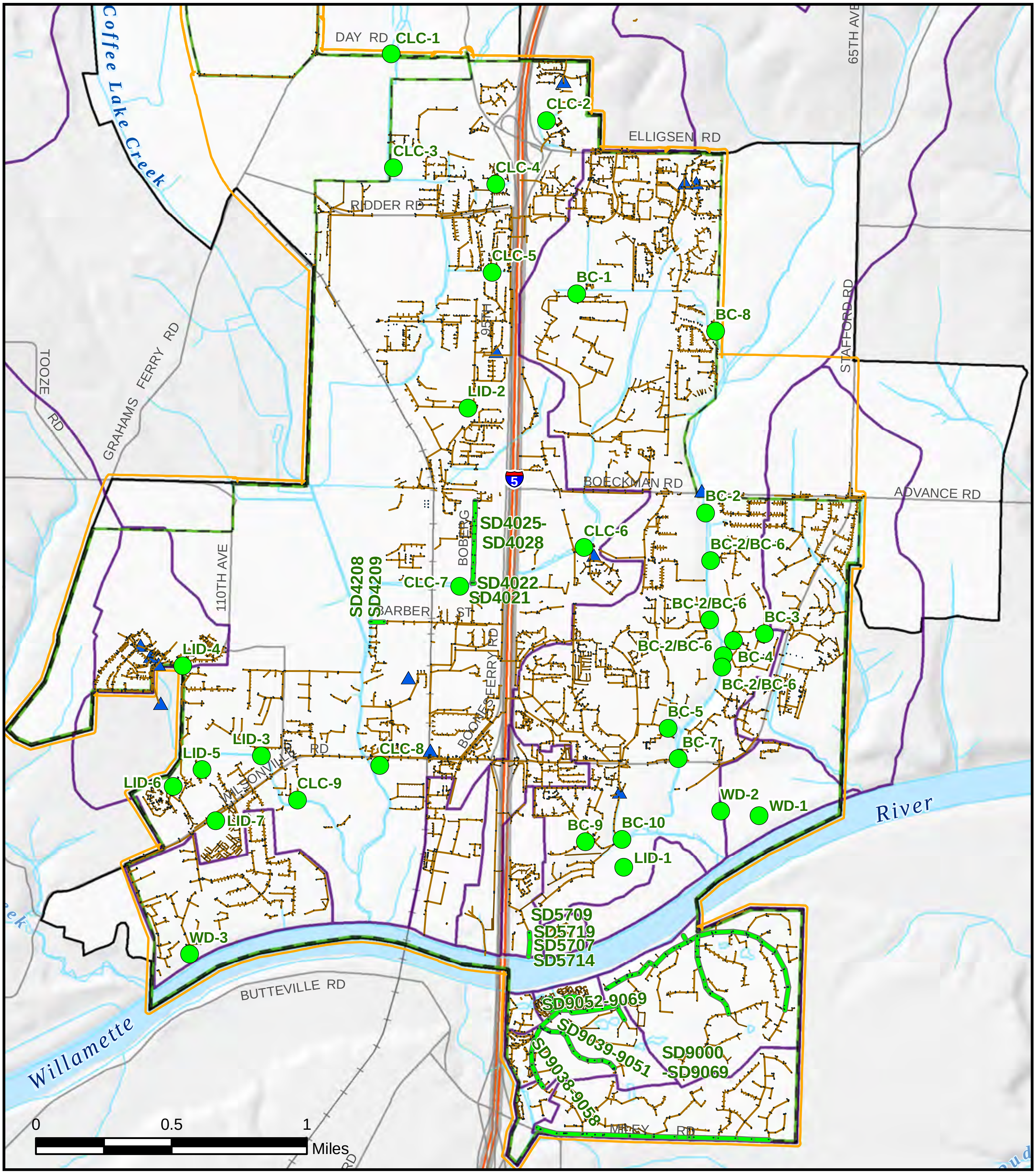


Figure ES-1
Capital Improvement Projects

City of Wilsonville
Stormwater Master Plan

March 2012

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- Capital Improvement Locations
- Capital Improvement Conduits
- Stormwater Lines
- Stormwater Structures
- Detention Ponds
- Study Area
- Streams
- UGB Boundary
- City Limits
- Watershed Boundaries

1.0 MASTER PLAN INTRODUCTION, GOALS, AND APPROACH

1.1 INTRODUCTION

1.2 GOALS

1.3 APPROACH

1.4 DOCUMENT ORGANIZATION

1.0 MASTER PLAN INTRODUTION, GOALS, AND APPROACH

1.1 INTRODUCTION

A Stormwater Master Plan was prepared for the City of Wilsonville in 2001 to identify projects for the capital improvement program (CIP) to address existing and future flooding, water quality, and policies, in order to implement a comprehensive and effective stormwater program. In 2006, the Master Plan was updated to remove a number of CIP projects that were no longer needed.

The City has developed this Master Plan to efficiently and effectively address increasing federal, state, regional, and local regulations for water quality, water quantity, and habitat. This new Master Plan combines planning, engineering, landscape architecture, environmental considerations, and public involvement to provide the City with tools to implement CIP projects and policies associated with a fully integrated stormwater program that satisfies various regulations and protects people and property.

1.2 GOALS

To manage stormwater runoff effectively while protecting the public from flooding and enhancing water quality and habitat, the City identified goals for this Master Plan and objectives for meeting these goals.

Goals:

1. Improve the environment and protect water quality;
2. Develop an efficient and effective CIP;
3. Maintain continual capacity in the stormwater system;
4. Gain public support for concepts contained in the Master Plan document;
5. Identify CIP projects that minimize overall costs including construction and long-term maintenance costs.

Objectives:

1. Assess current and future conditions of the stormwater system;
2. Identify drainage system improvements needed for flood control;
3. Meet federal, state, regional, and local regulations for water quality and habitat protection;
4. Integrate habitat needs, water quality protection, and regulatory requirements into CIP projects and recommended policies;
5. Coordinate with other City programs for efficient implementation and overall cost benefits, including Master Plans developed for City parks, pedestrian and bicycle trails, transportation improvements, drinking water, and wastewater programs;
6. Fund planning, construction, operation, and maintenance of the stormwater system;
7. Develop a framework to incorporate Low Impact Development into new development, redevelopment, and retrofit planning; and
8. Involve the public in the development of the Master Plan and its implementation.

1.3 APPROACH

The first objective, to assess current and future conditions of the stormwater system, was conducted for hydrologic, hydraulic, and water quality aspects of the City's stormwater system. The hydrologic and hydraulic aspects were assessed using hydrologic and hydraulic computer modeling software. The water quality aspects of the stormwater system were assessed to evaluate the existing water quality conditions and plan appropriately for the future. The results of these assessments were used as the baseline for satisfying six of the eight objectives.

Upon completion of the assessment objective, improvement projects were identified. Projects were identified by simultaneously considering (1) flooding concerns identified through modeling, (2) areas where opportunities were available for enhancement of habitat, stream, and/or wetlands, (3) areas where parks and recreation projects could be integrated, (4) areas identified by the public or City staff to have drainage or erosion issues, (5) the project's applicability with respect to regulatory requirements, and (6) reassessing projects identified in the 2001 Stormwater Master Plan. Through careful, thoughtful planning, stormwater management systems and associated improvement projects can be identified in ways that provide multiple benefits, including any or all of the components mentioned above. Projects were selected with an emphasis on multiple benefits.

Low Impact Development is a method of managing stormwater that can provide multiple benefits, and is becoming more accepted by government agencies and the development community. Low Impact Development practices are an important aspect of this plan and the associated improvement projects. Low Impact Development is considered a sustainable way to manage stormwater on site by mimicking the natural hydrologic function of healthy ecosystems in urban landscapes (such as streets and parking lots), through the use of infiltration, vegetative uptake, and creation of extended flow paths. These methods are capable of dramatically reducing pollution, decreasing runoff volume and temperature, and protecting aquatic habitat, while increasing the aesthetic value of the landscape. The use of Low Impact Development practices is integrated into this plan as a major component for managing stormwater on site. An in-depth description of Low Impact Development methodology is provided in Appendix B.

1.4 DOCUMENT ORGANIZATION

The organization of the remaining chapters of Wilsonville's Stormwater Master Plan is described below.

- Chapter 2 provides background information on regional, state, and federal regulations, covers existing policies that are still being implemented, and provides recommendations for new City policies pertaining to water quality and quantity.
- Chapter 3 provides a summary of the relevant characteristics of the City of Wilsonville, including general background, area, water bodies, soils, topography, wetlands, land use, and corresponding maps.
- Chapter 4 provides information on the City's existing stormwater drainage system, including conveyance, detention, water quality, and problem areas.
- Chapter 5 provides information on the City's efforts to involve its citizens in this Stormwater Master Plan, and educational information provided to the public.
- Chapter 6 describes the hydrologic and hydraulic model, including its selection, development, calibration, runs conducted, and results.
- Chapter 7 provides background on the City's urban stormwater quality and source and structural controls, information on water quality assessment for the City, and provides a planning tool for determining the effectiveness of water quality controls.
- Chapter 8 describes recommended projects for the CIP.
- Chapter 9 describes proposed implementation of projects in the CIP, including prioritization for construction, cost estimates, maintenance, and maps.
- Chapter 10 provides the financial analysis to evaluate revenues required from stormwater fees and system development charges (SDCs) to support the construction, operation and maintenance of the City's stormwater system.

2.0 REGULATIONS AND RECOMMENDED POLICIES

2.1 REGIONAL, STATE, AND FEDERAL REGULATIONS

2.2 CITY POLICIES AND IMPLEMENTATION MEASURES

2.3 EXISTING POLICIES

2.4 RECOMMENDED NEW POLICIES

2.0 REGULATIONS AND RECOMMENDED POLICIES

2.1 REGIONAL, STATE, AND FEDERAL REGULATIONS

A number of regional, state, and federal regulations address the quality and quantity of stormwater that is discharged to surface waters and groundwater by municipalities, including the City of Wilsonville.

On the federal level, discharges to surface water are regulated by the Clean Water Act (CWA) through National Pollutant Discharge Elimination System (NPDES) permits and total maximum daily loads (TMDLs). In Oregon, the Oregon Department of Environmental Quality (ODEQ) has the responsibility for implementing the NPDES program and the TMDL program on behalf of the U.S. Environmental Protection Agency (U.S. EPA). Discharges to groundwater are regulated by the federal Safe Drinking Water Act (SDWA).

Protection of floodplains, natural resources, and wildlife habitat is regulated by Metro, the Portland Metro Area regional government, through the development of Title 3 and Title 13, which implement Statewide Planning Goals 5, 6, and 7. Goal 5 addresses natural resources, scenic and historic areas, and open spaces. Goal 6 addresses air, water and land resources quality, and Goal 7 includes areas subject to natural hazards. Protection of floodplain is also regulated by the Federal Emergency Management Agency (FEMA) in part through the National Floodplain Insurance (NFIP).

2.1.1 NPDES Municipal Separate Storm Sewer System Permit

ODEQ issues NPDES permits for municipal separate storm sewer systems (MS4). A municipality's MS4 system is comprised of the stormwater conveyance system that discharges to surface waters.

The City of Wilsonville is one of thirteen co-permittees on the Clackamas County Phase I MS4 NPDES permit, which requires the City to implement a Stormwater Management Program to address various sources of stormwater pollution. As part of its Program, the City developed a Stormwater Management Plan which includes best management practices (BMPs) to address the four major components of its MS4 NPDES permit: (1) structural and source control BMPs to reduce pollutants from commercial and residential areas; (2) a program to detect and remove illicit discharges and improper disposal into the storm sewer system; (3) a program to monitor and control pollutants from industrial facilities; and (4) a program to reduce pollutants in stormwater discharges from construction sites.

The City most recently updated its Stormwater Management Plan in 2010 as part of the MS4 NPDES permit renewal submittal (City of Wilsonville MS4 NPDES Permit Renewal, September 2008). As summarized in the City's Stormwater Management Plan, a variety of source control and structural BMPs are implemented to reduce pollutant discharge associated with urban stormwater runoff to receiving surface waters. A new MS4 NPDES permit for the City was issued in 2011.

2.1.2 Willamette River Total Maximum Daily Loads

ODEQ is responsible for developing water quality standards and ensuring that the standards are met in order to protect beneficial uses of rivers, streams, lakes, and estuaries. As a result, the state monitors water quality and reviews available data and information to determine whether instream water quality standards are being met and the surface water body is protected. Section 303(d) of the Federal Clean Water Act requires each state to develop a list of water bodies that do not meet the standards. The list serves as a guide for developing and implementing watershed pollution reduction plans to achieve water quality standards and protect beneficial uses. These watershed pollution reduction plans are referred to as TMDLs. The City of Wilsonville's piped and open channel stormwater conveyance system includes major outfalls that discharge into one primary water body: the Willamette River.

In 2006, the Willamette River TMDL was finalized. This TMDL addresses the parameters of temperature, bacteria, and mercury. Bacteria and mercury are classified as stormwater parameters. The City currently implements strategies through its Stormwater Management Plan to address bacteria and mercury, mostly through the control of sediment. Temperature is not considered a stormwater issue. ODEQ has determined that lack of shade in the watersheds is causing water temperatures to rise in streams that drain to major rivers. The City developed specific strategies for addressing temperature as part of its TMDL Implementation Plan that was submitted in March 2008.

2.1.3 Underground Injection Control

The SDWA regulates the injection of stormwater into the ground in order to protect the quality of groundwater. Underground Injection Controls (UICs) are of specific interest to

ODEQ. The City of Wilsonville has not traditionally made significant use of public UICs or drywells for managing stormwater.

The City continues to move in the direction of Low Impact Development practices, which typically result in enhanced infiltration of stormwater into the ground. The types of Low Impact Development practices that are being considered include rain gardens, bioswales, pervious pavements, and reducing impervious areas. Under the regulatory framework, these practices are not considered to be UICs because the stormwater infiltrates from the surface of the ground through surface cover and soils, rather than being discharged directly into the subsurface. Therefore, these types of practices would not need to be addressed under SDWA requirements.

2.1.4 Metro's Urban Growth Management Functional Plan

Title 3: Water Quality and Floodplain Protection – Title 3 of Metro's Urban Growth Management Functional Plan was created to implement Oregon Statewide Planning Goal 6 (air, water and land resources quality) and Goal 7 (natural hazards). Adopted in 1998, Title 3 requires local jurisdictions to meet regional performance standards relating to water quality and floodplain management. Title 3 is designed to protect the beneficial water uses and functions and values of resources within Water Quality and Flood Management Areas by limiting or mitigating the impact on these areas from development activities and protecting life and property from dangers associated with flooding.

Title 13: Nature in Neighborhoods – On September 29, 2005 the Metro Council voted to approve a regional Nature in Neighborhoods program which became Title 13 of Metro's Urban Growth Management Functional Plan. Local governments were required to comply with Title 13 by January 5, 2009, and to report annually on the status of protection of habitat within the City. Title 13 was created to implement Oregon Statewide Planning Goal 5 (natural resources, scenic and historic areas and open spaces) and Goal 6 (air, water and land resources quality). Title 13 requires local jurisdictions to meet regional performance standards relating to **riparian** and **upland wildlife** habitat.

Title 13 builds on Title 3. Title 3's existing water quality and floodplain regulations remain in effect. However, Title 13's regulatory area is more site-specific and in some areas, greater in extent compared to Title 3. As with Title 3, Title 13 strives to conserve and protect fish and wildlife habitat and water quality through an “avoid-minimize-mitigate” standard. This reflects an intended balance between watershed health, property rights, and the importance of maintaining a compact urban form.

Title 13 includes design standards to help protect habitat and water quality and specifically addresses tree canopy conservation, erosion control, and ways to develop property with the lowest impacts to water and habitat quality. In addition, Title 13 requires local jurisdictions to evaluate their land development regulations and remove barriers to habitat-friendly development[2]. Habitat-friendly development practices, which are in large part comparable to Low Impact Development practices, include a broad range of development techniques and activities that reduce the detrimental impact on fish and wildlife habitat relative to traditional development practices.

The City developed the Significant Resource Overlay Zone (SROZ) in response to the Title 3 and Goal 5 requirements to protect wetlands, and riparian areas adjacent to water bodies. The SROZ provides protection for water quality, and through application of the City’s Title 13 compliance program, will implement many of the habitat friendly development practices. Additional recommended policies for water quality and habitat are described in the following sections of Chapter 2.

2.2 CITY POLICIES AND IMPLEMENTATION MEASURES

The City has implemented a number of policy recommendations developed for the 2001 Stormwater Master Plan. Section 2.3 lists the policies from the 2001 Stormwater Master Plan that will continue to be implemented, and Appendix A provides further detail on the status of these existing policies. Section 2.4 includes new policies that are recommended to the City to further the objectives identified in Chapter 1.

2.3 EXISTING POLICIES

2.3.1 General Stormwater Management Policies

Policy EXP-1: The City of Wilsonville shall assure that stormwater management has, to the maximum extent practicable, no negative impact on nearby streams, wetlands, groundwater or other water bodies.

[2] An analysis of the barriers to habitat-friendly development practices for the City of Wilsonville was prepared by Angelo Planning Group in November 2008 and is included in Appendix G.

Implementation Measure EXP-1a: The location of new projects will be based on consideration of the presence of existing wetlands. Depending on the circumstances, an expansion or improvement to existing wetlands may be preferred over the creation of new wetlands. Such a determination should be made in conjunction with all applicable law.

Policy EXP-2: The City of Wilsonville shall require that the maintenance of stormwater facilities be the responsibility of the private or public owner.

Implementation Measure EXP-2a: New developments shall be required to record approved maintenance agreements that include an easement for access to enforce the agreement. If maintenance is not adequately performed, the maintenance standards and schedule shall be reviewed and enforced by the City, as set forth in the maintenance agreement. Such maintenance shall be performed at the expense of the property owner.

Implementation Measure EXP-2b: All City-maintained conveyance systems shall be located in drainage easements, tracts, or right-of-way granted to the City of Wilsonville.

2.3.2 Fish Passage Culverts

Oregon Revised Statutes chapters 498.351 and 509.605 require any person, municipal corporation or government agency placing an artificial obstruction across a stream to provide a fishway for anadromous, food and game fish species where these are present, or could be present in the future.

Policy EXP-3: The City of Wilsonville shall require the use of culvert designs that meet Oregon Administrative Rule 635 Division 412 (Fish Passage).

Implementation Measure EXP-3a: Both public and private culvert designs will be reviewed by the City's authorized representative to determine their overall effectiveness in meeting the fish passage requirements specified by the state or federal agencies.

2.3.3 Stormwater Quality Policies

Policy EXP-4: The City of Wilsonville shall, as much as is practical, assure that the quality of stormwater leaving the site after development will be equal to or better than the quality of stormwater leaving the site before development.

Design Standards

Wilsonville's current standards for stormwater facility construction are contained in the Public Works Standards. These standards provide construction details and design criteria for water quality facilities.

Implementation Measure EXP-4a: Proposed new conveyance systems shall be constructed and aligned to emulate the natural conveyance system to the extent feasible. In fish-bearing waters or in any stream that has a history or potential for fish production, water-crossing structures shall provide for fish and wildlife passage as required by state or federal agencies, including Oregon Department of Fish and Wildlife.

Implementation Measure EXP-4b: Water quality control facilities shall be landscaped using diverse, native vegetation in order to provide wildlife habitat and provide shading for water temperature control. Landscaping shall be arranged so that it facilitates maintenance access.

Implementation Measure EXP-4c: The City will update the water quality design storm to be defined as the storm that produces 80% of annual stormwater runoff, as required by DEQ in the MS4 Phase I Permit.

On-Site Water Quality Facilities

Studies have shown that development increases the concentration in runoff of suspended sediment, oil and grease, and nutrients.

Policy EXP-5: The City of Wilsonville shall use a combination of regional and on-site facilities to achieve the recommended pollution reduction outlined in this Stormwater Master Plan.

Implementation Measure EXP-5a: Locate regional facilities downstream of existing development where suitable to protect existing wetland and riparian areas.

Source Controls for Development

Policy EXP-6: The City of Wilsonville shall continue to require on-site facilities to serve new or expanding developments, subject to prescribed standards.

Implementation Measure EXP-6a: Maintenance plans for on-site facilities shall be required prior to approval for occupancy of the associated development.

Implementation Measure EXP-6b: Special requirements may be warranted for development that poses a higher-than-normal risk of contamination of surface waters. This could include projects with heavy vehicular use or chemical storage, or developments that discharge directly to wetlands, lakes, or other sensitive areas.

2.3.4 Landscaping Policies

In order to improve the function of the stormwater facility, reduce maintenance requirements and enhance the aesthetics of surface water facilities, landscape standards are needed. Water quality facility design standards must be supplemented with landscaping standards to ensure community acceptance and long term maintainability. Other jurisdictions that have employed design standards that overlooked the landscape aspect of these facilities have witnessed a variety of failures.

Policy EXP-7: The City of Wilsonville shall require landscaping and on-going maintenance of the landscaping for stormwater facilities. See Public Works Standards for landscaping requirements.

Implementation Measure EXP-7a: Weed eradication should include eradication by proper use of herbicide and non-herbicide methods of all plants found on the prohibited species list. The purpose of this is to discourage invasive exotic plant species from infesting Wilsonville's natural drainage ways.

Implementation Measure EXP-7b: All water quality facilities must be assured of adequate irrigation for landscape survival. Permanent or temporary automatic irrigation systems may be required to ensure initial establishment.

2.3.5 Stormwater Quantity Policies

Design Standards

Wilsonville's current hydrology and hydraulic design standards for stormwater facility construction are contained in the Public Works Standards. These standards provide construction details and design criteria for pipes and channels. Policy guidelines identify the appropriate design storm and allowable impacts on upstream and downstream properties. Unless changed in the future to enhance stormwater handling, the following standards shall continue to be applied:

- The design storm for conveyance facilities is the 25-year storm.
- Several methods are acceptable for estimating the quantity and characteristics of surface water runoff. Refer to the Public Works Standards for hydrologic analysis requirements.
- On-site facilities shall be constructed to accept flows from upstream areas based on present conditions or developed conditions under current zoning, including detention facilities.
- Recorded agreements with downstream property owners are required to modify the location or concentrate flow discharged to downstream properties.
- Although stormwater detention is required, the capacity of the downstream system may also be required to be taken into account with the design of the on-site improvements.

Policy EXP-8: The City of Wilsonville shall continue to utilize Public Works Standards that provide a comprehensive set of requirements for surface water management facilities.

Implementation Measure EXP-8a: Periodic revisions to design and construction specifications and policy statements may be adopted to ensure high quality, maintainable facilities that protect against flooding and meet water quality goals.

Implementation Measure EXP-8b: Revised design and construction standards may be developed by using standards currently in use by other municipalities in the northwest such as Clean Water Services, the City of Portland, the City of Gresham, Clackamas County Water Environment Services, or King County, Washington.

2.4 RECOMMENDED NEW POLICIES

As described in Section 2.1, new regulations and requirements for water quality, water quantity, and habitat have resulted in a need for additional policies to implement a fully integrated stormwater program in the City. The policy recommendations provided in this section were developed through discussions with City staff to identify existing issues that need to be addressed and new issues that have arisen out of regulatory requirements.

2.4.1 Low Impact Development

Low Impact Development techniques are an effective, integrated approach to stormwater treatment because they emphasize the mimicking of natural systems through infiltration, vegetative uptake, and extensions of flow paths, which provide opportunities for multiple benefits including aesthetics and wildlife habitat. Due to the nature of these treatment processes, there are limitations to Low Impact Development and these techniques will not be appropriate in every development. Potential limitations to implementing Low Impact Development techniques include:

- site conditions, such as soils with inadequate infiltration capacity;
- insufficient space;
- topography;
- high ground water tables;
- location within a floodplain; and
- potential conflicts with Public Works Standards or other requirements.

The City believes that, in locations where they are appropriate, Low Impact Development techniques are the most effective means of meeting their water quality and quantity goals.

Policy LID-1: The City shall prioritize the implementation of Low Impact Development techniques and habitat-friendly development practices throughout the City for new development, redevelopment, and retrofitting existing development.

Implementation Measure LID-1a: The City shall create a list of approved Low Impact Development measures and implementation techniques to provide guidance to the development community for constructing Low Impact Development features on site. Objectives shall include elements of Metro's Title 13 approach and methods and other Low Impact Development techniques:

- Engineering and Design Approaches
  - Minimizing land disturbance for new development;
  - Locating impervious surfaces on poorly drained soils as much as possible;
  - Minimizing impervious surfaces;
    - Consider promoting shared driveways that connect two or more homes.
    - Reducing residential street width, with City approval.
  - Incorporating pervious materials, where feasible, particularly in parking and pedestrian areas;
  - Minimizing clearing and grading of sites;
  - Reducing parking requirements where bus or train service is available or developing shared parking arrangements; and
  - Using open channels for conveyance and treatment for street drainage;
- Landscaping Design
  - Minimizing soil compaction on new sites;
  - Requiring the use of soil amendments to improve the permeability of soils within landscaped areas;
  - Requiring the preservation and replacement of topsoil;
  - Maximizing the use of landscaping areas and traffic islands for stormwater treatment with rain gardens and filter strips.
- Stormwater Management Facility Design
  - Infiltrating stormwater on site for the water quality storm, where feasible;
  - Disconnecting impervious surfaces (minimizing effective impervious surfaces);
  - Integrating water quality and detention into natural features;
  - Mitigating impacts of impervious surfaces;
  - Encouraging all stormwater to be routed through vegetated areas prior to entering a storm drain;
- Building Design Solutions
  - Encourage the use of Green roofs (eco-roofs);
  - Disconnect downspouts where feasible as approved by the City's authorized representative;
  - Use rain barrel or cistern system; and
  - Encourage the use of a purple pipe system to reuse water.

Implementation Measure LID-1b: The City shall review and revise its Public Works Standards to prioritize the use of Low Impact Development practices prior to discharging stormwater into a conventional drainage system. The City's authorized representative shall review and approve Low Impact Development systems and verify their onsite use. Maintenance responsibilities shall be required for all owners of Low Impact Development improvements.

Implementation Measure LID-1c: The City shall incorporate Low Impact Development techniques into all new street and public works improvements as practicable.

Implementation Measure LID-1d: The City's Public Works Standards shall acknowledge the potential use of alternative paving materials. Clear and objective standards will be developed to provide guidance on when and how to use alternative paving materials. Alternatives may include pavers in parking stalls, for example.

Implementation Measure LID-1e: The City will amend its Public Works Standards to include exceptions or situational modifications to the existing standards that would allow for multi-function open drainage systems (including streets with curb cuts draining to a bioswale, rain garden, or other vegetated drainageway).

Policy LID-2: The City shall assist with implementation of Low Impact Development techniques as a water quality retrofit for existing development.

Implementation Measure LID-2a: The City shall develop incentives to encourage retrofits of Low Impact Development techniques in existing developments. Incentives may include partial funding of improvements, technical assistance, and reducing stormwater fees. Maintenance responsibilities shall be required for all owners of Low Impact Development improvements.

2.4.2 Water Quantity Control

The City's preferred method of managing stormwater runoff from new development and redevelopment is to limit runoff rates and maintain runoff volumes, as much as feasible, to those of predeveloped (refer to WQC-1d below) conditions and minimizing offsite impacts. New regulations by ODEQ require more stringent control of stormwater runoff. ODEQ regulations are implemented through the City's MS4 NPDES Permit that implements requirements of the CWA. The permit requires the City to manage, in part, the physical characteristics of stormwater, and the controls to limit the peak discharge rates and volume are in response to this requirement. The following policies address these proposed requirements and assist with encouraging the use of Low Impact Development.

Policy WQC-1: The City shall require new development and redevelopment to manage stormwater to match pre- and post-construction runoff rates and velocity, and to limit volume and increased duration of flow as much as feasible.

Implementation Measure WQC-1a: The City shall review and revise its Public Works Standards to require new development and redevelopment to manage stormwater onsite to match pre- and post-construction runoff rates and velocity for the 2-, 5-, 10-, and 25-year storm events and to limit volume and duration increases as much as feasible, or demonstrate why these limitations are not feasible. See WQC-1c for alternatives to on-site stormwater management.

Implementation Measure WQC-1b: The City shall revise its Public Works Standards to add the requirement to provide detention for runoff from a new or redevelopment onsite to a 50-year storm in the event there are existing problems or the potential for problems as a result of the proposed development. Existing problems may be the result of cumulative impacts of developments in the area, erosion, flooding, or other problems with the potential to negatively impact stormwater quality and quantity as identified by the City's authorized representative.

Implementation Measure WQC-1c: The City may allow new and redevelopment projects to either build a stormwater facility off-site or pay a fee in-lieu of onsite improvements when they are unable to meet the post-construction runoff requirements, as approved by the City's authorized representative.

Implementation Measure WQC-1d: The City shall review and revise its Public Works Standards to define pre-development as reflecting the historical vegetation which existed in the different regions of the City prior to urban settlement.

Policy WQC-2: The City shall require all new development and redevelopment with new impervious areas greater than 5,000 square feet to manage their stormwater onsite, including using detention as necessary, as defined by the Public Works Standards.

Implementation Measure WQC-2a: The City shall review and revise its Public Works Standards to require detention of all areas within the City. The following may be exempt from detention requirements:

- Detention for properties or development draining directly to and within 300 feet of the Willamette River;
- Detention for properties or development draining directly to and within 300 feet of the Coffee Lake wetlands; or
- As determined by the City's authorized representative.

Implementation Measure WQC-2b: The City shall review and revise the Public Works Standards to disallow any transfer of stormwater to a different basin or subbasin from the natural site drainage. For existing out-of-basin transfers, new and redeveloped sites shall be encouraged to correct drainage to return to predevelopment drainage basins.

Policy WQC-3: The City of Wilsonville shall assure that all stormwater facilities receive adequate maintenance. This applies to both water quantity and water quality facilities.

Implementation Measures WQC-3a: Inspection and maintenance procedures and frequencies are described in the Public Works Standards and the City's NPDES Stormwater Management Plan.

2.4.3 Water Quality Treatment and Riparian and Wildlife Habitat

Water quality treatment for new impervious areas is required by the NPDES Phase I permit. Current City standards require a 70 percent reduction of total suspended solids (TSS) for new development and redevelopment within the City. Additional recommendations for water quality and riparian and habitat protection include:

Policy WQT-1: The City shall require the provision of effective water quality treatment for all new development and redevelopment and consider ease of maintenance. The overall, post-development water quality shall be equivalent to or better than the predevelopment water quality conditions.

Implementation Measure WQT-1a: The City shall review and revise the Public Works Standards to strengthen water quality requirements as follows:

- The Public Works Standards are updated as necessary to implement evolving technology;
- Water quality treatment is required of all stormwater discharge resulting from the defined water quality storm before it leaves the site;
- Catch basins equipped with a down-turned elbow for control of oil and floatables are required on private property for all new development and redevelopment;
- All outfalls shall have an appropriately designed and constructed energy dissipation system to minimize downstream erosion and impacts to natural resources;
- Catch basins, area drains, and curb inlets shall include BMP Snout® or other approved system on all new public projects, reconstruction, or retrofits; and
- Unless there is an approved regional or sub-regional facility, the City has established a hierarchy of water quality facilities as follows:
  - Low Impact Development is the preferred option of onsite treatment;
  - Structural surface water quality facilities are the next preferred level of treatment;
  - A treatment train application (i.e., several Low Impact Development or structural surface water quality facilities (BMPs) inline); and
  - Underground treatment, such as buried precast settling tanks, is the least preferred form of treatment, and shall only be used when there are no other onsite alternatives.

Policy WQT-2: The City requires conservation of riparian areas, wetlands and streams consistent with the SROZ requirements.

Implementation Measure WQT-2a: The City shall continue to require that existing natural features, such as riparian, wetlands, and streams, be preserved and protected and, through public education, encourage enhancement and restoration of these resources. The City's authorized representative will review the plans to verify that disturbances to natural drainages are minimized.

Policy WQT-3: The City will rehabilitate outfalls identified in the Master Plan that are causing erosion.

Implementation Measure WQT-3a: The City shall evaluate and rehabilitate outfalls in Boeckman Creek to eliminate erosion with CIP funds dedicated for this purpose. Low Impact Development features and detention facilities will be constructed upstream to minimize flow to these outfalls.

Implementation Measure WQT-3b: The City will coordinate with private property owners and governmental agencies to evaluate and rehabilitate outfalls causing erosion outside of the City limits that are receiving water from within the City limits. Opportunities to provide Low Impact Development and additional detention measures will be analyzed and proposed for implementation within the City limits to reduce flows to these outfalls. The City may assist with the rehabilitation of these outfalls through technical assistance, partnership funding opportunities, or a combination of assistance and funding.

Policy WQT-4: The City will implement its TMDL Plan for temperature.

Implementation Measure WQT-4a: The City shall implement the TMDL Plan for temperature, which includes the following elements:

- Protect existing shade;
- Plant vegetation on public properties adjacent to streams for shade;
- Educate the public on benefits of shading streams and encourage planting on private properties;
- Evaluate ability to provide incentives for planting vegetation for shading purposes;
- Offer technical assistance for planting vegetation for shading purposes;
- Acquire training and write grants for tree planting projects;
- Encourage new developments to plant vegetation in buffer zones; and
- Seek partnership opportunities to assist with the funding of vegetation planting for shade on private properties.
- Encourage the use of pavement alternatives, such as concrete pavement instead of asphalt pavement to reduce thermal loading from roadway runoff.

Implementation Measure WQT-4b: The City of Wilsonville shall require shading of surface facilities in order to reduce water temperatures in new surface water facilities and encourage shading in existing facilities. The City shall not permit the use of unshaded, shallow *(less than 3 feet average depth)* surface water facilities where water would be ponded more than two days.

Implementation Measure WQT-4c: Within power line easements, trees and vegetation with shorter mature heights are required to avoid conflicts with power lines and power line maintenance. Other design features may be needed to shade ponded water in these areas.

Policy WQT-5: The City will improve habitat for fish and wildlife.

Implementation Measure WQT-5a: The City will develop incentives and public education materials to encourage the following:

- Use of native plants using the City of Portland's native plant list;
- Preservation and replacement of topsoil;
- Use of existing vegetation to serve as required landscaping;
- Restoration of stream corridors; and
- Educate the public about noxious and non-native invasive plant species.

Implementation Measure WQT-5b: The City shall update the fencing criteria to require wildlife-friendly design and installation of fencing to ensure safe and effective wildlife passage to wildlife corridors and away from roads for sites within the Significant Resource Overlay Zone.

2.4.4 Source Control

Stormwater management plans have been developed by the City to address pollution prevention as required by federal regulations for the NPDES Permit and the TMDL requirements. Prevention is the most effective and least expensive form of treatment. Policies that will assist the City with its source control efforts are listed below.

Policy SC-1: The City encourages reduction of pollutant sources to the maximum extent practicable (MEP). Water quality planning and implementation shall be consistent with the NPDES Phase I permit, the Willamette River TMDL, and the City's Sanitary Sewer requirements.

Implementation Measure SC-1a: The City shall develop a Stormwater Ordinance (City Code, Chapter 8) to address implementation of the Stormwater Program, including NDPES Phase I and TMDL requirements.

Implementation Measure SC-1b: The City shall, as part of its Stormwater Ordinance, specify source control strategies, including:

- Prohibit the discharge of chlorinated swimming pool water to a storm drain system;
- Use efficient irrigation systems, whether from city water system or private well, to minimize both water use and runoff potential of chlorinated water;
- Require spill protection plans or containment strategies for storage facilities or containers that have the ability to discharge pollutants into the storm drainage system, such as drums of oil and grease; and
- Continue to implement a public education program to inform businesses that the discharge of fats, oil, and grease (FOG) to the City's stormwater system is prohibited.

Implementation Measure SC-1c: On an annual basis, City staff will continue to monitor major storm sewer outfalls for compliance with water quality standards, as described in the City's NPDES Stormwater Management Plan.

Implementation Measure SC-1d: If monitoring detects noncompliance with water quality standards, staff will systematically begin sampling upstream in an effort to identify the source of the illicit discharge. Enforcement procedures for the correction of an illicit discharge are performed under the legal authority of the Wilsonville Code, Section 6.202(1)(e).

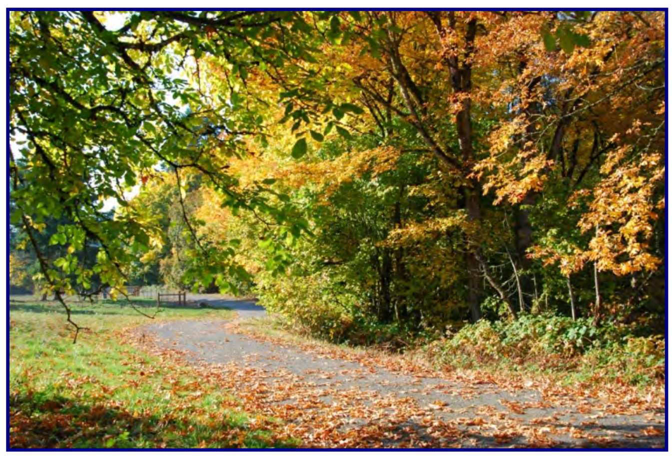
Policy SC-2: The City of Wilsonville shall take steps to minimize erosion resulting from land use and development activities.

Implementation Measure SC-2a: The City shall continue to implement erosion control plan review, inspection, and enforcement as identified in the Public Works Standards.

REFERENCES:

City of Wilsonville MS4 NPDES Permit Renewal, September 2008.

3.0 STUDY AREA CHARACTERISTICS



3.0 STUDY AREA CHARACTERISTICS

3.1 BACKGROUND

The City of Wilsonville is located in both Washington and Clackamas Counties, approximately 20 miles south of Portland, Oregon, in the Willamette River Valley (Figure 3-1). It is in the middle Willamette River Basin, from River Mile 37.0 to River Mile 39.8. The Willamette River runs east–west through the City. The majority of the City is situated north of the Willamette River, with only the Charbonneau development located south of the river. The Interstate 5 (I-5) freeway corridor runs north–south through the City, dividing it into two nearly equal parts on the east and west sides.

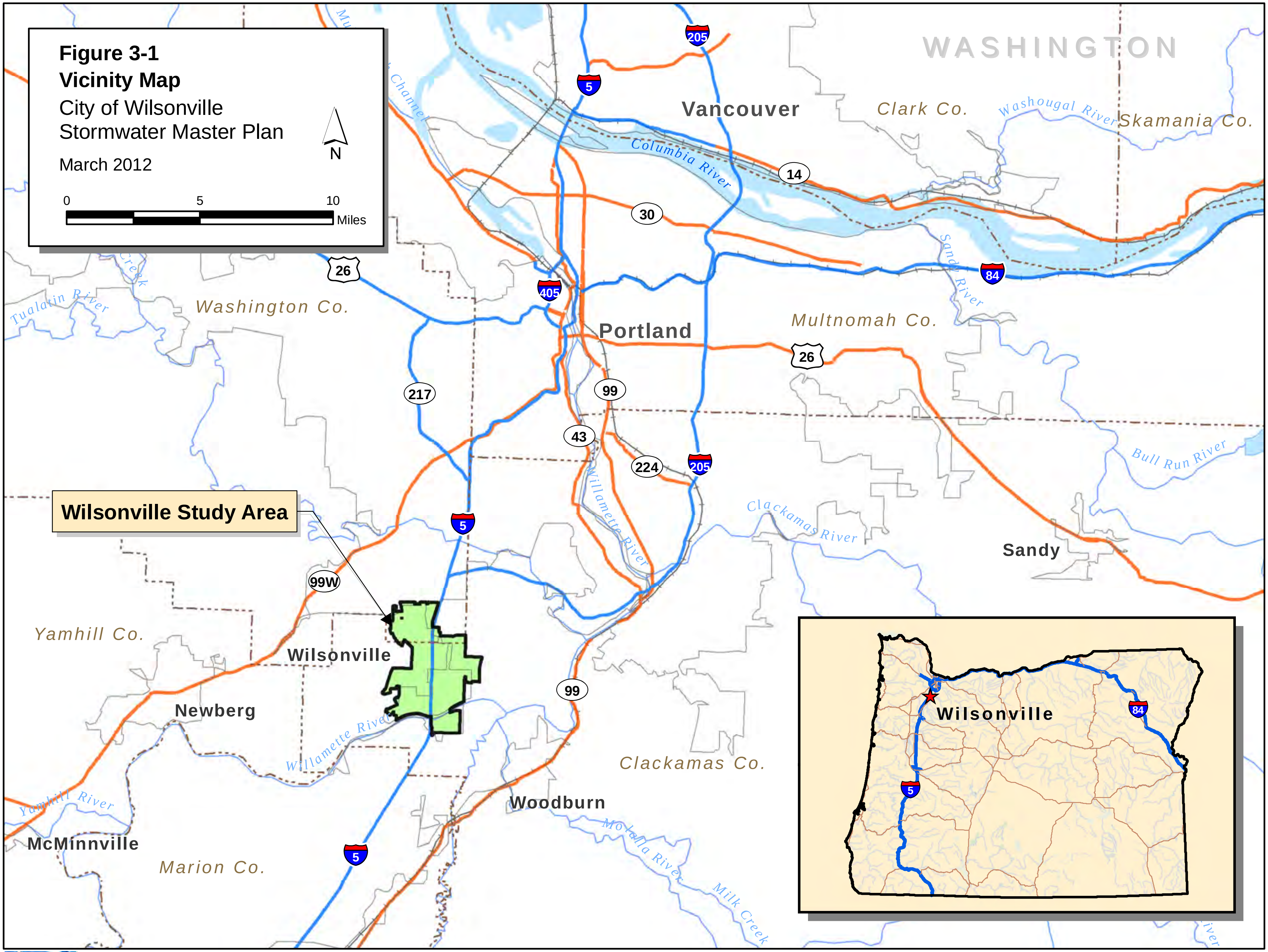
The City of Wilsonville has a population of 19,525 (Portland State University, 2011). Due to its close proximity to the City of Portland and the addition of a commuter rail system, the City has experienced significant recent growth. Population records indicate that the City has experienced a population increase of approximately 300 percent over the last 20 years.

The City of Wilsonville is responsible for providing drinking water, storm sewer, and sanitary sewer services for areas within the City limits. With regards to the storm sewer services, the City is required to manage the quality and quantity of its stormwater runoff and its receiving waterbodies. The City has prepared a Stormwater Management Plan, to comply with its NPDES MS4 Permit and a TMDL Implementation Plan to meet the Willamette River TMDL, for managing and protecting these resources, as mentioned in Section 2.1.

The City manages and protects many natural areas within its jurisdictional limits for the good of the environment and to provide recreational opportunities to its citizens. Twelve public parks are within the City limits, and it has a strong urban forestry program, including being a Tree City USA City for eleven years.

3.2 STUDY AREA

The study area defined for this Stormwater Master Plan includes areas within the City limits, areas within the current UGB, and additional planning areas identified by the City as aspirational in Metro's urban reserve establishment process. Additional areas outside of the study area were included in the model. These areas are within basins that drain to the City's stormwater conveyance system, and were included in the hydrologic model developed for purposes of this Master Plan in order to provide more accurate flow



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File Path: O:\25696563 Wilsonville SWMP Update\4000 Deliverables\STORMWATER MASTER PLAN\CD\Disc 3 - GIS\Figure 3-1 Vicinity.mxd estimations within the City's stormwater system. Although modeled, these areas were not considered as part of the study area, since there are no plans to annex these areas into the City or extend stormwater services into these areas.

Portions of the City's planning areas contribute to basins that drain outside of the six identified drainage basins within the City (see below for a detailed discussion of these drainage basins). Since the City may annex these areas into the UGB within the next 20 years, but they are not currently developed or within the City's UGB, they were modeled only as part of the future conditions scenario. Table 3-1 displays the breakdown of these areas.

Two major natural streams run north–south through the City: Boeckman Creek and Coffee Lake Creek. Although the majority of the City drains to these two streams, the City has six distinct drainage basins as shown in Figure 3-2: the Coffee Lake Creek Basin, Boeckman Creek Basin, Meridian Creek Basin, Villebois Basin, Charbonneau Basin, and a sixth basin comprised of areas draining directly to the Willamette River. See Table 3-1 for a breakdown of basin areas. These water bodies and their watersheds are part of the Middle Willamette Subbasin, an area that starts upstream of Willamette Falls in Oregon City.

Table 3-1
Drainage Basin Area Summary

Drainage Basin	Acres Within City Limits	Acres Outside City Limits and Within UGB	Acres Within Planning Areas[1]	Acres Within Study Area[2]	Acres Outside of Study Area[3]	Total Acres (Modeled)
Coffee Lake Creek	2,124.4	272.9	862.5	3,259.8	1,817.8	5,077.6
Boeckman Creek	1,097.5	92.9	223.5	1,413.9	580.1	1,994.0
Meridian Creek	194.8	84.3	89.5	368.6	107.3	475.9
Villebois	126.0	0.0	0.0	126.0	0.1	126.1
Charbonneau	481.8	0.0	0.0	481.8	0.2	482.0
Willamette-Direct	491.4	0.0	0.5	491.9	0.8	492.7
Other (Newland Creek, unnamed tributary, and Mill Creek	81.4	9.6	310.0	401.0	0.0	401.0
Total[4]	**4,597.3**	**459.7**	**1,486.0**	**6,543.0**	**2,506.3**	**9,049.3**

Notes:
1. Includes areas outside of the UGB, which have been preliminarily identified as urban reserve areas.
2. Includes areas within the City limits, areas within the current UGB, and additional planning areas identified by the City as aspirational in Metro's urban reserve establishment process.
3. Includes areas within drainage basin, but outside study area.
4. Acreage based on basins delineated by URS.

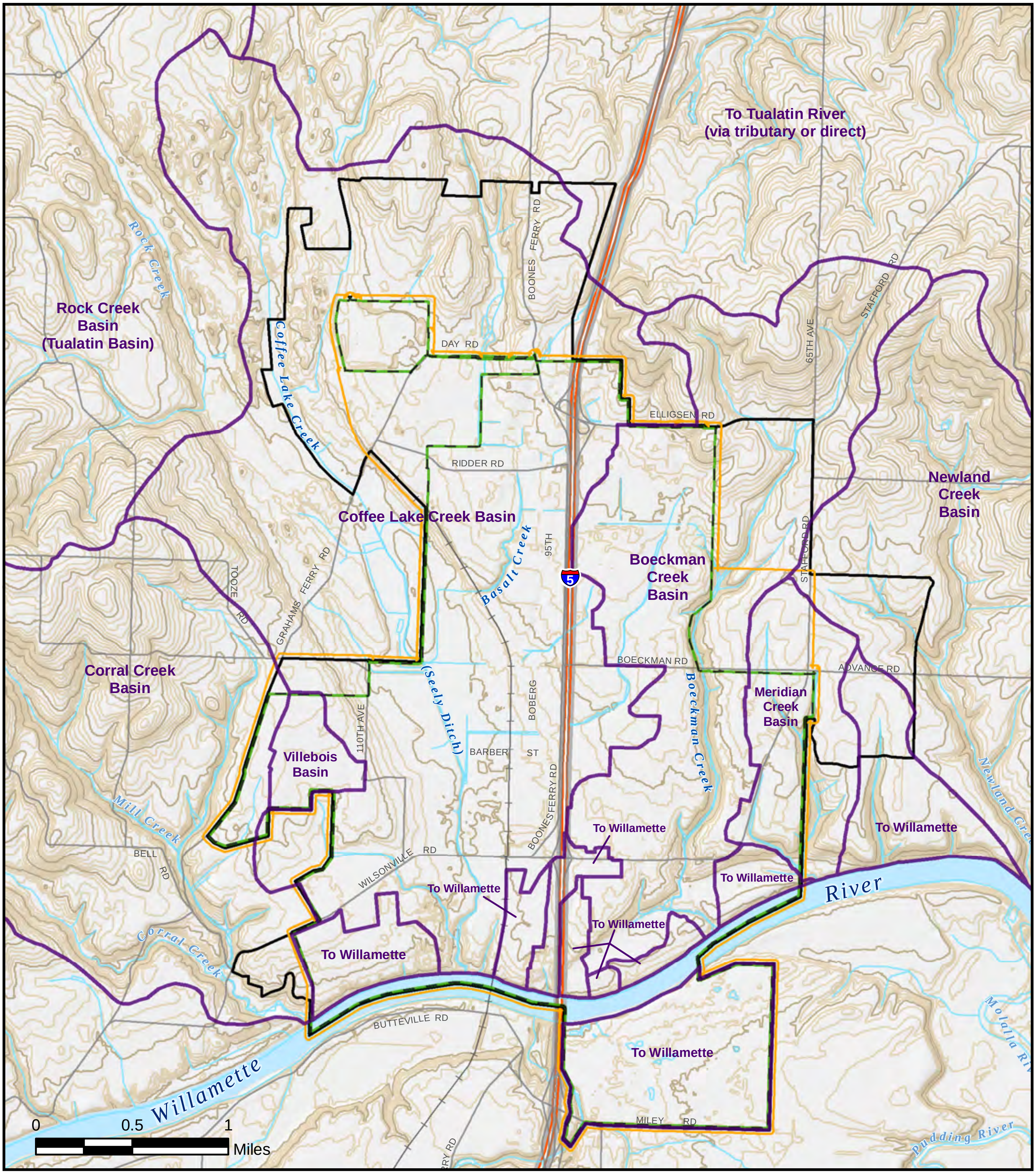

Figure 3-2

Drainage Basins and Study Area

City of Wilsonville
Stormwater Master Plan

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Contour Line: 50'
Contour Line: 10'
Study Area
Streams
UGB Boundary
City Limits

Coffee Lake Creek Basin

As in the rest of the City, the stormwater drainage system within the Coffee Lake Creek basin is comprised of pipes, culverts, natural channels, and constructed channels. Coffee Lake Creek has three major tributaries: Basalt Creek, which conveys water from the northern portion of the basin, and the Middle and South Tributaries. Arrowhead Creek also discharges into Coffee Lake Creek at the southern end of the City, approximately 1,000 feet prior to discharging into the Willamette River. The I-5 corridor runs through the Coffee Lake Creek Basin. Numerous culverts were constructed before the majority of the City was developed to convey stormwater from the east side of I-5 west toward Coffee Lake Creek. Per the City's 2001 Stormwater Master Plan, as the City continued to develop, drainage from approximately 330 acres east of I-5 was re-routed to Boeckman Creek to avoid capacity problems with the culverts under I-5.

Basalt Creek drains a major portion of the Coffee Lake Creek Basin (1,094 acres), and extends north of the City's UGB into the City of Tualatin UGB and east of the I-5 corridor. The upper reaches of Basalt Creek have been directed into pipes or constructed channels and a portion of the constructed channel in the northern portion of the City (near Commerce Circle) has a negative slope, which helps to prevent flooding downstream. Basalt Creek discharges into the Coffee Lake wetlands west of the railroad, approximately midway between SW Freeman Drive and SW Boeckman Road.

The Middle Tributary of Coffee Lake Creek conveys runoff from the eastern portion of the City and discharges to Coffee Lake Creek near Boeckman Road. The Middle Tributary runs west through a piped system and then a realigned channel, and finally enters Seely Ditch where the flow decreases as it enters the Coffee Lake wetlands. The wetland, although still significant, has been reduced in size over the years due to irrigation diversions.

The South Tributary to Coffee Lake Creek flows west to discharge into Seely Ditch at the southern end of the wetlands. Coffee Lake Creek then flows south, combining with Arrowhead Creek, prior to discharging to the Willamette River.

Boeckman Creek Basin

As described above, due to development and the limited capacity of existing culverts passing underneath I-5, the Boeckman Creek basin has been enlarged by routing additional area east of I-5 to Boeckman Creek with the addition of pipe. The Boeckman Creek watershed covers the majority of the area within the City, east of the I-5 corridor. Boeckman Creek has steep canyon walls on either side, with a wooded corridor along the majority of the creek. There are small wetlands along the length of the creek.

Meridian Creek Basin

Located east of Boeckman Creek and draining directly to the Willamette River, the Meridian Creek Basin drains the southeastern portion of the City, a total of about 470 acres, and discharges into the Willamette River just east of the City limits. About 195 acres are within the current City limits.

Villebois Basin

The Villebois Basin, which was the site of the former Dammasch State Hospital, covers approximately 126 acres within the City, and, based on existing topography, the basin drains west, then south to the Willamette River outside of the City. As part of development activities approximately 50 years ago associated with the Dammasch Hospital, this basin was routed outside of the Coffee Lake Creek Basin, its natural drainage corridor (City of Wilsonville Stormwater Master Plan, page 4-4, 2001). Since this occurred, new residential construction has begun on the Villebois development, which is located in the basin. A splitter manhole has been constructed downstream of the development, to restore flows (up to 20 cubic feet per second) to Arrowhead Creek, and send the remainder to a natural channel outside of the City limits.

Willamette Basins

The Charbonneau District, south of the Willamette River, encompasses approximately 482 acres, is composed entirely of piped conduits, and discharges to the Willamette River via three constructed pipe outfalls. Several small pockets in the south end of the City (north of the Willamette River) encompassing approximately 493 acres discharge directly to the Willamette River via piped outfalls or overland flow.

Other Areas

Some other areas within the City's planning area (and outside of the current UGB) drain to Newland Creek, an unnamed tributary on the east side of the City located between Newland Creek and Meridian Creek, and Mill Creek on the west side of the City. All of these streams drain to the Willamette River. Planning areas are those sites that may be included in the UGB over the next 20 years. These are classified as "other" in Table 3-1.

3.3 CLIMATE

The City of Wilsonville has a moderate climate with cool, wet winters and warm, dry summers. The average annual rainfall in the City is approximately 42 inches, with over 90 percent of the annual rainfall occurring from October through June.

3.4 TOPOGRAPHY

The City of Wilsonville is relatively flat, with the exception of the steep canyons surrounding Boeckman Creek (Table 3-2). The topography ranges from 376 feet above sea level in the upper reaches of the Basalt Creek subbasin to 61 feet above sea level at the Willamette River near the I-5 bridge (Figure 3-2). All drainages and creeks are tributaries to the Willamette River. The majority of the City is within the Coffee Lake Creek Basin or the Boeckman Creek Basin, as shown in Table 3-1.

Table 3-2
Average Slopes by Basin

Drainage Basin	Percentage of Area with Slopes 0% to 5%	Percentage of Area with Slopes 5% to 10%	Percentage of Area with Slopes 10% - 25%	Percentage of Area with Slopes > 25%
Coffee Lake Creek	77.69	12.4	6.6	3.3
Boeckman Creek	65.8	14.3	11.8	8.2
Meridian Creek	72.6	10.5	8.8	8.1
Villebois	92.4	6.6	0.8	0.2
Charbonneau	73.8	15.2	8.5	2.5
Willamette-Direct	60.1	18.2	12.6	9.0

3.5 SOILS

The Soil Conservation Service (SCS) hydrologic soil group classification is an important parameter influencing the runoff characteristics of an area and the volume of runoff that subsequently discharges to surface waters. Soils with high infiltration rates have lower runoff volumes and velocities, while soils with slower infiltration rates have higher runoff volumes and velocities. Infiltration parameters associated with each SCS hydrologic soil group are summarized in Table 3-3.

Table 3-3
Infiltration Capability by SCS Hydrologic Soil Class[1]

Soil Type	A	B	C	D
Saturated hydraulic conductivity	Very high	High to Moderately High	Moderately High to Moderately Low	Moderately Low
Approximate range of infiltration rates	1.4 to 14 inches/hour	0.14 to 1.4 inches/hour	0.014 to 0.14 inch/hour	0.0014 to 0.014 inch/hour

Note:
1. Source: Based on USDA technical manual, Chapter 3c, and represents saturated conditions

There are no Group A soils in the City. Soils classified as hydrologic Group B are moderately drained and generally grouped on the north side of the Willamette River, extending northwest. Group B soils are also present on the south shore of the Willamette River in the Charbonneau District, as well as the southern portion of the Charbonneau District itself. Soil Group C has slower infiltration rates and covers the majority of the City. Group D soils, which have very slow infiltration rates, are generally dispersed in small pockets throughout the City, north of the Willamette River (Figure 3-3).

The hydrologic soil groups were an important aspect of the hydrologic modeling, and were used as a planning tool for determining appropriate locations for certain types of BMPs. For instance, LID solutions would not be effective in an area with slow infiltrating soils (Group D). Table 3-4 summarizes the soil types within the City.

Table 3-4
Breakdown of Soil Type Within the Study Area
(acres)

Drainage Basin	SCS Hydrologic Soil Class			
	A	B	C	D
Coffee Lake Creek	0	1,938.4	1,138.7	182.8
Boeckman Creek	0	140.3	1,186.6	87.3
Meridian Creek	0	0.4	344.4	24.2
Villebois	0	0.3	110.5	15.2
Charbonneau	0	107.1	374.8	0.0
Willamette-Direct	0	270.6	195.3	26.1
Other (Newland Creek, unnamed tributary, and Mill Creek	0	90.1	297.4	7.8
Total	**0**	**2,547.2**	**3,647.7**	**343.4**

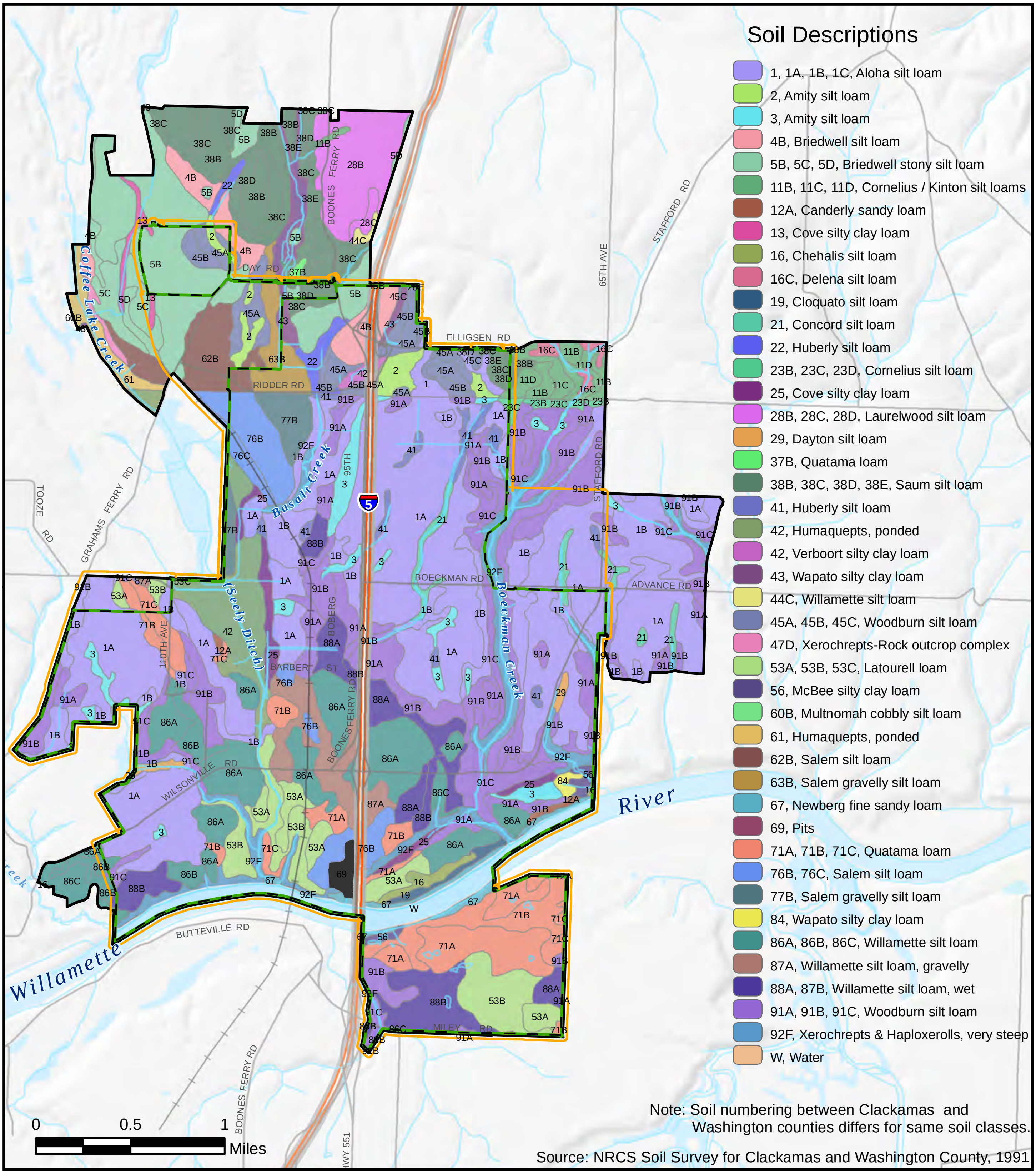

Figure 3-3
Study Area Soil Types

City of Wilsonville
Stormwater Master Plan

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Study Area
Streams
UGB Boundary
City Limits

3.6 WETLANDS

From a local wetland inventory completed by the City in 1997-1998, 54 wetland sites were identified, comprising a total of 254.1 acres. Of the 254.1 acres of wetlands assessed and mapped, 138.7 acres belong to the large Coffee Lake Creek wetland, which includes Seely Ditch and extends from Wilsonville Road north to the northwestern boundary of the City's UGB. Other natural wetlands are present along the other streams within the City, including the three main tributaries to Coffee Lake Creek (Basalt Creek, middle tributary to Coffee Lake Creek, and south tributary to Coffee Lake Creek), Boeckman Creek in the eastern area of the City, and Arrowhead Creek in the southwest area of the City. In addition, small wetlands not associated with a major drainage are dispersed throughout the City (Figure 3-4).

3.7 LAND USE

Land use has a direct correlation with the quantity and quality of stormwater runoff generated. Different land uses are associated with different percentages of impervious surface, which affect the volume and velocity of stormwater runoff expected (Table 3-5). Different land uses are also associated with different pollutant-generating activities, which affect the amount of pollutants in stormwater runoff. Development activities result in increases in overall pollutant loads because (1) the conversion of pervious surfaces to impervious surfaces results in increases in stormwater runoff volume, and (2) the change in pollutant-generating activities associated with the transformation of vacant land or open space to a residential, commercial, or industrial land use with higher pollutant generating potential.

This Stormwater Master Plan and the associated hydrologic and hydraulic model were developed to account for existing land use conditions and the expected change in land use for future conditions. Thus, water quality and quantity changes can be forecasted, and appropriate stormwater planning can mitigate these potentially negative effects.

Table 3-5
Land Use and Associated Impervious Coverage

Land Use Category	Percentage of Impervious Surface
Agriculture	5
Industrial	85
Open Space	5
Vacant	5
Commercial	80
Commercial – Villebois	85
Residential	35
Residential – Villebois	60
Multi-Family Residential	55
Multi-Family Residential – Villebois	85

Note: These values were referenced from the Wilsonville 2001 Stormwater Master Plan and were used to generate impervious percentages, by subbasin, used in the hydrologic model.

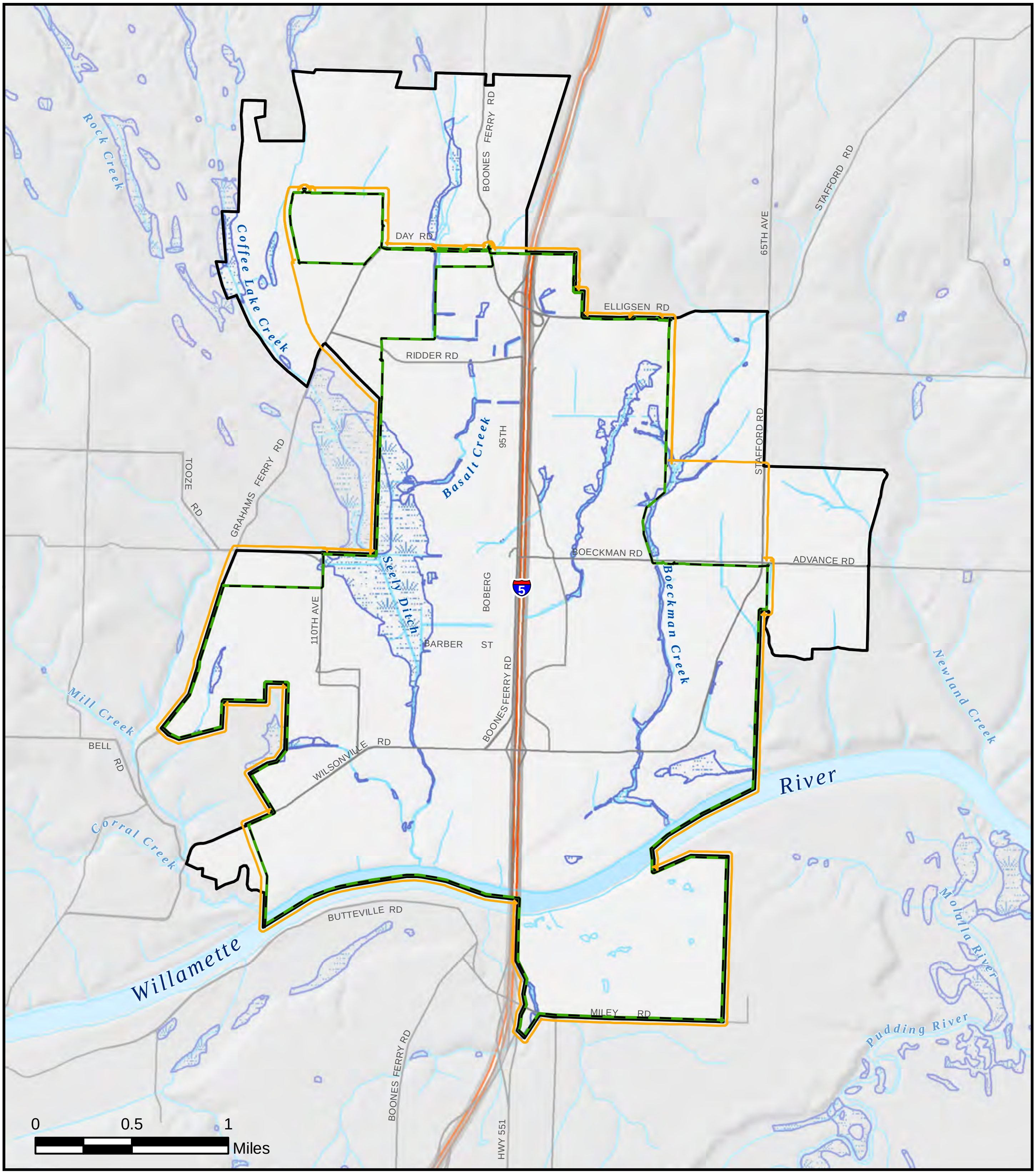

Figure 3-4
Study Area Wetlands

City of Wilsonville
Stormwater Master Plan

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Wetland Areas
Study Area
Streams
UGB Boundary
City Limits

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3.7.1 Existing Land Use

The City of Wilsonville has been undergoing rapid development over the last decade. A majority of the existing land use in the City is residential, commercial, and industrial. In developed areas, the zoning correlates well with the City's land uses.

The existing area of industrial land use is primarily located along the central I-5 corridor in the City. Existing commercial land use areas are primarily clustered around the intersections of I-5/Wilsonville Road and I-5/Elligsen Road. Residential land use is distributed throughout the City but is centralized south of the Willamette River in the Charbonneau Development, west of I-5 along Wilsonville Road, and southeast of the I-5/Boeckman Road intersection.

Villebois Village is a recent, mixed-use development on the west side of the City that is partially developed. The impervious percentages by land use type have been adjusted for the Villebois Village development to account for the higher-density development. Increased development density can allow for more large open space areas throughout the City such as wetlands, riparian areas, and parks. See Table 3-6 for existing land use breakdowns, and Figure 3-5 for a graphical depiction of existing land use within the City.

3.7.2 Future Land Use

Future land use conditions were estimated for purposes of developing the hydrologic model for the Stormwater Master Plan. The assumptions used for modeling developed areas and associated land use coverage under existing conditions were maintained for the future conditions. All areas inside the current and projected UGB and areas that were included as vacant in the existing condition model were assumed to be fully developed for the future condition model. Future condition land use coverage was defined based on current or anticipated zoning classification.

One of the largest existing vacant areas expected to develop is the Villebois Village. Existing conditions reflect only partial development of the area. Future conditions reflect full build-out of the total Village area (approximately 480 acres). In addition, an area north of the City's UGB was added to the Metro UGB in 2004. Future jurisdictional boundaries and land uses will be determined through joint master planning efforts. The area has been modeled as industrial land use so that the most conservative stormwater flows are projected. The area is included in the analysis due to its location in Willamette River drainage basins.

As discussed in Section 3.2, planning areas were not modeled for the existing conditions scenario. These include three areas east of the current UGB, encompassing 251 acres, 187 acres, and 157 acres, and a fourth area encompassing approximately 51 acres to the west of the current UGB, near the Willamette River. These areas are existing agricultural areas, and are expected to be re-zoned as single-family or multi-family residential upon inclusion in the UGB. See Table 3-6 for a summary of future land use, and Figure 3-6 for a graphical depiction of future land use based on zoning.

Table 3-6
Existing and Future Condition Land Use
Classifications for the City of Wilsonville

Land Use/Zoning Category	Existing Land Use[1] (acres)	Future Land Use[2] (acres)
Agriculture	80.3	135.2
Commercial	671.2	680.5
Industrial	1,045.2	2,180.8
Multi-family Residential	305.1	487.7
Multi-family Residential – Villebois	46.7	46.7
Single-Family Residential	1,051.2	1,651.7
Single-Family Residential – Villebois	80.2	159.9
Open Space	875.3	918.6
Vacant	459.1	299.2
Total[3]	**4,614.2**	**6,560.6**

Notes:
1. Existing land use breakdown includes all area within City limits.
2. Future land use breakdown includes all areas within the entire study area (City limits, existing UGB, and future planning areas).
3. Total acreage differs from Table 3-1 because basins were delineated using a different Willamette River GIS file than were used for the land use/zoning files.

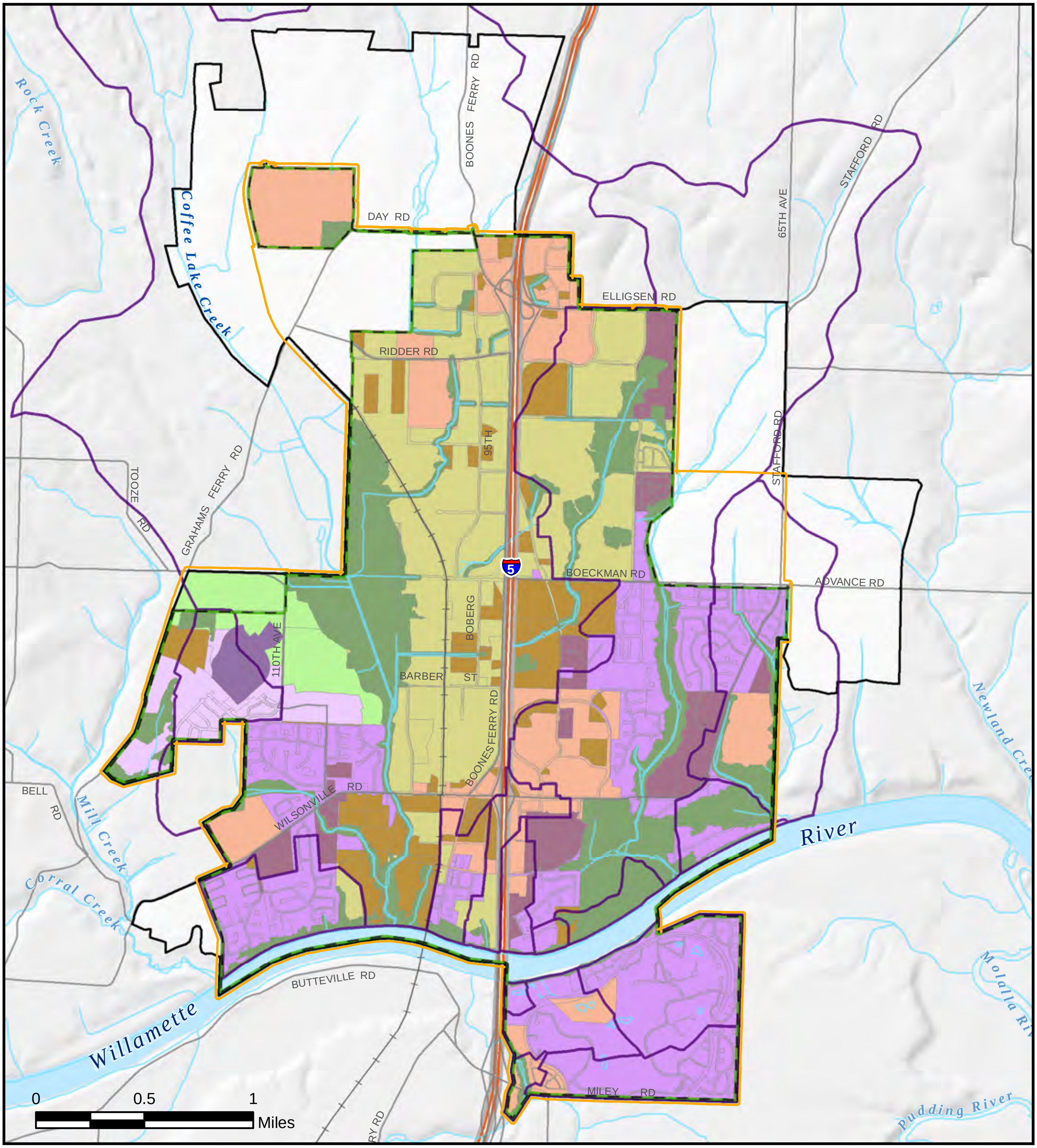
REFERENCES:

Portland State University Center for Population Research and the U.S. Census Bureau.

Economic Development Center website. Accessed February 10, 2009.

City of Wilsonville Stormwater Master Plan, page 4-4, June, 2001, Tetra Tech/KCM.

USDA technical manual, Chapter 3c.



Commercial / Government	Study Area
Single Family Residential	Streams
Single Family Residential - Villebois	UGB Boundary
Multi-Family Residential	City Limits
Multi-Family Residential - Villebois	Watershed Boundaries
Industrial	
Vacant	
Agriculture	
Parks and Open Space	

Figure 3-5

Current Land Use

City of Wilsonville
Stormwater Master Plan

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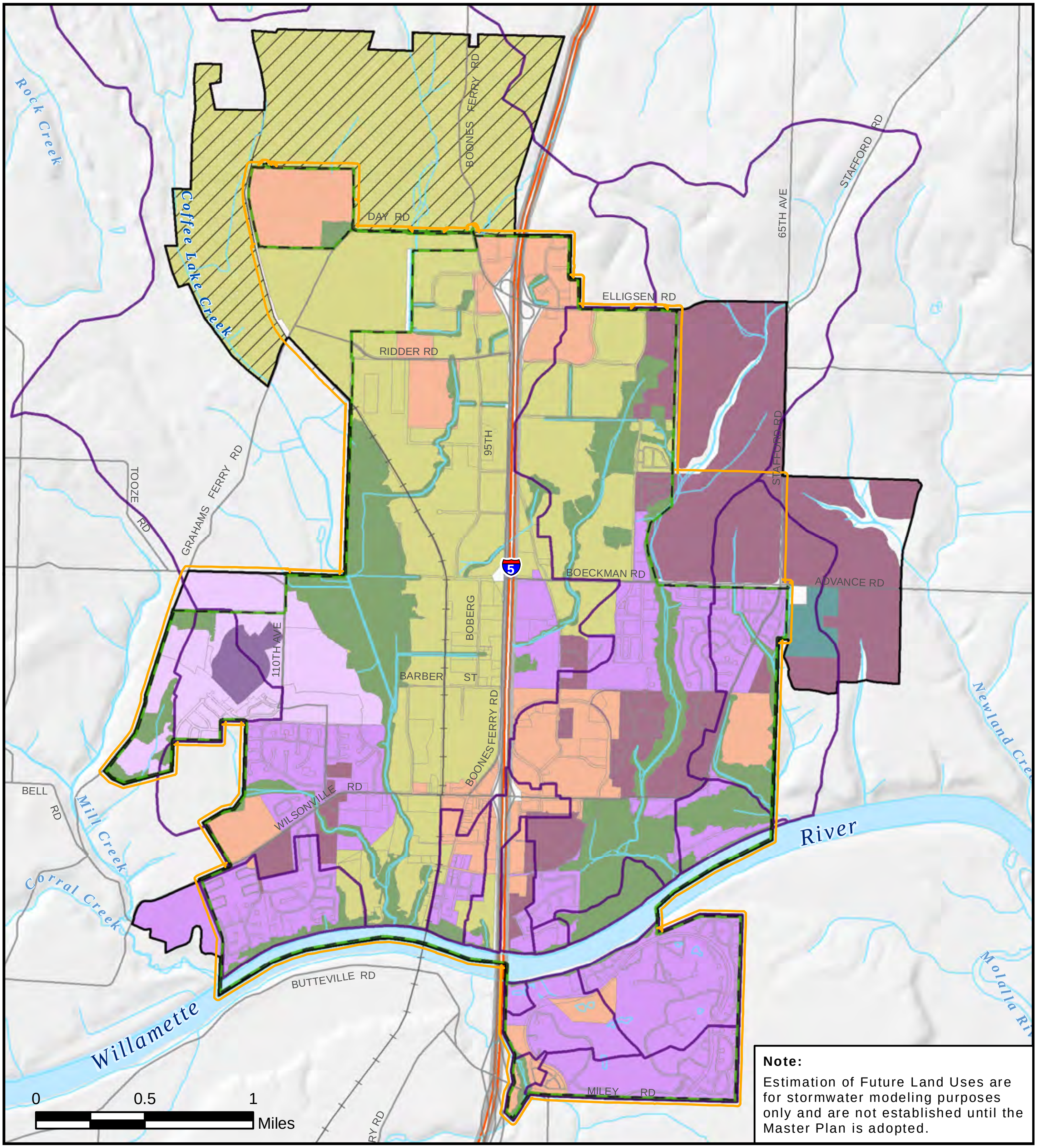

Figure 3-6

Future Land Use Based on Zoning

City of Wilsonville
Stormwater Master Plan

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- Commercial / Government
- School
- Single Family Residential
- Single Family Residential - Villebois
- Multi-Family Residential
- Multi-Family Residential - Villebois
- Industrial
- Agriculture
- Parks and Open Space

- Within Metro UGB (See Section 3.7.2)
- Study Area
- Streams
- UGB Boundary
- City Limits
- Watershed Boundaries

4.0 EXISTING STORMWATER DRAINAGE SYSTEM

4.0 EXISTING STORMWATER DRAINAGE SYSTEM

4.1 CONVEYANCE SYSTEM

The City of Wilsonville's conveyance system is comprised of pipes, culverts, natural channels, and constructed channels.

Piped System

The City of Wilsonville has an extensive pipe network for the conveyance of stormwater runoff throughout the City. Pipes range from 8 inches to 48 inches in diameter, and are both public and privately owned. More than 19 miles of pipe 15 inches in diameter or greater was modeled for this Stormwater Master Plan. Typical pipe materials are polyvinyl chloride (PVC), reinforced concrete pipe (RCP), and corrugated metal pipe (CMP). The City is currently in the process of replacing sections of CMP with RCP and PVC due to its superior durability, particularly when changing road surfaces from asphalt to concrete.

Open Channels

A significant portion of the City's stormwater conveyance system consists of natural and constructed open channels. Although surveying channel dimensions was not included as part of this Plan, defined channel widths range from 4 feet up to 20 feet (Seely Ditch), with wetland areas modeled up to 50 feet wide. Approximately 14 miles of open channel were included in the model.

4.2 WATER QUANTITY FACILITIES

Numerous private and public water quantity facilities are present throughout the City, including small onsite facilities and several large regional water quantity facilities. Facility types include round pipe, arch pipe, underground vaults, and aboveground ponds. City design standards require water quantity facilities for all new development and re-development so that post-construction flows do not exceed pre-development rates for the 2-year, 10-year, and 25-year storms. Private and public regional water quantity facilities are summarized, by basin, below.[3]

[3] The acreage of areas draining to detention basins is based on delineation conducted by URS using topography with 2-foot contours.

Coffee Lake Creek Basin (private facilities)

- Stafford Pond – Southeast of the intersection of SW St. Helens Road and SW Parkway Avenue, draining approximately 69 acres.
- Renaissance Pond – Northeast of SW Parkway Ave and SW Maxine Lane, draining approximately 57 acres.
- Coca-Cola Pond – Between the railroad and SW Kinsman Road, north of the end of SW Seely Avenue, draining approximately 33 acres.
- Villebois South 2 Arrowhead Creek, Pond E1 – In the Villebois South 4 area, managing runoff from the northern portion of the development, draining approximately 77 acres.
- Villebois South 2 Arrowhead Creek, Pond E2 – South of Pond E1 in the Villebois South 2 area, draining approximately 8 acres.
- Villebois South 1 Arrowhead Creek, Pond F – Southwest of the SW Orleans Avenue and SW Costa Circle intersection in the Villebois South 1 area, downstream of Ponds E1 and E2, draining approximately 126 acres.
- Wilsonville Distribution Center – North of Wilsonville Road and east of the railroad tracks, draining approximately 58 acres.
- Tonkin Automotive – East of 95th Avenue and north of Nike Access Road, drains approximately 16 acres.

Boeckman Creek Basin (public facilities)

- Boeckman Pond – A large reservoir north of SW Boeckman Road and east of SW Canyon Creek Road, draining approximately 1,252 acres.
- Memorial Park Pond (formerly known as the Library Pond) – East of SW Memorial Drive, across the street from the Wilsonville public library, draining approximately 160 acres.

4.3 WATER QUALITY FACILITIES

Many different types of structural water quality BMPs are available, both proprietary and non-proprietary. Each has specific strengths, target pollutants, maintenance requirements, and associated costs. A significant amount of the City of Wilsonville's area currently drains to structural water quality BMPs. The most prevalent structural water quality BMPs within the City of Wilsonville fall into four categories:

- Hydrodynamic separators
- Media filtration systems
- Wet ponds
- Swales

The BMP coverage in the City of Wilsonville by land use type is summarized in Table 4-1.

Table 4-1
Water Quality Best Management Practices Coverage

Land Use	BMP Coverage (acres)
Single-Family Residential	77.31
Commercial	278.74
Multi-Family Residential	119.93
Industrial	283.24
Total – Citywide	**759.22**

4.4 EXISTING FLOODING AND WATER QUALITY PROBLEM AREAS

Problem areas typically involved areas of flooding and evidence of significant erosion. Problem areas were evaluated to determine potential CIP projects and to verify the accuracy of the hydrologic and hydraulic model. Information on existing problem areas was generally provided by City staff and through field observations. The City experienced a 25-year storm on January 1, 2009, and observations regarding flooding were made during this event to identify additional problem areas. The problem areas are described in the following section.

4.4.1 Existing Problem Areas

The following problem areas are identified by number on Figure 4-1.

P1. Commerce Circle Industrial Area

Location: Day Road South to Stafford Business Park

This area has poor drainage and is prone to flooding. Basalt Creek overtops its banks during moderate storm events, flooding the parking lot along the western side of the Commerce Circle Business Park. Some segments of Basalt Creek in this vicinity have negative slopes, preventing flooding from occurring downstream. Negative channel slopes in various sections along the channel in this segment are believed to contribute to the flooding in this area.

P2. Agricultural Field East of Pheasant Ridge

Location: East of Pheasant Ridge, North of Elligsen Road

Runoff from the agricultural field adds a significant amount of silt to Boeckman Creek. The problem is believed to be largely due to plowing being done close to the edge of the field to the western and southern edges of the road. The area is not currently within City limits, and would benefit from collaboration with the Soil and Water Conservation District to address the issue.

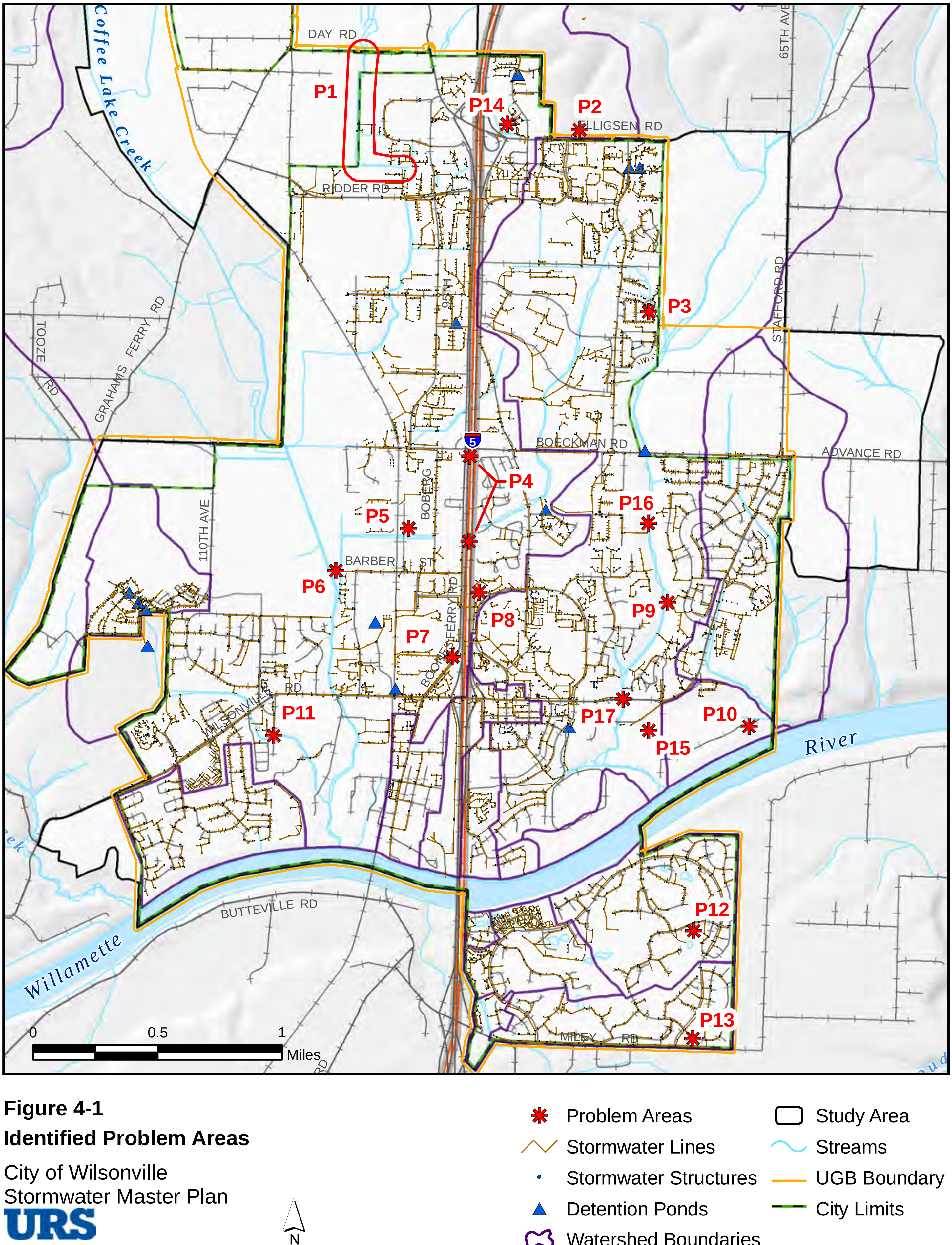

Figure 4-1
Identified Problem Areas

City of Wilsonville
Stormwater Master Plan

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March 2012

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P3. Colvin Lane Channel

Location: Channel South of Colvin Lane

The bank south of Colvin Lane shows evidence of scouring, likely due to a pipe installed in the creek channel by a private property owner. Erosion resulting from the undersized pipe installed in the creek channel increases sediment loads to the creek, causing water quality to deteriorate. This pipe should be removed and the drainage way should be vegetated to stabilize the steep slopes.

P4. Corrugated Metal Pipes under I-5

Location: Various locations along Parkway Avenue and Boones Ferry Road

Several pipes that cross under I-5 between Parkway Avenue and Boones Ferry Road are made of corrugated metal. These pipes are at the end of their design life, and need to be replaced. However, one pipe under I-5, north of Barber Street, provides detention for upstream areas east of the freeway. If this pipe is replaced and upsized, the pipe would no longer offer detention and a new facility will need to be constructed to avoid downstream flooding.

P5. South Tributary to Coffee Lake Creek at Boberg Road

Location: East of Boberg Road at South Tributary to Coffee Lake Creek

Currently two 42-inch diameter parallel concrete culverts convey the south tributary to Coffee Lake Creek under Boberg Road. On the western side of Boberg Road, the two parallel culverts and a 21-inch diameter corrugated metal pipe from the north both discharge into the tributary to Coffee Lake Creek. There is evidence of scouring at this location in the channel from heavy flows. At the inlet side of the parallel culverts, east of Boberg Road vegetation appears to be impeding flows, causing erosion and scour behind the headwall of the culvert.

P6. Culvert at West End of Barber Street

Location: Culvert underneath private property access gate, running north to south, at the west end of Barber Street.

This culvert restricts flow and needs to be replaced.

P7. 18-Inch Storm Drain Under I-5

Location: Underneath I-5 from Town Center Loop West to Boones Ferry Road

Drainage is poor in this area, and the condition of the pipe is uncertain.

P8. Outfall South of Les Schwab

Location: Just east of I-5 and North of Town Center Loop West

The outfall restricts discharges from neighboring properties to Oregon Department of Transporation (ODOT) right-of-way, causing small amounts of flooding at Town Center Loop West during heavy rainstorms.

P9. Boeckman Creek Outfall West of Gelleschaft Water Well

Location: West of Gesellschaft Water Well

Extreme scouring has occurred in this drainage to Boeckman Creek. Previous attempts to control runoff were made, including installing an asphalt apron and installing gabions in three locations along the drainageway. Water has bypassed and undermined the gabion structures, rendering them ineffective for dissipating energy. The Gesellschaft Water Well is a backup supply source, and discharges water once a week to maintain the water's freshness which increases the flows into the drainage way.

P10. Undersized Culvert under Montgomery Way

Location: East end of Montgomery Way at culvert for a small creek in the Southeast portion of the City, north of the Willamette River

The existing 30-inch corrugated metal pipe culvert is undersized, and it is partially filled with debris, further reducing its capacity. During heavy rainstorms, this culvert causes some minor flooding; residents north of the culvert have reported sheet flow flooding in the area.

P11. Culverts under Jobsey Lane at Arrowhead Creek

Location: Jobsey Lane South of Wilsonville Road

The existing culvert is damaged, thereby hindering flow, and needs to be replaced.

P12. Charbonneau Pipe Replacement

Location: Throughout the Charbonneau Community
The pipes making up the stormwater drainage system in the Charbonneau Community south of the Willamette River are approximately 30 to 40 years old and many are in poor condition. Drainage issues have been identified throughout the community, although no comprehensive list has been compiled. The majority of the pipes in this area are corrugated metal material that is seriously decayed, and nearing the end of its service life. During the 25-year storm on January 1, 2009, flooding occurred near Miley Road. Catch basins within the development are currently spaced approximately 800 to 1,000 feet apart, roughly twice the distance that would be required based on current design standards. The entire pipe network within the Charbonneau Community needs to be replaced with more durable pipe, and catch basins should be replaced according to current City standards. In addition to the storm drainage system, water lines, wastewater facilities and roadways are at the end of their useful service life. All of the infrastructure in Charbonneau should be considered for upgrading and replacement for economy in construction, reduction in maintenance and long term serviceability.

P13. Wall Built over Storm Drainage Pipes in the Charbonneau Community

Location: Southern boundary of the Charbonneau Community, west of French Prairie East Entrance

A private wall was built over the existing storm drain pipes along NE Miley Road in the Charbonneau Community. The wall is settling and breaking, most likely contributing to the degrading condition of the stormdrain pipes in this location. The wall also hinders access to the existing pipe system in that area for maintenance and/or repair.

P14. Property Northeast of I-5 at Elligsen Road

Location: Northeast of the I-5/Elligsen Road interchange

During the 25-year storm on January 1, 2009, flooding was reported in the basement of the La Quinta Inn. Possible contributing factors include a detention facility to the south of the hotel that is in need of maintenance, or a high groundwater table. The 36-inch diameter pipe installed by ODOT designed to pass water from the La Quinta Inn site underneath Elligsen Road appears to be in good condition.

P15. Rose Lane Culvert

Location: Rose Lane at the southeastern corner of the City

A 12-inch corrugated metal pipe culvert at Rose Lane is not large enough to adequately convey flows underneath Rose Lane. In addition, the roadway and pipe are lower in topography than upstream or downstream areas, causing water to collect and flood over the roadway until the water slowly infiltrates or evaporates. In addition to exploring the opportunities to rehabilitate wetlands on both sides of the roadway, the City can install a larger pipe and raise the roadway to alleviate some of the flooding.

P16. Outfalls in Boeckman Creek

Location: Boeckman Creek

A number of outfalls drain stormwater to steep slopes in Boeckman Creek with little or no energy dissipation at the outfall location. These outfalls have caused serious erosion problems, along the steep slopes adjacent to the creek and the water quality has deteriorated. Rebuilding the last sections of the outfalls to direct discharge downstream and avoid the erosive effect of discharging water perpendicular to the creek, adding vegetation and providing energy dissipation at the outfall will reduce the erosion that is currently occurring at these sites.

P17. Wilsonville Road Bridge over Boeckman Creek

Location: Wilsonville Road at Boeckman Creek

At the intersection with Wilsonville Road, Boeckman Creek is somewhat incised but it overflows regularly into its floodplain. Erosion has occurred around the bridge footings in the Creek.

4.4.2 Evaluation of Problem Areas

With the exception of some isolated problem areas detailed above, the City does not have serious flooding problems for existing land use.

The largest pipe replacement project involves rebuilding the Charbonneau District, a large private development south of the Willamette River. As the system deteriorates, more sediment and debris is entering the pipe through cracks in the pipe, increasing the concern over water quality of the discharge. Replacement of the storm drains can be tied into replacement of other utilities and upgrading the roadway. This would be a good opportunity to install Low Impact Development facilities throughout the development, further enhancing water quality benefits for this project.

Outfalls into the steep canyons of Boeckman Creek and other steep slopes are of increasing concern. With expanding impervious areas upstream larger stormwater flows are generated, and there is the potential to destabilize the steep canyon slopes. High-priority projects have been identified to address the rehabilitation of the outfalls while also reducing upstream flows. Policies have been identified in Section 2.0 of this Master Plan to assist with implementation of Low Impact Development projects and reduction of upstream flows.

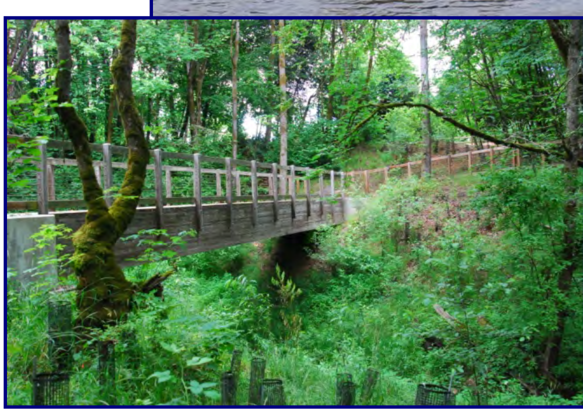
5.0 PUBLIC PROCESS

5.1 STORMWATER MASTER PLAN OPEN HOUSE

5.2 PUBLIC EDUCATION MATERIALS

5.3 PLANNING COMMISSION APPROVAL

5.4 CITY COUNCIL APPROVAL



5.0 PUBLIC PROCESS

Public involvement is a key component of the City's strategy to implement its stormwater management program. The City values public input and depends on the public's understanding of stormwater issues to support stormwater programs, policies, and Capital Improvement Program (CIP) projects. Some of the CIP projects recommended in this Plan involve incentives for the public to assist with implementation of the City's stormwater goals and objectives—specifically, construction of improvements on private properties. Success of these policies and programs depends on public understanding of the need for such improvements and on the level of assistance that the City may be able to provide. Assistance can be in the form of technical support or partial funding.

The public process for this Stormwater Master Plan is an ongoing effort to involve the public in stormwater-related public works projects. The following activities are associated with maintaining public involvement for development of this Stormwater Master Plan:

- Two open houses,
- Stormwater Master Plan updates on the City's website,
- Public education materials at City Hall,
- Stormwater Master Plan updates in the City's monthly newsletter,
- Stormwater Master Plan updates in the monthly utility bills,
- Presentations and public hearings at Planning Commission Meetings, and
- Work sessions and a public hearing for adoption of the Stormwater Master Plan by the City Council

5.1 STORMWATER MASTER PLAN OPEN HOUSE

The first open house related to this Stormwater Master Plan was hosted by the Planning Commission and held at City Hall on October 16, 2008. Ten people attended the 2-hour open house along with City staff and members of the Planning Commission. Information was provided on stormwater programs in general, the existing stormwater conveyance system, current stormwater-related issues, and potential solutions for existing stormwater issues (i.e., Low Impact Development options). Persons attending the open house were provided with information on the purpose of the Stormwater Master Plan and were encouraged to ask questions and to provide input on existing drainage problems and any other concerns. Members of the public were in general agreement with the City's vision on implementing Low Impact Development projects throughout the City to address stormwater quantity and quality. No stormwater comments were submitted to the City as a result of the open house. A second open house was hosted by the Planning Commission and held on May 27, 2009 to present the draft Stormwater Master Plan with proposed CIP projects, Low Impact Development opportunities and examples, and policies to implement sustainable stormwater solutions. Invitations to the open house were sent out via the City website, City newsletter, and utility bill insert. Members of the public were invited to discuss findings of the Plan and proposed solutions, and to hear how they might participate in the proposed implementation strategies. One member of the public and City staff attended the second open house. There were no comments on the proposed projects or stormwater policies.

5.2 PUBLIC EDUCATION MATERIALS

The City provided information about the status of the Stormwater Master Plan on its website, at community events, and in a utility insert. These materials also provided educational information related to stormwater, including the causes of water quality problems, the benefits of source control, opportunities for public participation in solutions, and how the CIP recommendations help address the stormwater problems.

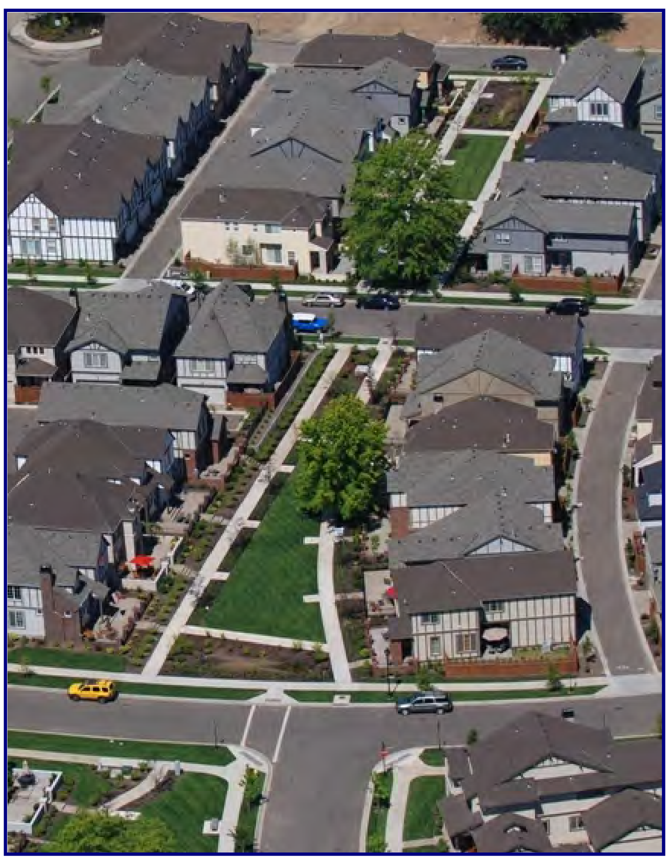
5.3 PLANNING COMMISSION APPROVAL

The draft Stormwater Master Plan was presented to the City Planning Commission over several months, including May 13, June 10, July 8, and October 14, 2009. A public hearing was held on the draft Master Plan at the City Planning Commission meeting on January 13, 2009. The City Planning Commission recommended the Stormwater Master Plan for approval by the City Council.

5.4 CITY COUNCIL APPROVAL

Following a recommendation from the Planning Commission to adopt the Stormwater Master Plan, the City Council conducted a number of work sessions and held public hearings in December 2011 and February 2012. Thereafter, following incorporation of changes to the draft Master Plan, it was adopted by the City Council on February 23, 2012. Members of the public were encouraged to participate and comment at these meetings and public hearings.

6.0 HYDROLOGIC AND HYDRAULIC ANALYSIS



6.0 HYDROLOGIC AND HYDRAULIC ANALYSIS

6.1 GOALS OF ANALYSIS

Modeling of the City of Wilsonville's stormwater system was conducted to determine the condition and function of the system for various storm events during current and future development conditions and the flow-reduction benefits of future Low Impact Development implementation. Results of the modeling effort were used to develop CIP projects for future stormwater system improvements. More detail regarding the model and its calibration are provided in Appendix D.

6.2 MODEL SELECTION

Wilsonville city staff selected the InfoSWMM model for use in the hydrologic and hydraulic modeling of the stormwater system. This decision was made after URS conducted research on a number of models, including the Hydra model used for preparation of the City's 2001 Stormwater Master Plan, and the City evaluated its specific needs with regard to a hydrologic and hydraulic model.

InfoSWMM has a Geographic Information System (GIS) interface and allows the user to readily change scenarios and rerun the model with new assumptions, is able to incorporate projects, which is an important component of this Stormwater Master Plan, and has separate modules for: potable water, wastewater, and stormwater. Using a unified platform would provide efficiency in training and communication between staff and technical support. Low Impact Development modeling and results are discussed in Section 6.7.

6.3 MODEL DEVELOPMENT

Stormwater modeling includes both a hydrologic and a hydraulic component. Development of the model, including a summary of hydrologic and hydraulic input parameters is described below. Tables summarizing all model input parameters are provided in Appendix D.

6.3.1 Hydrologic Model Data

Subbasin Delineation

Subbasins were originally delineated for the City's 2001 Stormwater Master Plan. For this Stormwater Master Plan, these subbasins were checked and adjusted as necessary based on topography (2-foot contours). Subbasins were updated in accordance with input from City staff on changes in drainage patterns and project as-built information. In some cases, storm system components installed for new development resulted in redirected drainage from natural or pre-developed runoff patterns and discharge into neighboring subbasins. Section 3.2 provides more information on the major basins within the City.

Model Input Parameters

The hydrologic input data for the InfoSWMM model was taken from the GIS data provided by the City, and from the previous Hydra model. The Hydra model provided drainage configurations for more recent developments (i.e., Villebois).

The following user-defined hydrologic parameters were included for each subbasin in the InfoSWMM model:

- Subbasin name or number
- Subbasin (acres)
- Impervious surface percentage (percent)
- Average ground slope (percent)
- Subbasin width (feet)
- Manning's roughness coefficient for impervious areas
- Manning's roughness coefficient for pervious areas
- Depression storage for impervious areas (inches)
- Depression storage for pervious areas (inches)
- Green-Ampt soil infiltration parameters: initial moisture deficit of soil, hydraulic conductivity of soil, and suction head at the wetting front.

A summary is provided below for each user-defined hydrologic parameter entered into the InfoSWMM model.

Subbasin Number

Subbasins were assigned numbers based on the numbering convention provided by the City. Subbasins that are not currently in the City boundaries, and are only simulated for the future conditions scenario, have the prefix "Fut."

Subbasin Area (acres)

Subbasin areas were calculated in accordance with the updated subbasin delineation and included in the model.

Subbasin Impervious Surface Percentage

The City of Wilsonville defines percentage of impervious surface by associated land use (Table 3-5). Using GIS, a weighted average of the percentage of impervious surface was calculated for each subbasin, reflective of the subbasin's overall land use coverage. This was calculated for both the current and future condition scenarios.

Refer to Section 3.6 for a discussion regarding the determination of land use for existing and future conditions. A complete list of percentage of impervious surface by subbasin, as used in the model, is provided in Appendix D.

Subbasin Average Ground Slope (percent)

The subbasin slope is the average slope along the pathway of overland flow to the inlet of the drainage system. The subbasin slope was calculated using digital topographic data in GIS and averaged over each subbasin. A complete list of average ground slope by subbasin, as used in the model, is provided in Appendix D.

Subbasin Width (feet)

The subbasin width describes the geometry of the subbasin and influences the runoff patterns for the subbasin. For simplicity, generalized subbasin width estimates for the model were calculated as the square root of the subbasin area.

Manning's Roughness Coefficient for Impervious and Pervious Areas

Manning's roughness coefficient (*n*) provides a measure of the friction resistance to flow across a surface or channel. The InfoSWMM model used the same values of Manning's *n* as the previous Hydra model. Manning's *n* for impervious surface is 0.011, and the Manning's *n* for pervious areas is 0.13.

Depression Storage for Impervious and Pervious Areas (inches)

Depression storage is the maximum surface storage provided by ponding, surface wetting, etc., that is filled prior to runoff occurring. The InfoSWMM model used the depression storage values used for the previous Hydra model. The depression storage for impervious surface is 0.05 inch, and the depression storage for pervious surface is 0.1 inch.

Green-Ampt Infiltration Parameters (units vary)

The Green-Ampt method was used to estimate runoff and infiltration in the InfoSWMM model. The Green-Ampt method calculates infiltration of stormwater into soils using antecedent moisture conditions (initial moisture deficit), suction head, and the hydraulic conductivity of the soil. The values of these three parameters were based on soil types in the City of Wilsonville (Figure 3-3). Specific soils types and their distribution within each subbasin were determined using GIS files from the Natural Resources Conservation Service (NRCS). Using GIS, area-weighted averages for each of the three parameters (initial moisture deficit, suction head, and hydraulic conductivity) were calculated on a subbasin basis, using information in Table 6-1.

Table 6-1
Green-Ampt Infiltration Parameters by Soil Type

Soil Texture Class	Hydraulic Conductivity (in/hr)	Suction Head (inches)	Initial Moisture Deficit (fraction)
Sand	4.74	1.93	0.413
Loamy Sand	1.18	2.4	0.39
Sandy Loam	0.43	4.33	0.368
Loam	0.13	3.5	0.347
Silt Loam	0.26	6.69	0.366
Sandy Clay Loam	0.06	8.66	0.262
Clay Loam	0.04	8.27	0.277
Silty Clay Loam	0.04	10.63	0.261
Sandy Clay	0.02	9.45	0.209
Silty Clay	0.02	11.42	0.228
Clay	0.01	12.6	0.210

6.3.2 Hydraulic Model Data

The hydraulic modeling effort focused on significant components of the public conveyance system, specifically pipe and open channel conveyances. As with most public stormwater systems, the location and function of existing conveyance and detention facilities are not well documented, especially for older systems installed prior to current documentation and stormwater management efforts. Thus, modeling was limited to major stormwater systems, including interceptors that provide for the primary drainage for each basin. Pipes 15-inches in diameter and larger were included in the model (with a few exceptions). Simplification of the modeled drainage system minimized overall model run time.

The source of hydraulic input data used in development of the hydraulic model was primarily GIS data provided by the City. Additional data provided by the City: as-built drawings, project design reports, and limited field reconnaissance, including staff input, helped to qualify the updated system inventory. The previous Hydra model was used to fill in data gaps, and provided additional information related to open channel geometry.

URS conducted field work to verify the locations and configurations of selected outfalls, culverts under roadways, and detention facilities. Major culverts, such as the Coffee Lake Creek crossing at Wilsonville Road, were inspected and their sizes and shapes were verified for inclusion in the model. Surveying was not conducted as a part of this effort.

The existing modeled system was presented to the City, adjusted based on City comments, and approved at a meeting with City staff in October, 2008.

Model Input Parameters (Conduits)

Conduit Length (feet)

Conduits (pipes and open channel conveyances) connect all nodes (junctions, outfalls, and storage nodes) within the hydraulic system and convey water through the system. Conduit length was calculated as the distance between two nodes.

Manning's Roughness Coefficient (*n*)

Manning's roughness coefficients (*n*) were defined for all conduits, based on pipe material or open channel surface coverage. Manning's *n* for pipes was assigned based on the system inventory data supplied by the City and on the typical n values by pipe material:

n = 0.011 for PVC
n = 0.013 for RCP
n = 0.024 for CMP

Pipes with unknown materials were assigned the Manning's *n* for concrete, 0.013.

Open channels were assumed to have a Manning's "n" of 0.035, consistent with assumptions used for the previous Hydra model.

Invert Elevations (feet)

Invert elevations represent the elevation at the node with which a conduit enters or exits. Invert elevations are used to calculate the slope of the conduit. Invert elevations used in the model are primarily based on GIS data as-built drawings.

Cross-Sectional Geometry (feet)

Cross-sectional geometry was specified for piped and open channel conduits. For round pipe, the cross-sectional geometry is considered the pipe diameter. For arch-shaped conduits (pipes), the cross-sectional geometry considers the pipe width (in feet) and height (in feet). Cross-sectional geometry used in the model is primarily based on GIS data and as-built drawings.

All open channel conduits were assumed to be trapezoidal with depth equal to the depth of the conduit segments upstream and downstream of the particular open channel segment, as was used in the existing Hydra model.

Model Input Parameters (Nodes)

Three main types of nodes are used in the InfoSWMM model: junctions, outfalls, and storage nodes. Junction nodes can receive runoff from a subbasin or connect conduits. Outfall nodes can receive flow from a subbasin or a conduit and are used to define the downstream boundary of the conveyance system. Storage nodes represent detention facilities which are designed to collect, store, and release runoff at a reduced rate. The discharge from the storage nodes is typically described by a stage-discharge curve provided by the City. In instances where this was not available, pipes and/or orifices were used to simulate the discharge at specific storm events.

Rim Elevation (feet)

Rim elevation is an estimate of the ground elevation at the node. These values were estimated and input into the model based on GIS data, as-built drawings, and 2-foot contour elevations.

Ponded Area (square feet)

The ponded area is the area around a node that is allowed to pond and subsequently drains back into the system. This parameter is only required for junction nodes and was set at 20 square feet for all junctions to provide a reasonable amount of allowable ponding to occur at each node that would re-enter the storm system after ponding subsided.

Maximum Depth (feet)

Maximum depth is the distance from the ground surface to the outlet invert elevation of a storage node. These values were derived from information provided by the City for the modeled storage nodes.

Storage Curves

The City provided tabular storage curves representing a depth versus surface-area relationship; these were used to define the available storage volume for storage nodes. Only larger water quantity facilities were included in the model, although there are additional numerous smaller water quantity facilities installed throughout the City.

6.4 MODEL CALIBRATION

The InfoSWMM model was calibrated using flow monitoring data collected at specific outfalls by the City of Wilsonville with equipment installed through a contract with URS. The City of Wilsonville validated the results of the calibration using anecdotal evidence of flooding and comparing those locations with the calibrated model results for specific storm events.

Flow monitoring was conducted on four outfalls: two outfalls adjacent to the Willamette River (one at SW Belknap Court and one at Tauchman Road); one outfall at the Library on Wilsonville Road; and one at Ridder Road, in the northern part of the City. The location at Ridder Road experienced continual build-up of gravel in the outfall due to beaver dam activity upstream and widely differing flow measurements were observed. Therefore, model calibration used data from the other three flow monitoring sites.

Flow and rainfall data collected from March 13 to March 16, 2008 were used for the calibration. This period was selected as the calibration period due to distinct peaks in rainfall during those days. The Clean Water Services LTR rainfall gauge (located along SW Pacific Highway) and associated rainfall data were used for the calibration because of the gauge's proximity to the City and availability of 15-minute (rather than hourly or daily) rainfall data readings. Other nearby gauges were assessed, but the other gauges did not have 15-minute data available. Data readings at 15-minute intervals are preferred because they better reflect the variability in rainfall intensity over storm durations. It should be noted that the accuracy of a calibration using flow measurements is dependent on site-specific rainfall. The use of a non site-specific rainfall gauge for model input (as is the case for Wilsonville) results in modeled flows that may differ somewhat from actual flows. Best professional judgment was used during the calibration effort.

Prior to calibration, a sensitivity analysis was conducted to determine which hydrologic input parameters to adjust in calibrating the model. The parameters most likely to affect the peak flows are percentages of subbasin impervious surface and subbasin widths; therefore these parameters were chosen for the sensitivity analysis. Based on the sensitivity analysis, it was determined that changes in impervious percentages affect peak flow rates more than changes in subbasin width. Therefore, changing the impervious percentages allowed for more accurate calibration of the model and a better match of modeled and monitored peak flow rates.

Calibration focused on matching the general shape of the modeled and observed runoff hydrographs, as well as matching a few of the peaks, particularly the highest peaks recorded. Peak flows were used for calibration rather than volumes to ensure adequate sizing of stormwater systems for high flows, particularly for future conditions.

Results of the calibration indicate that the best match of peak modeled flow rates and peak monitored or observed flow rates occurred with a 25 percent increase in the modeled impervious percentage value. Because some of the subbasins already had impervious values of 75 percent or more and a 25 percent increase in imperviousness would result in a subbasin impervious percentage greater than 100 percent, a maximum impervious percentage was set at 95 percent, which reflects landscape features and minor pervious areas.

Due to the sensitivity of impervious percentage as a calibration parameter, it is recommended that the City update the land use-based average impervious percentages to actual impervious percentages from the LIDAR data collection efforts currently underway. At that time, the City may consider recalibration of the model to reflect more accurate drainage characteristics.

6.5 MODEL SIMULATIONS

6.5.1 Rainfall Events

Once flow calibration of the model was complete, the InfoSWMM model was run for existing and future development conditions for the 2-, 5-, 10-, 25-, 50-, and 100-year, 24-hour design storm events. A summary of the volume of rainfall associated with each design storm is provided in Table 6-2. An SCS Type IA rainfall distribution was used to define the intensity of rainfall for each storm event, in other words, how the rainfall is statistically distributed over a 24-hour period.

Table 6-2
24-Hour Design Storms for the City of Wilsonville[4]

Storm Event	Rainfall (inches)
2-year	2.50
5-year	3.00
10-year	3.45
25-year	3.90
50-year	4.25
100-year	4.50

Results of the existing condition simulations were initially compared with locations identified by City staff as having existing flooding and drainage issues as follow-up to the calibration process, in order to verify that the existing condition model is reflective of actual drainage patterns. For example, the City experienced an equivalent 25-year, 24-

[4] Complete table including the 24-hour storm distribution is included in Appendix D.

hour storm event on January 1, 2009. The existing condition model results for the 25-year storm were discussed with City staff and compared to field observations, in order to assess the accuracy of the model. During this storm, the City did not experience much flooding, and it was determined that the model was relatively conservative in predicting areas of flooding and surcharging of pipes, given the magnitude of flooding predicted by the model. Although conservative, no additional modifications to the calibrated model were made as a result of this comparison. Results of this effort did result in the exclusion of modeled flooding locations with relatively minor flooding (i.e., 0.1 acre-inch of volume or less) from the proposed CIP project list.

6.5.2 Scenarios

Existing and Future Conditions

The existing and future condition simulations were used to identify locations of existing and future potential flooding and for flood control CIP projects. Information related to the results of the hydrologic and hydraulic modeling is provided in Section 6.6.

6.6 MODEL RESULTS

Results of the 2-year, 10-year, and 25-year, 24-hour storm events were reviewed to identify locations of existing and future condition flooding. Flooding is indicated in the InfoSWMM model as nodes where the simulated water surface elevation is above the rim elevation. The model reports the volume of water above the rim elevation and the duration of the water surface elevation remaining above the rim elevation. Identification of nodes that experience flooding allows for the identification of the conduits that require upsizing or upgrading.

Under both existing and future conditions, the model predicts that several conduits are undersized (i.e., the pipes experience a brief surcharge). The surcharge was not sufficient to cause flooding in the upstream or downstream nodes, so these conduits were not considered problem areas or considered for a flood control CIP project as no flooding was expected.

In addition, as described previously, locations of minor flooding (i.e., 0.1 acre-inch of volume or less) were also not considered a flooding problem, and no CIPs were generated for these locations. This is a result of the conservative nature of the model with respect to the comparison of modeled results and observed flooding locations. Also, some of the as-built information used to develop the model did not match the GIS topographic mapping that was used to supplement the model, indicating that rim elevations may not be accurate in some areas.

6.6.1 Existing Conditions

The existing conditions model included all areas within the current City limits, for existing condition land use, as well as upstream drainage areas outside of the City limits. Existing conditions were modeled to identify nodes where flooding occurs and the associated conduits for the development of flood control CIP projects. Locations of existing condition flooding were given the highest priority when developing CIP projects.

General areas that are predicted by the model to experience flooding during existing conditions, and for which flooding has been confirmed by City staff are described below. All flooding is predicted by the model to occur in the 2-year storm event.

Commerce Circle – Commerce Circle is a business park development in the northwestern area of the City. The stormwater conveyance system in this area is comprised of culverts and the Basalt Creek open channel system, which is predicted to overtop its banks and flood nodes (a point connecting two or more linear segments) along the channel, beginning at the 2-year, 24-hour storm event, along the northwest section of the Commerce Circle business development.

This area is known to flood, and the parking lots in the development were originally designed to flood and provide additional detention. Therefore, some flooding is to be expected in this area. Portions of the open channel system have a reverse slope, contributing to the predicted and observed flooding. The reverse slope has not been removed so as to avoid moving the flooding to a downstream location.

SW Boberg Road north of SW Barber Street – The most upstream node of the piped system that is located upstream from the section of the South tributary to Coffee Lake Creek, west of SW Boberg Road was predicted by the model to flood during the 2-year, 24-hour storm event. The downstream flooding and an undersized pipe network are the likely causes of the predicted flooding along SW Boberg Road, north of SW Barber Street.

Hillman Court and 95th Avenue – Flooding was identified along SW 95th Avenue, just north of SW Freeman Road to SW Hillman Road, beginning at the 2-year, 24-hour storm event. A pipe constriction (12-inch pipe) downstream of the 24-inch pipe is the primary cause of predicted flooding at this location.

Charbonneau District – The Charbonneau District is an older development (approximately 40 years old) on the south side of the Willamette River. The flooding predicted by the model was generally concentrated in the northeastern portion of the development. Flooding of some nodes along the northern portion of SW French Prairie Road were predicted to begin at the 2-year, 24-hour event, with additional areas flooding at the 10-year, 24-hour storm event.

The existing pipe network in this area is primarily comprised of CMP and according to City staff, has historically been in need of repair, replacement, and some upsizing.

6.6.2 Future Conditions

The future conditions scenario includes all areas within the current UGB and the future planning areas expected to be annexed into the UGB within the next 20 years.

Flooding locations predicted by the model under the future conditions were consistent with those identified for current conditions, although the volume of flooding was typically higher, and additional nodes within the same localized area were predicted to flood.

A comprehensive review of future condition model results show that several additional surcharging conduits and nodes experiencing minor flooding (i.e., less than 0.1 acre-inch). However, as described earlier, these locations were not considered in the development of CIP projects.

6.6.3 Model Results Analysis and Findings

Results of the InfoSWMM model simulations indicate that there are currently no predicted major existing or future condition flooding locations within the City. CIP projects have been developed for the flooding locations described above and are discussed further in Section 8.

It should be noted that modeling of the City's open channel system used channel dimensions that were approximated for the InfoSWMM model, based on the information included in the previous Hydra model. Changes in the channel dimensions, side slopes, and configuration due to erosion may have occurred since the original survey information was obtained and this would result in differences between the model results and field observations. Several flooding areas identified above are associated with open channel flooding. To better assess flooding potential in these locations and to further refine the hydraulic model, a survey of the open channel system in the City should be conducted to update channel geometry inputs of the model.

6.7 LOW IMPACT DEVELOPMENT MODELING

Additional model simulations were conducted to determine the potential benefits of reducing stormwater runoff flows and volumes as a result of the implementation of Low

Impact Development throughout the City. Low Impact Development was generally modeled assuming future condition land use, in order to compare flow conditions and pipe capacity with and without Low Impact Development. Low Impact Development application was assumed for a percentage of a subbasin. With a majority of the City already developed, it is unlikely that any subbasin will be able to fully incorporate Low Impact Development techniques throughout the subbasin.

6.7.1 Modeling Methods

InfoSWMM does not have a specific feature to incorporate Low Impact Development facilities such as rain gardens, bioswales, or pervious pavement directly into the model. As a result, two different methods were used to simulate functioning of Low Impact Development for this Master Plan: 1) adding storage nodes to simulate flow reduction as a result of Low Impact Development elements, and 2) adjusting impervious area of a subbasin to account for the application of Low Impact Development. These methods are described further below. Model runs were made for the 2-year and 25-year, 24-hour storm events to identify relative reductions in peak flows.

Adding Storage Nodes

The first method of simulating Low Impact Development involves the addition of storage nodes to simulate facilities such as installation of pervious pavement, rain gardens, and green roofs. In order to model Low Impact Development as a storage node, the storage node was sized to hold the runoff volume generated from a single subbasin during a water quality storm event.[5] All runoff from that specific subbasin was routed to the storage node, and the outlet from the storage node was set at an elevation such that all runoff exceeding the water quality storm event would be discharged to the existing stormwater conveyance system. This essentially simulates the basic concept of Low Impact Development systems, which is to manage all runoff onsite for storm events up to the water quality design storm, and send flows in excess of the water quality storm event to the conventional stormwater system.

Utilizing storage nodes is a conservative method for evaluating Low Impact Development since the storage node does not have capacity for infiltration. Thus, once the storage node is at capacity, all additional flows are simulated as discharging to the storm conveyance system when in actuality, as the facility infiltrates flow, the capacity of the system increases.

[5] The water quality event of 2/3 of the 2-year, 24-hour event was used for this modeling effort, rather than the City's defined water quality storm of .36 inches in 4 hours, for two reasons. First, the new draft NPDES Phase I permit requirements specify treatment of 80% of annual runoff and the 2/3 of the 2 year, 24 hour event, used by many municipalities in the Northwest, is likely to meet this requirement. It was outside the scope of this project to identify the specific storm for the City. Secondly, a 24 hour distribution of runoff that is required by the model was available for this storm and is not available for the 4 hour event.

Adjusting Impervious Areas

The second Low Impact Development modeling method requires adjustment of the impervious percentage of a subbasin to reflect the application of Low Impact Development as additional pervious surface. The impervious coverage in each subbasin is decreased to reflect a reduction in impervious surface as a result of Low Impact Development implementation and such reduction in impervious surface results in a reduction of modeled stormwater flows from a subbasin. As Low Impact Development typically utilizes vegetation and pervious areas as the facility, adjusting the impervious percentage is a direct method of accounting for Low Impact Development in a subbasin; however, this method does not allow for direct modeling of the capacity of the Low Impact Development system to collect and dispose of a specified volume of runoff (i.e., runoff from a specific design storm). This method does provide a quick, general overview of potential impacts of Low Impact Development throughout the City. The method of reducing impervious percentages is able to simulate the infiltration benefits of Low Impact Development, but it does not simulate any storage. However, it overestimates the infiltration at the larger events, since presumably a Low Impact Development system would be at an overflow state during an event such as the 25-year, or any event greater than the defined water quality storm.

6.7.2 Modeling Scenarios

In order to simulate Low Impact Development implementation as a retrofit option across a subbasin, two implementation scenarios were developed. The first scenario assumes Low Impact Development implementation across 10 percent of the subbasin and the second assumes Low Impact Development implementation across 25 percent of the basin. These percentages were selected to evaluate the relative effectiveness of various magnitudes of Low Impact Development in a subbasin.

For the storage node method, to simulate these two scenarios in the model, the storage node was sized to hold the equivalent runoff volume for the water quality design storm from 10 percent and 25 percent of the total subbasin area. As described above, flows generated from storm events exceeding the water quality storm were sent to “overflow” into the stormwater conveyance system.

For the adjusting impervious area method, implementation of Low Impact Development in 10 percent and 25 percent of the subbasin area meant reducing the impervious area of the subbasin by 10 percent and 25 percent, respectively.

6.7.3 Modeling Results

The results of Low Impact Development simulations for both methods: the storage node and the impervious area adjustment methods are described below.

Adding Storage Nodes

Adding storage nodes for Low Impact Development simulation was a very time-intensive process; therefore, this method was only performed on one basin. The basin chosen had an area of approximately 63 acres and an impervious percentage of approximately 65 percent (for future land use conditions), representing primarily residential land use. In order to compare benefits of Low Impact Development with respect to associated land use, a second model run was conducted for the same subbasin assuming commercial land use (85 percent impervious). For each run, the storage node was sized equivalent to the runoff volume for the respective land use (65 percent impervious or 85 percent impervious).

By adding storage nodes to simulate 10 percent and 25 percent Low Impact Development facilities in the basin, the model predicted some reduction in peak flows at both the 2-year and 25-year event. As can be seen by the results in Table 6-3 below, the storage node method predicts Low Impact Development to be more effective with increased Low Impact Development coverage at 25 percent rather than 10 percent and that benefits diminish with larger storms. Basins with larger associated impervious percentages also yield more benefits so that Low Impact Development has a potentially greater impact for commercial applications than residential installations.

Table 6-3
Predicted Percent Reduction of Peak Flows Utilizing Low Impact Development – Storage Node Method

Storm Event	Land Use	With 25 percent Low Impact Development	With 10 percent Low Impact Development
2-Year	Commercial	19.1	3.4
	Residential	15.5	2.2
25-Year	Commercial	14.9	2.0
	Residential	11.4	1.2

Adjusting Impervious Area

Since this method was less time-intensive than the storage node method, it was modeled throughout the City in order to gain an understanding of the effects of Low Impact Development if implemented City-wide. The results suggest that by decreasing the impervious percentage City-wide by 10 and 25 percent, modeled peak flows decreased. This method predicted a higher reduction in peak flows than the storage node method, and overestimates the reduction in flows at the 25-year event. This is because the model assumes significant infiltration at the 25-year event, but Low Impact Development systems typically are in overflow conditions for the majority of the 25-year event. The summary of the results, averaged City-wide, is shown below.

Table 6-4
Predicted Percent Reduction of Peak Flows Utilizing Low Impact Development – Adjusting Impervious Percentage Method

Storm Event	With 25 percent Low Impact Development	With 10 percent Low Impact Development
2-Year	30.0	8.7
25-Year	22.1	9.0

Results

Although Low Impact Development does have some flow-reduction benefits, it appears not to be effective for the larger, less frequent storm events, such as the 25-year event. As is seen in Tables 6-3 and 6-4, both methods display the most flow-reduction benefits at the 2-year storm event, and when implemented at 25 percent. In a natural system, the lower and more frequent storms do not result in appreciable stormwater runoff; the 25-year storms will result in stormwater discharges. The potential for flow reduction at the low intensity chronic events has advantages in that it provides protection for erosion at outfalls, which has been identified as a problem in the City, especially along Boeckman Creek. The results also suggest that, in order to see flow reduction benefits, Low Impact Development should be implemented to at least 25 percent. In order to gain the most benefit from Low Impact Development, it is recommended that the City look at Low Impact Development solutions on a subbasin basis, rather than a City-wide basis. For instance, if Low Impact Development could be implemented in numerous properties in one subbasin, noticeable benefits would be expected at the downstream outfall. If the same acreage of Low Impact Development was implemented in various locations throughout the City, the benefits would not be as apparent. The installation of Low Impact Development is only expected to produce negligible benefits with respect to flood control, and is not expected to eliminate the need for upsizing pipes or providing overflows for the 25-year storm event.

Low Impact Development is a site specific approach to sustainable stormwater management. In order to gain a better understanding of its effects on flow and volume reduction, a smaller scaled model is recommended that has the ability to model small parcels. One recommended method is to extract a subbasin from the InfoSWMM model used for this Master Plan, and supplement it with more detailed information such as small, arterial storm drains and site specific stormwater controls (i.e. treatment systems, detention systems, etc.). It is not recommended to simply add this information to the same model used for this Master Plan since the level of detail would not be consistent throughout the model.

Of the two Low Impact Development analysis methods used, the node storage method would be the recommended approach for future City modeling since it is used by InfoSWMM technical support and it is the more conservative of the two methods. Caution is warranted in relying too heavily on the results of Low Impact Development Modeling for planning reduced infrastructure systems because effectiveness of Low Impact Development systems tend to be highly dependent on proper installation and ongoing maintenance.

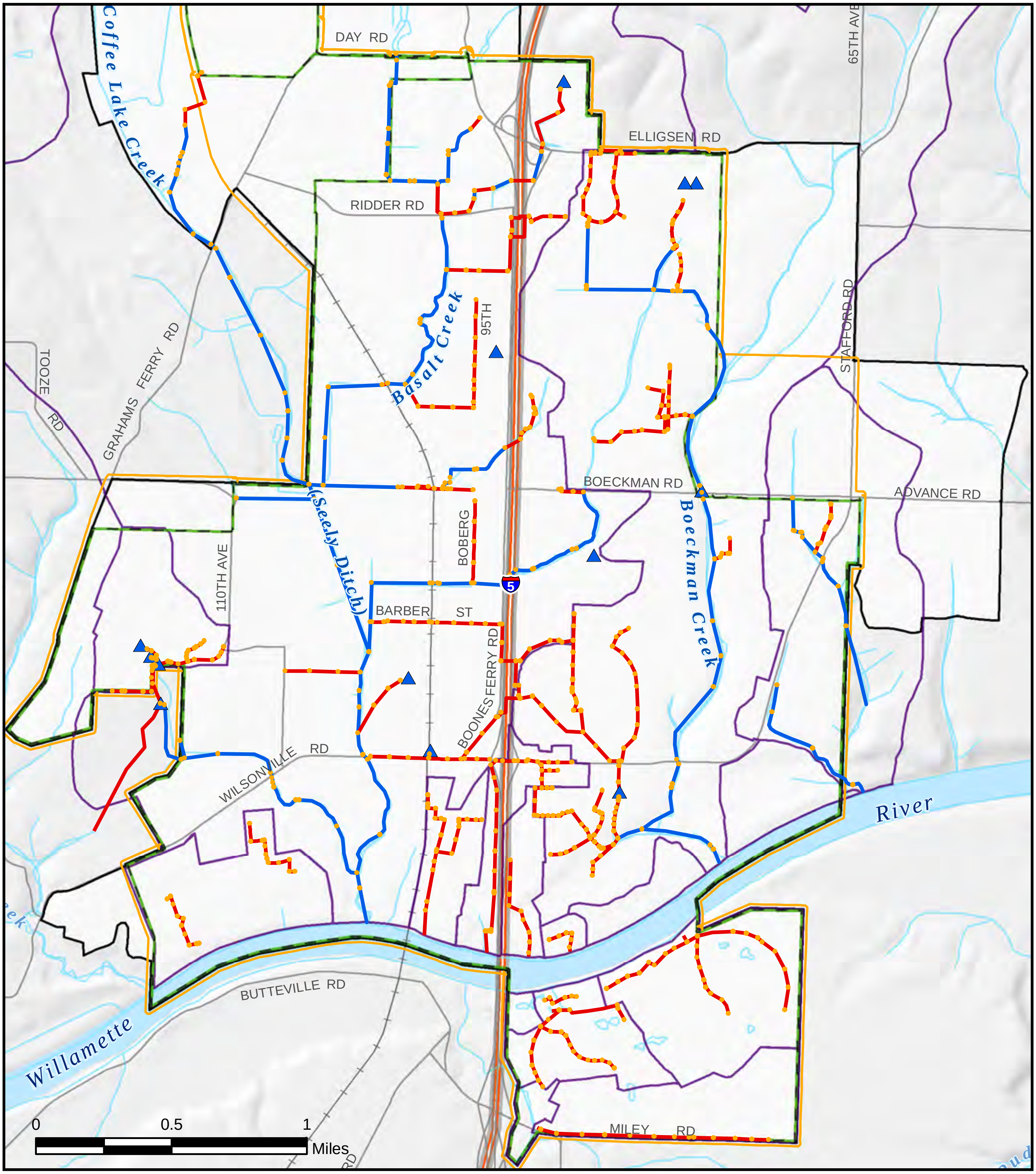


Figure 6-1
Existing Modeled Stormwater System

City of Wilsonville
Stormwater Master Plan

URS

March 2012

Modeled Open Channel
Modeled Stormwater Conduit
Modeled Stormwater Junctions
Modeled Detention Ponds
Watershed Boundaries
Study Area
Streams
UGB Boundary
City Limits

File Path: O:\25696563 Wilsonville SWMP Update\4000 Deliverables\STORMWATER MASTER PLAN\CD\Disc 3 - GIS\Figure 6-1 Existing Stormwater System.mxd

7.0 WATER QUALITY

7.0 WATER QUALITY

This chapter provides background information on urban stormwater quality; summarizes existing source and structural controls for water quality that are implemented in the City of Wilsonville; and discusses current pollutant loading analysis conducted for the City as part of their Municipal Separate Storm Sewer System (MS4) NPDES permit, including the anticipated effectiveness of pollutant removal associated with typical structural controls for water quality implemented in the City.

In addition, with implementation of new structural controls for water quality associated with this Stormwater Master Plan (i.e., development and installation of proposed water quality CIP projects), this section also describes how the existing pollutant loading analysis can be used to prioritize locations of future water quality projects.

7.1 BACKGROUND

Historically, stormwater management has primarily focused on drainage and flood control. As described previously, increased development or urbanization results in an increase in the quantity and peak flow rate of runoff. As a result, drainage system components are often too small to manage the increased load. While urban area flooding problems have historically been addressed through capital improvements for stormwater conveyance, other adverse impacts associated with urbanization are also of concern; in particular, the degraded quality of stormwater runoff.

Typical parameters of concern with respect to urban stormwater runoff and receiving surface waters include bacteria, heavy metals, oil & grease, sediments, nutrients, and temperature. Recently, more attention has been given to toxics (such as pesticides) and chemicals/contaminants of emerging concern such as pharmaceuticals. The sources of these pollutants are varied; some sources are human-caused, and require action by both the City and the public to minimize, while others are not directly attributed to human activities, and are therefore more difficult to control. Table 7-1 details typical urban stormwater pollutants, their sources, and associated potential in-stream water quality issues.

Table 7-1
Typical Urban Stormwater Pollutants

Typical Stormwater Pollutant*	Description	Major Sources Potentially Associated with Stormwater Runoff	Potential In Stream Water Quality Problem
Bacteria	- E. coli • Enterococcus, • Fecal coliform, and • Fecal streptococcus	- Animal wastes (droppings from wild/domestic animals), - Human wastes (leaking sanitary sewer pipes, and seepage from septic tanks as well as illicit discharges).	These are commonly used as indicators of human microbial pathogens. Water contact may cause eye and skin irritations and gastro-intestinal diseases if water is swallowed.
Heavy Metals	- Antimony - Arsenic - Beryllium - Cadmium - Chromium - Copper - Lead - Mercury - Nickel - Selenium - Silver - Thallium - Zinc	- Vehicles (combustion of fossil fuels, improper disposal of car batteries, wear/tear of tires and brake pads), - Metal corrosion (rain gutters, metal roofs, etc.), - Pigments for paints, - Solder, - Moss killers, - Fungicides, - Pesticides, - Wood preservatives.	Heavy metals are toxic to aquatic ecosystems. These metals are considered to be the most significant toxic substances that are commonly found in urban stormwater runoff.
Oil & Grease	A broad group of pollutants including: - Animal fats, and - Petroleum products.	- Food wastes (animal and vegetable fats from garbage), - Petroleum products (gas, oils, lubricants, etc.).	These compounds can coat the surface of the water limiting oxygen exchange, clog fish gills, and cling to waterfowl feathers. When ingested these compounds can be toxic to birds, animals and other aquatic life.
Total Suspended Solids	Sediments in the water are considered to be pollutants when they exceed natural concentrations and adversely affect water quality and/or beneficial uses of the water.	- Erosion due to increased stream flows, - Construction site runoff, - Landscaping activities, - Agricultural activities, - Logging, - Other ground-disturbing activities.	Sediments cause increased turbidity, reduced prey capture for sight feeding predators, clogging of gills/filters of fish and aquatic insects, reduced oxygen levels, and blocked light which limits food production available for fish. Sediments also accumulate in stream bottoms, which reduces the capacity of the stream (and hence increases the potential for flooding) and covers stream bottom habitats. Sediment also acts as a carrier of toxic pollutants such as metals and organics.

Table 7-1
Typical Urban Stormwater Pollutants

Typical Stormwater Pollutant*	Description	Major Sources Potentially Associated with Stormwater Runoff	Potential In Stream Water Quality Problem
Nutrients	- Nitrogen - Phosphorus	- Landscaping activities, - Yard debris, - Human wastes (leaks from septic tanks and sanitary sewers), - Animal wastes, - Vehicle exhausts, - Agricultural activities, - Detergents (car washing), - Food Processing.	Excess levels of nutrients can lead to eutrophication (stimulation of excessive plant growth, potentially leading to a reduction in dissolved oxygen) in downstream receiving waters. Problems include surface algal scum, odors, reduced oxygen levels, and dense mats of algae. In addition to water quality problems, these effects have an adverse impact on the aesthetic quality of water bodies.
Organics	There are many organic compounds both natural and synthetic; however, the synthetic organics are of most concern and include pollutants from: - Fuels - Solvents - Pesticides - Herbicides.	- Illegal dumping, - Illicit connections, - Spills, - Leaks from drums and storage tanks, - Landscaping activities, - Agricultural activities.	Most synthetic organics are highly toxic to aquatic life at very low concentrations, and many are carcinogenic (cancer causing) or suspected carcinogens.
Litter and Other Floatable Debris	- Plastics, - Paper products, - Yard debris, - Tires, - Metal, - Glass, - Appliances, - Old Electronics.	- Littering, - Dumping, - Spills.	These pollutants degrade the aesthetic quality of water bodies. In addition, they contribute pollutants as they decompose, and they can reduce the capacity of the water body. Excess yard debris contributes to high levels of nutrients and it reduces oxygen levels as it decomposes. Some discarded materials such as appliances, tires, and auto wreckage may contain toxic/ heavy metals such as mercury, cadmium and copper.

7.2 SOURCE CONTROL MEASURES

Source control measures or BMPs are activities targeted at preventing the discharge of pollutants *to* the MS4 as opposed to a system that removes pollutants *from* the MS4. Stormwater pollutant control at the source is generally the most cost-effective type of pollution control. The City implements many source control BMPs as part of its efforts to comply with its NPDES MS4 Permit. Source control BMPs are described in the City's Stormwater Management Plan and include activities such as public education, maintenance (i.e., catch basin cleaning, street sweeping, structural control facility maintenance), and programmatic actions targeted at pollutant removal through inspection, education, and response.

Although source controls are considered effective for the removal of stormwater pollutants, it is generally difficult to quantify the effectiveness due to the number of variables that influence the implementation of such measures.

7.3 STRUCTURAL CONTROLS

In addition to source control BMPs, the City of Wilsonville has a number of private and public structural controls or BMPs to remove pollutants from the MS4. Specifically, structural controls are structural BMPs such as extended detention ponds, wet ponds, constructed wetlands, bioswales, filters, sediment manholes that directly remove pollutants from stormwater through a variety of unit processes, including sedimentation, filtration, infiltration, and uptake by vegetation. Effective structural controls generally use multiple removal unit processes. For example, Low Impact Development practices such as rain gardens and pervious pavement promote reduced stormwater runoff volumes by using infiltration while natural vegetation promotes filtration and vegetative uptake of pollutants.

As documented in the City's Stormwater Management Plan and Public Works Standards, the City of Wilsonville requires structural controls for stormwater quality (and quantity) on all development sites with new impervious area over 5,000 square feet. Typical structural controls used in the City of Wilsonville for water quality include bioswales, extended detention ponds, bioretention cells, and filters.

The removal efficiency of structural controls can vary in accordance with design and sizing, maintenance, and influent stormwater characteristics. Monitoring data are available for a variety of structural control systems, which allows for estimates of the overall system effectiveness to be quantified.

7.4 WATER QUALITY ASSESSMENT

7.4.1 Existing Pollutant Load Analysis

In accordance with the City of Wilsonville's 2008 Phase I MS4 NPDES Permit renewal, the City submitted benchmarks, or total pollutant load reduction estimates, for each parameter (pollutant) with an established TMDL and wasteload allocation. The calculation of benchmarks required the City to estimate pollutant load generation for the TMDL parameters using land use and drainage areas served by structural BMPs (controls). As described previously, it is difficult to quantify the effectiveness of source control BMPs; therefore only structural controls were directly used in the analysis.

In an urbanized environment, the general characteristics of urban runoff may be attributed to the land use associated with the source of discharge. The Oregon Association of Clean Water Agencies funded a study in 1996 and created a report titled "Analysis of Oregon Urban Runoff Water Quality Monitoring Data Collected from 1990 to 1996" that was based on a series of statistical analyses of stormwater monitoring data collected by the Oregon Municipal Stormwater NPDES applicants and permitted agencies in the Willamette Valley. The report indicates that stormwater pollutant concentrations from different land uses are statistically different from each other, and as development occurs and changes to land use are observed (e.g., transition of open space or undeveloped land use to a developed land use), pollutants in the stormwater runoff generally increase. Results of this analysis were revisited by representatives from various Phase I jurisdictions in 2006 and again in 2008 in accordance with the Phase I permit renewal submittals to develop updated land use-based event mean concentrations for use in the benchmarking effort.

Representatives from various jurisdictions also reviewed structural BMP (controls) monitoring data to assess the effectiveness of various structural controls in terms of effluent concentration for use in the benchmarking effort.

Using the updated, land use-based event mean concentrations and the effluent concentrations of various structural controls, the City of Wilsonville used a spreadsheet model that employs the U.S. EPA's simple method to calculate pollutant loads. The model calculates loads for a variety of pollutants based on the area information entered into the spreadsheet. Before running the model, the City of Wilsonville inventoried its existing land use coverage (including vacant areas) and existing structural controls and calculated the associated drainage areas in order to populate the model. Results of the inventory indicate land use is primarily residential, followed by industrial, open space, and commercial. In addition, the City of Wilsonville also inventoried its existing structural controls including bioswales, extended detention ponds, and wet ponds. Structural controls are used to manage approximately 30 percent of the City's total drainage area.

Pollutant loads and associated benchmarks are summarized in the City's permit renewal submittal (City of Wilsonville NPDES Permit Renewal Submittal, September 2008).

7.4.2 Projected Pollutant Load Reduction Potential

Review of the data used in preparation of the City's benchmarks (Section 7.4.1) can provide insight into the loading potential of various land use categories and the effectiveness of various types of structural controls, based on the upstream land use and pollutants of concern.

Based on the land use event mean concentration data used in preparation of the City's benchmarks, industrial land use generally shows the highest pollutant concentrations, followed by commercial, and residential, and finally open space (i.e., undeveloped) land use which represents the lowest pollutant concentrations. This ranking could vary depending on the type of pollutant. Based on the BMP effluent data used in the preparation of the City's benchmarks, structural controls that use infiltration in addition to other unit processes achieve the greatest pollutant removal because pollutant loads are reduced as a function of runoff volume reduction and pollutant removal capabilities. Therefore, Low Impact Development techniques (porous pavement, rain gardens), followed by wetlands, bioswales, and ponds generally achieve the highest pollutant removal. Pollutant removal due to structural controls is also a function of the land use (and contributing influent pollutant concentrations) and the type of pollutant itself. Thus, this ranking can also vary.

Because the relative effectiveness of certain types of structural controls can vary as a function of the contributing land use and the type of pollutant, Table 7-2 was developed as a tool for the City to use to determine what type of structural control may provide the most benefit in accordance with the contributing area land use and the pollutant of concern. It can also be used as a way to plan and prioritize other improvement projects that may have a potential to incorporate water quality. This table was developed using the updated land use–based event mean concentrations and the effluent concentrations of various structural controls, consistent with the data used in the City's 2008 benchmarking effort, and the spreadsheet load model. The spreadsheet model was run, assuming an arbitrary 50-acre area with constant land use coverage (either industrial, commercial, or residential); 40 inches of annual rainfall; and complete coverage of one type of structural control (bioswale, wetland, detention pond, green street, or filter) that is sized to treat 80 percent of the average annual runoff. Pollutant reduction is presented in terms of a total percentage of the anticipated reduction.

Table 7-2
Effectiveness of Typical Structural Controls by Land Use and Pollutant of Concern (Total Percentage of the Anticipated Reduction)

Structural Control	Land Use	Total Suspended Solids	E. Coli	Total Phosphorus	Total Zinc
Green Street (Raingarden and Pervious Pavement)	Industrial	80	80	80	80
	Residential	80	80	80	80
	Commercial	80	80	80	80
Bioswale	Industrial	73	23	56	75
	Residential	59	23	45	47
	Commercial	63	23	49	62
Constructed Wetland	Industrial	69	0	55	76
	Residential	50	56	43	53
	Commercial	56	48	46	64
Extended Detention Pond	Industrial	66	18	38	69
	Residential	40	18	20	13
	Commercial	48	19	23	36
Filters (sand, compost)	Industrial	61	66	56	78
	Residential	28	76	45	67
	Commercial	38	75	48	74

Notes:
1. The source control is applied throughout the target drainage area.
2. TSS = total suspended solids; TP = total phosphorus

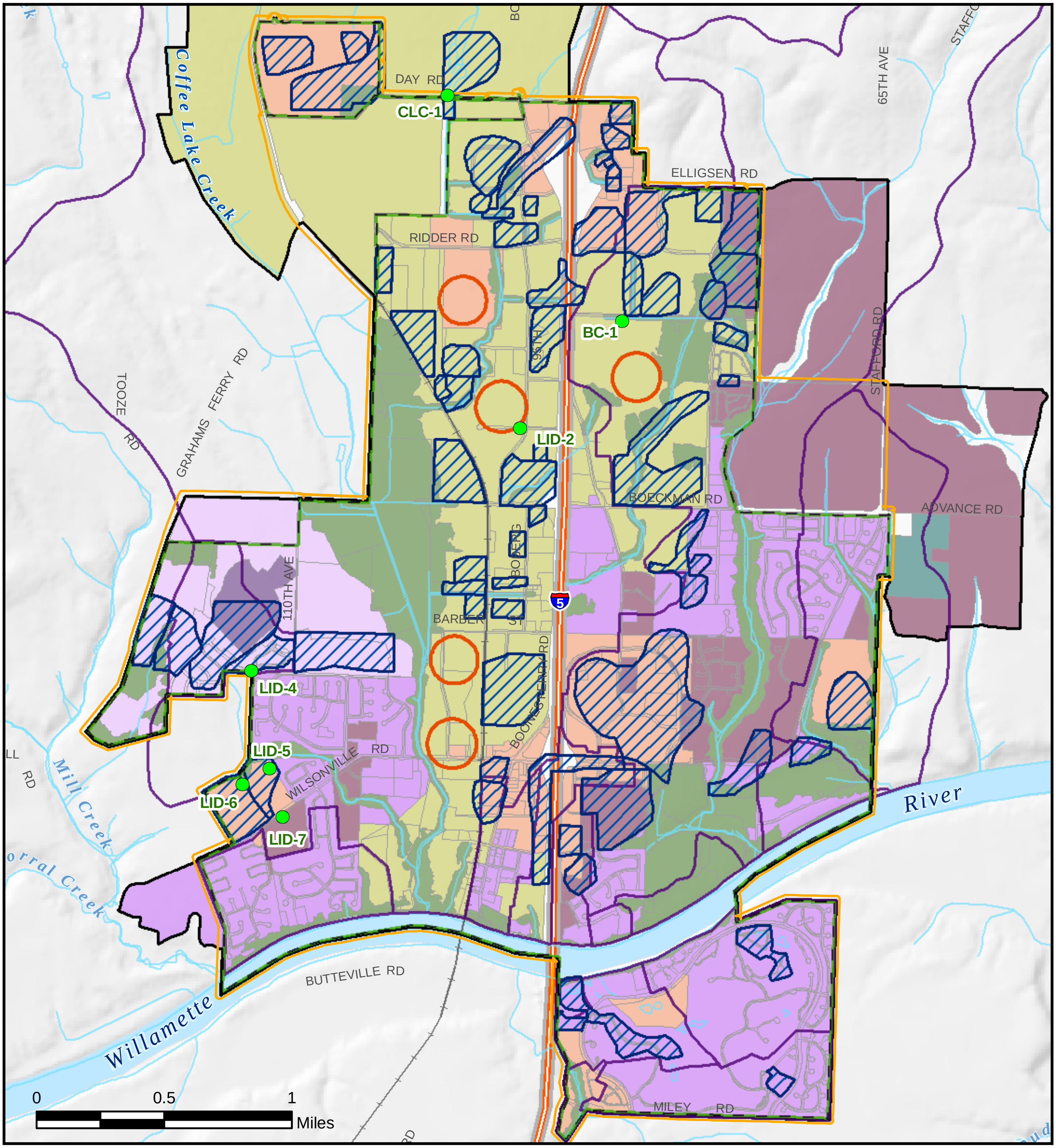
7.4.3 Future Planning for Water Quality

The calculation of benchmarks or pollutant load reduction estimates is a permit requirement for the City of Wilsonville. In conjunction with the City's permit renewal submittal (180 days prior to permit expiration), pollutant loads reflecting current and future (5+ years) conditions will need to be calculated based on existing and projected land use coverage and structural control coverage. Continual updating of the existing land use and structural control coverage will allow the City to more effectively meet future permit deadlines associated with the benchmarking effort.

As part of the City of Wilsonville Master Plan, structural controls in the form of CIP projects and private stormwater facilities are proposed for water quality (See Chapter 8). As these CIP projects and private stormwater facilities are designed and constructed, drainage areas associated with the facilities can be added to the existing structural control coverage for incorporation into future benchmarking efforts. As the CIP projects and private stormwater facilities are constructed and drainage areas added to the structural control coverage, additional pollutant load reduction associated with the increased area which is covered by structural controls will be reflected in future spreadsheet model simulations.

In Figure 7-1, locations of high pollutant generation potential are identified. These areas, called high source areas for purposes of pollutant load calculations, are represented by land use that is relatively high in pollutant generation potential (i.e., industrial or commercial land use) and a lack of existing structural control coverage. Selection and implementation of certain structural controls, using Table 7-1 as a guide, can result in significant pollutant load reductions in these areas.

The high source areas may represent locations where the City wishes to focus implementation of Low Impact Development techniques; per Table 7-1, use of raingardens and pervious pavement (Low Impact Development systems) results in the greatest projected pollutant load reduction for all assessed land use and pollutant categories. The City may also consider these areas for any additional, future water quality efforts.



High Pollutant Source Area
Proposed CIPs for Water Quality
Existing Structural BMP Coverage
Study Area
Streams
UGB Boundary
City Limits
Watershed Boundaries

Commercial / Government
School
Single Family Res.
Single Family Res. - Villebois
Multi-Family Res.
Multi-Family Res. - Villebois
Industrial
Agriculture
Parks and Open Space

Figure 7-1
High Pollutant Source Areas

City of Wilsonville
Stormwater Master Plan

URS
March 2012

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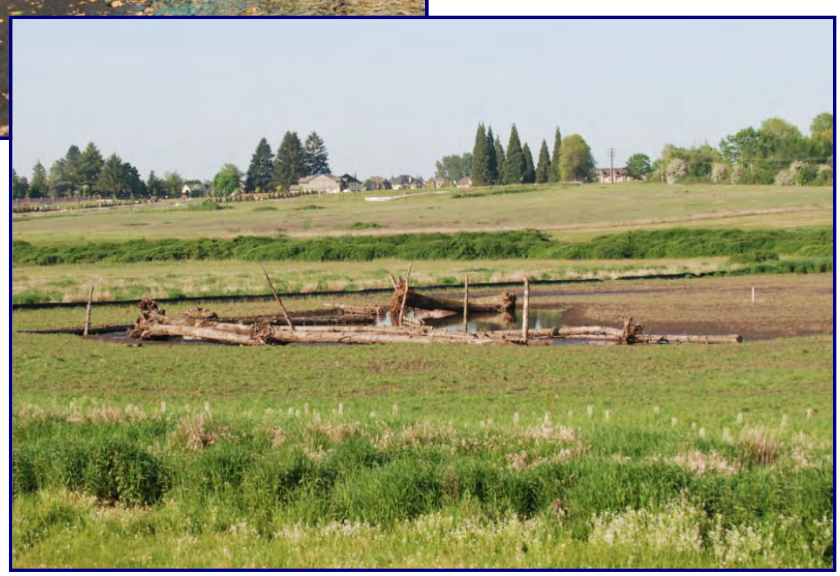
File Path: O:\25696563 Wilsonville SWMP Update\4000 Deliverables\STORMWATER MASTER PLAN\CD\Disc 3 - GIS\Figure 7-1 High Pollutant Source Areas.mxd

8.0 RECOMMENDED PROJECTS

8.1 CAPITAL IMPROVEMENT PROGRAM (CIP)

8.2 CIP PROJECT SUMMARY



8.0 RECOMMENDED PROJECTS

The primary objective of this Stormwater Master Plan Update is to evaluate existing and future conditions for flooding and water quality and recommend appropriate capital improvement program (CIP) projects to maintain continual capacity of the storm system. An integrated approach was used to develop the CIP projects in order to efficiently implement projects identified through this master planning effort. The goal of the City in implementing stormwater projects is to maximize the benefit of each project while protecting and enhancing the surface waters in the City and maintaining safe conditions for the public and associated properties. Benefits to be considered include flood control, enhancing water quality, increasing habitat for wildlife, implementing projects that are cost effective, and the possibility of combining these CIP projects with other projects (such as transportation projects). These and other benefits are further explored in Section 9.0, which discusses the prioritization of the list of CIP projects to be implemented.

The City identified locations that have known flooding or water quality problems. Modeling was then conducted to verify existing flooding locations and to determine locations of flooding that would result from future development. The model was calibrated to match flow monitoring results from three outfalls and verified by comparing the calibrated model with flooding locations identified by the City. CIP projects addressing flood control were then established for existing and future conveyance deficiencies. Some flooding was addressed with pipe upgrades and replacement, which benefits water quality by minimizing erosive flows and scour in open channels. Additional efforts were made to integrate flood control and water quality using systems such as extended detention ponds when applicable. In addition, locations were identified for water quality improvements and natural resource enhancements.

Some of the CIP project locations were identified as part of the 2001 Stormwater Master Plan. These projects included wetland enhancements and stream restoration that have been revisited and updated as part of this master planning effort. New to this Master Plan are Low Impact Development projects and practices. As described previously, the use of Low Impact Development practices meets multiple objectives for the City, including stormwater flow control, surface water quality enhancement, landscaping, and groundwater recharge, and provides for an integrated method of achieving the City's stormwater management goals.

CIP projects are identified in Section 8.1 along with preliminary construction cost estimates. Additional, supplemental information for select restoration and Low Impact Development projects is included in Appendix F. More detailed cost summary sheets are provided in Appendix H for each project. A summary of projects, construction cost estimates, and maintenance cost estimates are provided in Table 8-2 for each proposed CIP project. The assumptions for the cost estimates are provided in Appendix E.

8.1 CAPITAL IMPROVEMENT PROGRAM (CIP)

CIP projects were developed to meet the goals and objectives identified in Section 1.0, including maintaining adequate conveyance for existing and future development, implementing regulatory requirements, and addressing existing problems. Recommended CIP projects are classified as pipe upgrades, restoration, Low Impact Development projects and studies.

8.1.1 Pipe Upgrades and Improvements

Pipe upgrades and improvement locations were identified through the InfoSWMM modeling effort (locations are described and listed in Section 6.6) and staff-identified problem areas (Section 4.4). Pipe projects address flood control, provide capacity for future development and include rehabilitation of existing outfalls. The CIP projects were sized to accommodate future development condition flows for the 25-year design storm, see Figure 8-1 at the end of this chapter. Information regarding these proposed projects is described below, including existing conditions, proposed solutions, project benefits, cost estimates, and existing and future condition flow rates. Some projects were identified for increased pipe capacity resulting from increased flow rates in the future condition, however some projects were identified due to known existing conditions of the pipe and may not necessarily need additional capacity due to the predicted future flow rates. Potential constraints have not been identified for each pipe project description, since all proposed pipe projects are either in the public right-of-way or in public easements.

Tables of flows for existing and future development have been provided for the 2-, 10-, and 25-year flows where pipe have been modeled in InfoSWMM.

CLC-9 – Jobsey Lane Culvert Replacement

Project Location: Arrowhead Creek at Jobsey Lane

Existing Conditions: This culvert was not identified as undersized by the modeling efforts; however it is damaged and inhibits flows from Arrowhead Creek underneath Jobsey Lane. See existing problem area P11 in Section 4.4.1.

Proposed Solution: The existing 48-inch culvert will be replaced with a bridge designed primarily for pedestrian use, with the allowance for maintenance vehicles. Replacement of the existing culvert with this bridge structure will allow Arrowhead Creek to be conveyed freely underneath Jobsey Lane, reduce flooding potential, and enhance water quality by reducing the potential of scour at the culvert.

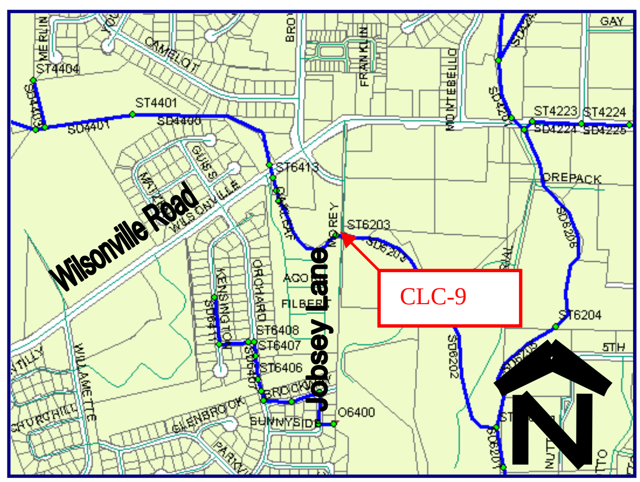
Project Benefits: Alleviate potential flooding, reduce scour and erosion

Cost estimate: $115,028

Flow Comparison at Project Location:

Storm Event	Existing Condition Flow Rate (cfs)	Future Condition Flow Rate (cfs)
2-year	60.0	60.7
10-year	84.3	86.0
25-year	97.0	108.1

Aerial view of Project CLC-9



Map view of Project CLC-9

SD4021 and SD4022 - Boberg Road Culvert Replacement

Project Location: South Tributary to Coffee Lake Creek at Boberg Road

Existing Conditions: Model results determined that the existing 42-inch parallel culverts at Boberg Road are of adequate size to convey existing and future condition flows underneath Boberg Road. However, the area of transition from the natural channel to the culverts is experiencing scouring around the inlet and outlet of the culverts, and behind the headwall at the culverts' upstream end. Additional detail of this problem is provided under problem P5 in Section 4.4.1.

Proposed Solution: To provide a smoother transition, at both the inlet and the outlet, it is recommended that the existing culverts be replaced with a 4-foot by 6-foot box culvert. The box culvert will better replicate the channel's geometry, minimizing the disruption of the hydraulic profile through the culvert, and reducing scour at both the upstream and downstream ends of the culvert. Including a concrete apron at the upstream side is also recommended to eliminate the current issue of vegetation growing near the inlet, impeding flows. The replacement of the culverts will increase the integrity of the channel and enhance water quality by preventing further erosion and subsequent deposition of sediment into the creek.

Project Benefits: Channel restoration, water quality, reduce erosion

Cost estimate: $65,393

Flow Comparison at Project Location:

Storm Event	Existing Condition Flow Rate (cfs)	Future Condition Flow Rate (cfs)
2-year	48.5	68.9
10-year	61.9	74.3
25-year	65.2	70.4[1]

Map view of Project SD4021 & SD4022


Looking West at Project SD4021 & SD4022

[1] The model predicts 25-year flow within these pipes as less than 10-year events because the downstream channel is shown to be overcapacity in the model, restricting flow from upstream conduits for the 25-year.

SD4208 and SD4209 - Barber Street Pipe Replacement

Project Location: Western End of Barber Street

Existing Conditions: The pipe network along SW Barber Street, continuing west past the intersection with Kinsman Road, is old CMP and needs to be replaced. The model predicts pipe surcharge and flooding upstream of these two pipe segments. However, the City has recently re-surfaced that section of SW Barber Street, and in conjunction with those improvements, has also replaced the pipe in that area (segments upstream of SD4208 and SD4209) with more durable pipe, but did not increase the size of those pipe segments. Additional detail of this problem is provided under problem P6 in Section 4.4.1.

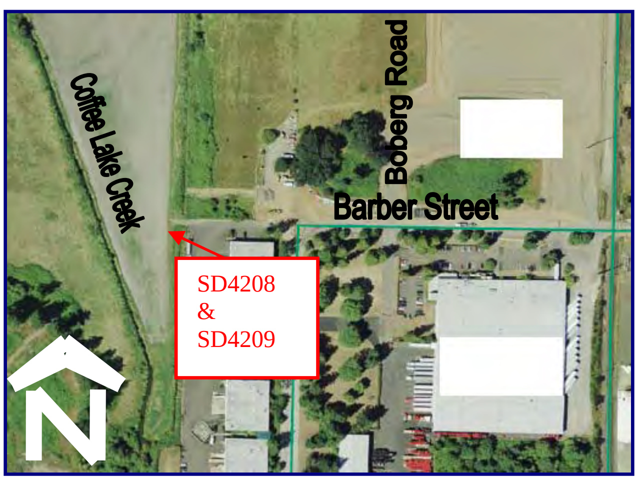
Proposed Solution: There are no plans to make further improvements to pipe upstream of this proposed project. Pipe segment SD4209 is a 42-inch diameter pipe, and discharges into segment SD4208, which is a 36-inch diameter pipe. When these two pipe segments are replaced with RCP, it is recommended that segment SD4208 be upsized to 42-inch diameter pipe. This improvement is expected to reduce the potential for flooding in the upstream network.

Project Benefits: Alleviate flooding, improve durability of pipe, reduce downstream erosion potential

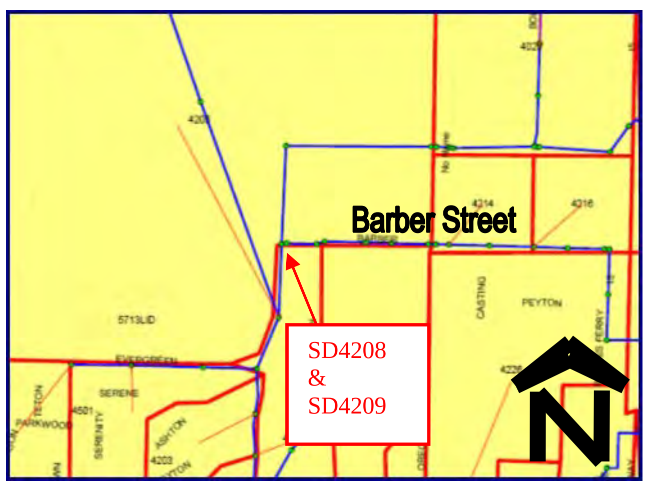
Cost Estimate: $213,196

Flow Comparison at Project Location:

Storm Event	Existing Condition Flow Rate (cfs)	Future Condition Flow Rate (cfs)
2-year	19.9	26.6
10-year	24.4	41.7
25-year	26.1	40.2[1]



Map view of Project SD4208 & SD4209



Aerial view of Project SD4208 & SD4209

[1] Pipe discharges to Coffee Lake Creek, which is overcapacity and causes some backwater conditions in SD4208. This may be due to differing dimensions of the Coffee Lake Creek channel with respect to model input (rather than) actual conditions (see ST-3 in Section 8.1.4).

SD4025 through SD4028 - Boberg Road Pipe Replacement

Project Location: Boberg Road from stream crossing to Boeckman Road

Existing Conditions: As mentioned in Section 6.6, the model predicted that the pipe network along Boberg Road north of Barber Street will flood during existing and future conditions. This is most likely due to the South Tributary to Coffee Lake Creek channel, which receives discharge from the pipe network.

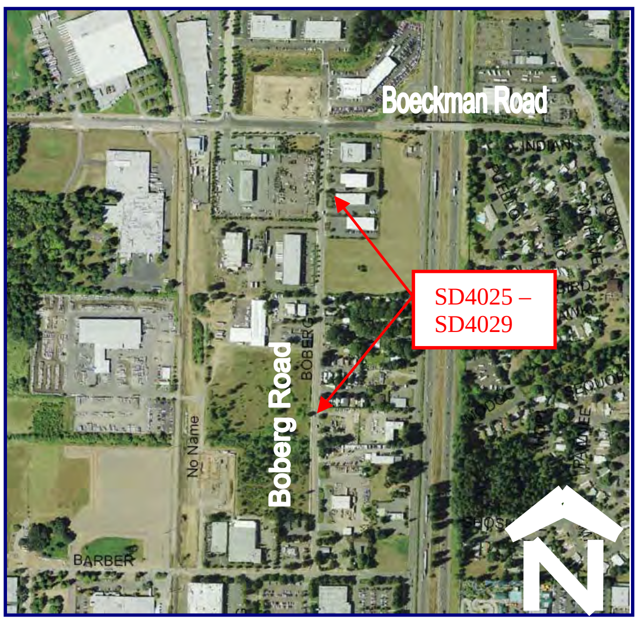
Proposed Solution: The City plans to make future surface improvements to Boberg Road, and it is recommended that the pipe sections also be replaced with a more durable material in conjunction with road improvements. It is recommended that the three segments SD4025, SD4026, and SD4027 be upsized from 21-inch diameter pipe to 24-inch diameter pipe, and for the most upstream section, SD4028, to remain the same size at 18-inches in diameter.

Project Benefits: Alleviate flooding, improve durability of pipe

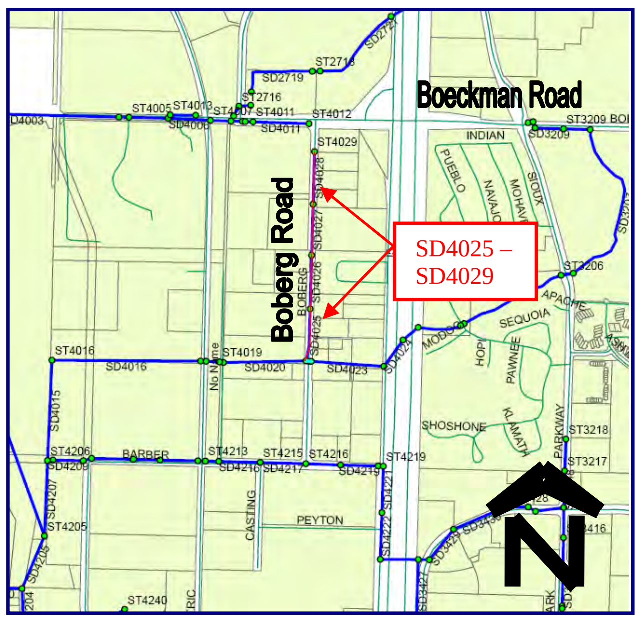
Cost estimate: $733,590

Flow Comparison at Project Location:

Storm Event	Existing Condition Flow Rate (cfs)	Future Condition Flow Rate (cfs)
2-year	9.4	11.9
10-year	13.4	12.8
25-year[1]	8.30	12.5



Aerial view of Project SD4025 - 4028



Map view of Project SD4025 - 4028

[1] The model predicts 25-year flow within these pipes as less than the 2- and 10-year events because the downstream channel is shown to be overcapacity in the model, restricting flow from upstream conduits for the 25-year. This also applies to the future condition for the 10-year flow. This is most likely attributed to discrepancies in the geometry of the actual channel compared to the model input (See ST-3).

SD5707, SD5709, SD5714, and SD5719 - SW Parkway Pipes Replacement

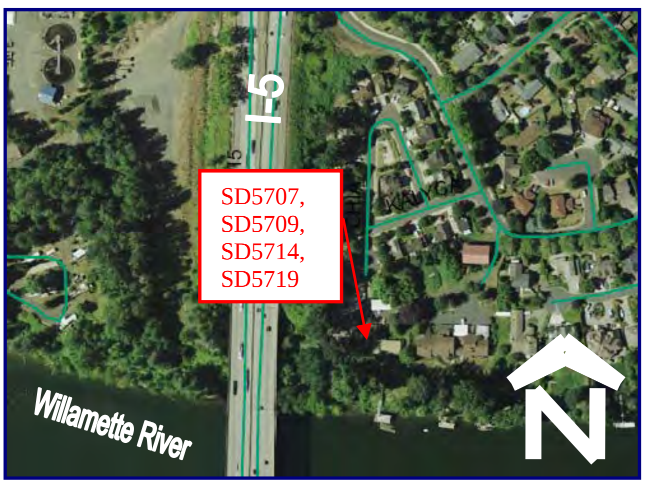
Project Location: SW Parkway from Wilson Street to Willamette River outfall

Existing Conditions: A pipe network runs along SW Parkway Avenue, with the main line beginning south of Memorial Drive and draining approximately 50 acres before discharging into the Willamette River. The pipe network begins with 48-inch diameter pipe, and tapers to 15 inches at the outfall, running very close to the foundation of at least two structures Although steep slopes allow for smaller pipes, it is common practice to maintain the pipe size, and not decrease pipe diameters downstream. The model predicted flooding upstream of the pipe network during future and existing conditions, which would be addressed by implementing this CIP project.

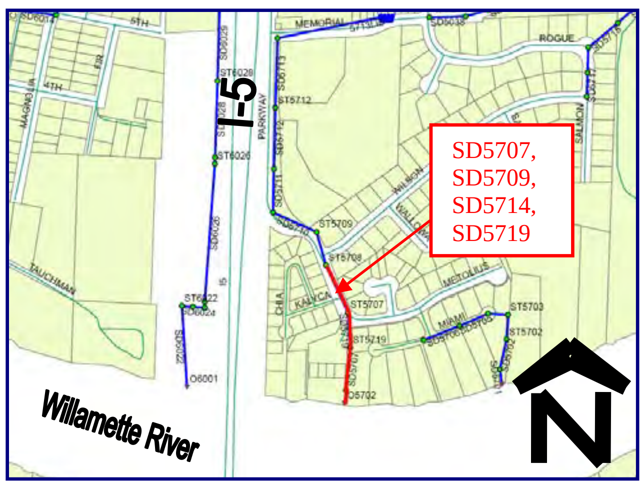
Proposed Solution: There are several options for implementing this project, which include replacing pipe segments SD5707, SD5709, SD5714, and SD5719 with 48-inch diameter pipe, installing a parallel pipe to split flows, or a combination of both; or installing a detention pipe on Parkway Avenue

Project Benefits: Alleviate flooding

Cost estimate: $497,405



Aerial view of Project SD5707, SD5709, SD5714 & SD5719



Map view of Project SD5707, SD5709, SD5714 & SD5719

BC-8 Canyon Creek Estates Pipe Removal

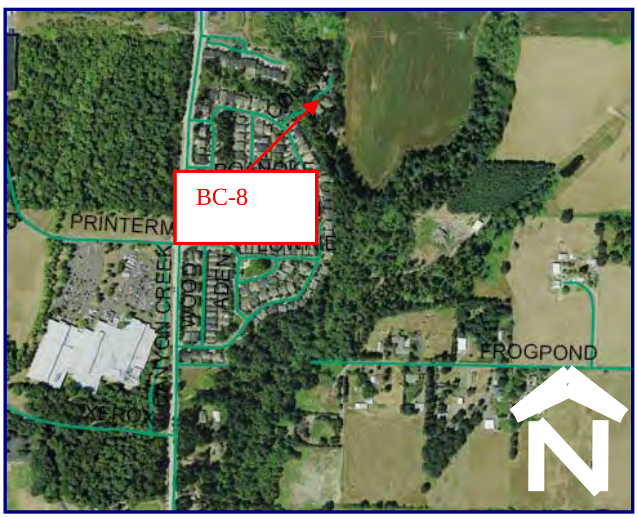
Project Location: Colvin Lane in Canyon Creek Estates

Existing Conditions: Erosion is occurring upstream and downstream of an existing culvert in the channel. Side slopes of the channel are steep, which enhances natural erosion. Additional detail of this problem is provided under problem P3 in Section 4.4.1.

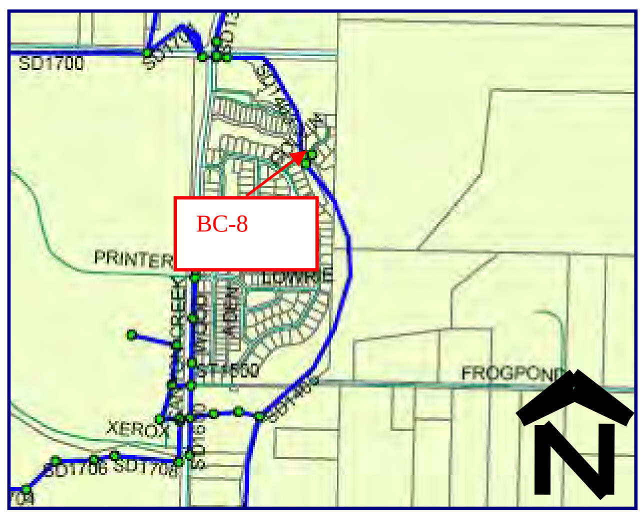
Proposed Solution: Removal of the culvert and rehabilitation of the creek channel are proposed to fix existing and future channel erosion. Planting of vegetation following removal of the culvert will need to include techniques that strengthen the creek banks through bio-engineering, such as live stakes made from live cuttings of plants that enhance bank stability or other reinforcing techniques.

Project Benefits: Enhance water quality, reduce erosion

Cost Estimate: $129,504



Aerial view of Project BC-8



Map view of Project BC-8

SD9000 through SD9069 – Charbonneau Pipe Replacement

Project Location: Charbonneau District

Existing Conditions: As described in Section 6.6, the Charbonneau District has an old pipe network consisting of mostly corrugated metal pipes. In addition to the degraded condition of existing pipes, flooding has been reported throughout the community and is predicted by the model. Other infrastructure, including water and wastewater facilities and roadways, have also reached their effective service life and may require replacement. Additional detail of this problem is provided under problem P12 in Section 4.4.1.

Proposed Solution: See the description of Studies, ST-6, for a brief description of a Charbonneau Infrastructure Replacement Study that will evaluate how to most effectively provide services to Charbonneau and to coordinate the work with other utilities in the District including water, sewer and roads.

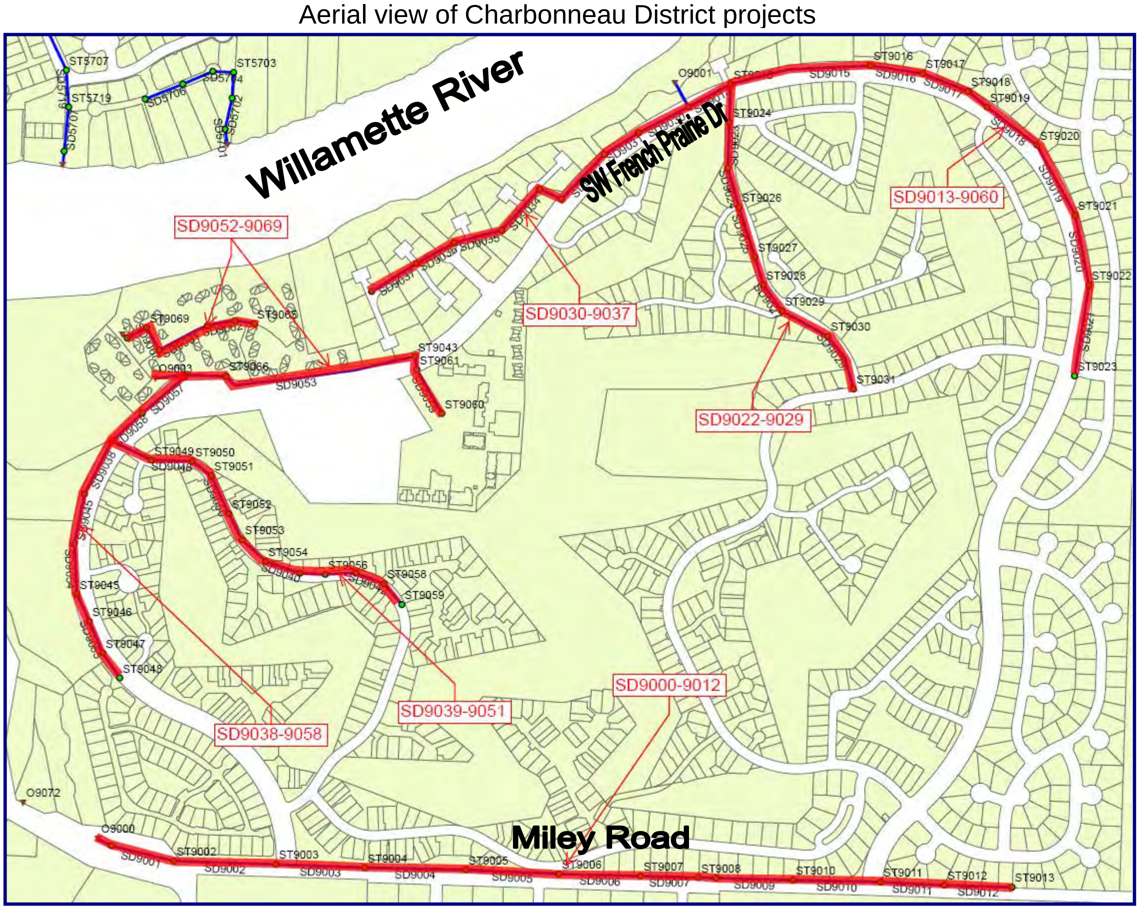
The following separate projects describe proposed upgrades to the major stormdrain pipe in Charbonneau and are listed as the following CIP projects:

Project ID	Project Location	Cost Estimate
SD9000-9012	S Charbonneau – Miley Road	$3,198,175
SD9013-9021; 9060	NE Charbonneau – French Prairie Drive	$1,680,563
SD9022-9029	NE Charbonneau – Old Farm Road	$1,015,021
SD9030-9037	NE Charbonneau – Edgewater Drive East and French Prairie Drive	$996,254
SD9038; 9045; 9046; 9054-9058	NW Charbonneau – French Prairie Rd Drive west of Boones Bend	$867,417
SD9039; 9044; 9047; 9051	NW Charbonneau – Boones Bend Road	$855,395
SD9052; 9053; 9059; 9061-9069	NW Charbonneau – Curry Drive and French Prairie Road	$1,043,501

Project Benefits: Alleviate flooding, enhance water quality

Cost estimate: $9,656,326

Aerial view of Charbonneau District projects



Map view of Charbonneau District

BC-2 – Boeckman Creek Outfall Rehabilitation

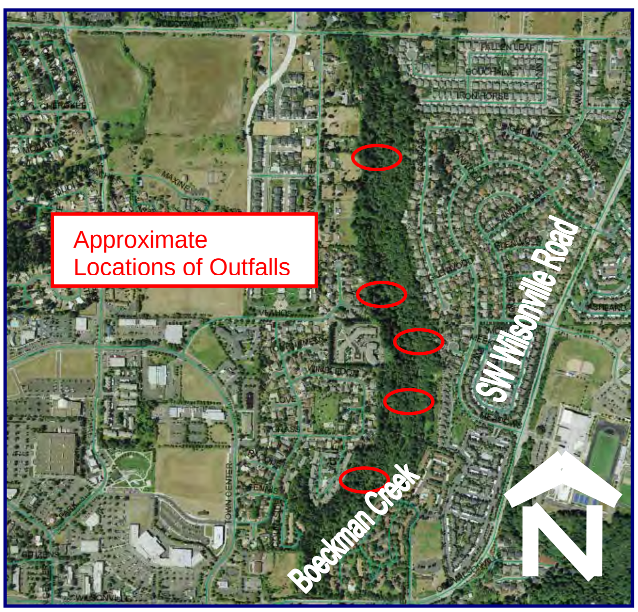
Project Location: Five outfalls in Boeckman Creek, between SW Boeckman Road and SW Wilsonville Road

Existing Conditions: Stormwater outfalls have been installed discharging runoff to Boeckman Creek with little regard to the steepness of the slopes, the amount of stormwater discharging to the canyon side slopes, and the energy dissipation necessary to avoid erosion. Steep slopes and increasing discharges due to paving of upstream areas have resulted in severe erosion in several locations along the creek. Additional detail of this problem is provided under problem P16 in Section 4.4.1.

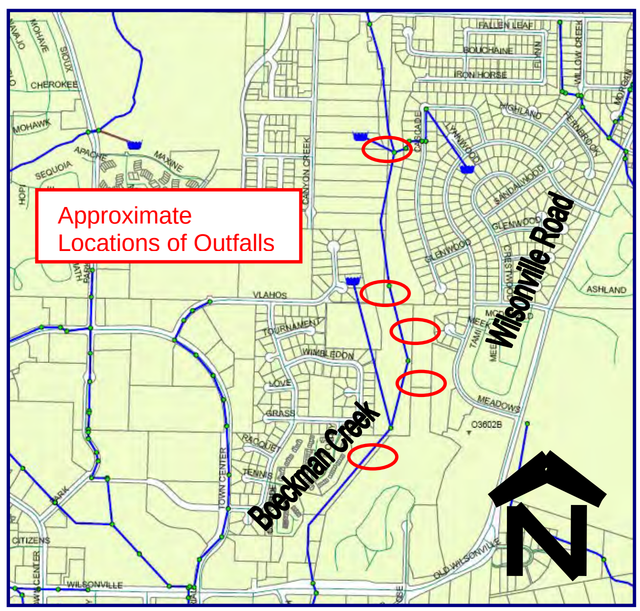
Proposed Solution: Outfall rehabilitation projects were identified through field visits with City staff along Boeckman Creek. This fund will provide the City with capital to evaluate up to five outfalls, determine the need to realign the outfall to allow drainage to discharge along the flow of the creek (rather than perpendicular to the creek), and add energy dissipaters and vegetation to stabilize the outfall.

Project Benefits: Enhance water quality, reduce erosion

Cost Estimate: $167,580



Aerial view of Project BC-2



Map view of Project BC-2

BC-3 – Cascade Loop Detention Pipe Installation

Project Location: Cascade Loop II

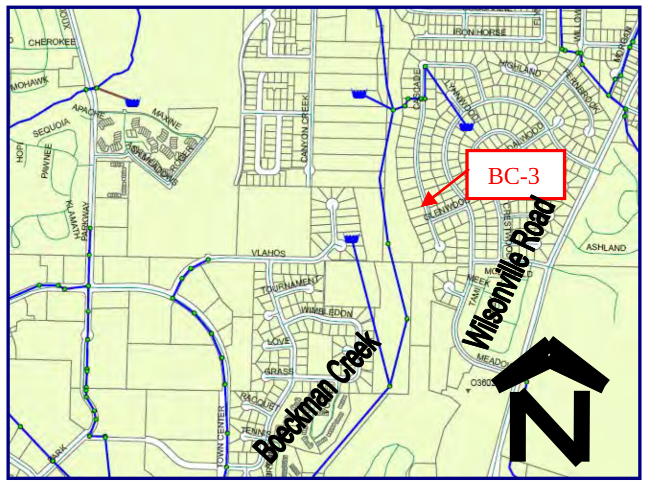
Existing Conditions: An estimated 30 acres discharge to Boeckman Creek Canyon via the Gesellschaft Outfall, causing erosion in the canyon and its drainages.

Proposed Solution: A detention pipe is proposed for installation in the right-of-way along Cascade Loop to reduce downstream flows. This project is expected to reduce erosion at the outfall by reducing velocities and peak flows from the 2-year through 25-year storm events.

Project Benefits: Reduce flooding, reduce erosion

Cost Estimate: $810,109

Aerial view of Project BC-3



Map view of Project BC-3

BC-5 – Boeckman Creek Outfall Realignment

Project Location: Boeckman Creek, north of SW Wilsonville Road

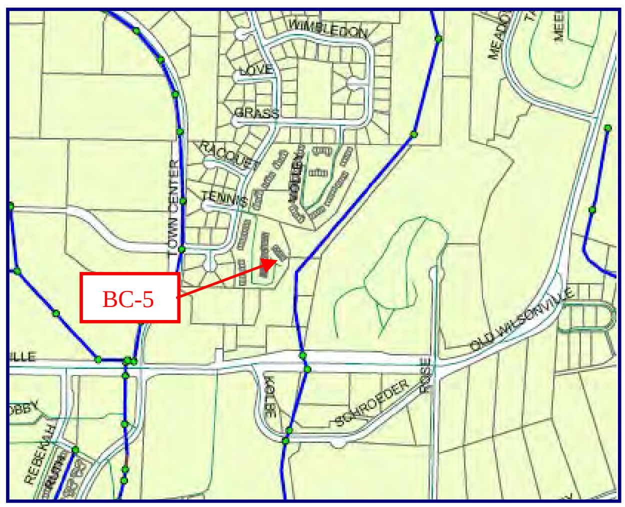
Existing Conditions: An 18-inch CMP outfall to Boeckman Creek that drains approximately 11 acres, about 300 feet north of Wilsonville Road, is installed perpendicular to the creek and discharges to a bubbler structure about 3 feet high. Water builds up in the pipe until it flows out of the top of the structure. Some erosion is occurring around the bubbler structure resulting from water dropping out of the top of the structure under pressure.

Proposed Solution: Realign the last few segments of the pipe and remove the bubbler structure. The pipe would be realigned to allow water to discharge downstream in the direction of the creek flow, reducing the erosion occurring at the outfall. Along with riprap for energy dissipation and vegetation for stability of the riparian area, this project will assist with stabilizing the outfall.

Project Benefit: Enhance water quality, reduce erosion

Cost Estimate: $38,441

Aerial view of Project BC-5



Map view of Project BC-5

BC-6 – Multiple Detention Pipe Installation

Project Location: Upstream of Outfall Projects identified in Project BC-2

Existing Conditions: Steep slopes and increasing discharges due to paving of areas draining to Boeckman Creek have resulted in severe erosion in several locations along the creek.

Proposed Solution: Install detention pipes upstream of four of the outfalls to be rehabilitated as part of CIP project BC-2. These projects are expected to reduce velocities and peak flows from the 2-year through 25-year storm events, preventing erosion near the rehabilitated outfalls. Refer to the graphic on page 8-11 for approximate locations of the detention pipes. The proposed locations and associated costs are as follows:

Project Location	Approximate Drainage Area Served	Cost Estimate
Cascade Loop I – northern portion of Cascade Loop	10.5 acres	$325,295
Vlahos Court	15.0 acres	$463,945
Meadows Loop	18.7 acres	$577,708
Bridgecreek Apartments	25.6 acres	$1,052,432

Project Benefits: Reduce erosion, enhance water quality

Cost Estimate: $2,419,380

WD-1 – Montgomery Way Culvert Replacement

Project Location: Montgomery Way, east of Rose Lane

Existing Conditions: As described in Section 4.4.1, existing problem P10, flooding has been reported near the culvert at Montgomery Way.

Proposed Solution: It is recommended that the diameter of this culvert be increased from 30 inches to 48 inches to alleviate flooding.

Project Benefits: Alleviate flooding, reduce erosion

Cost Estimate: $44,354

WD-2 – Rose Lane Culvert Replacement

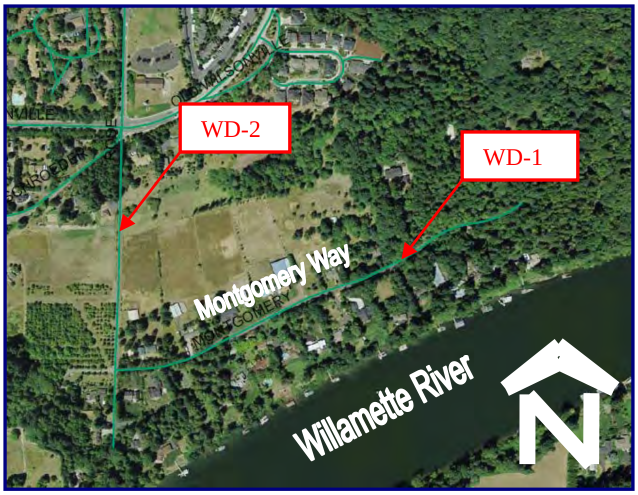
Project Location: Creek crossing at Rose Lane, south of Wilsonville Road

Existing Conditions: As described in Section 4.4.1, problem P15, the existing 12-inch culvert at Rose Lane is too small to convey flows underneath the roadway.

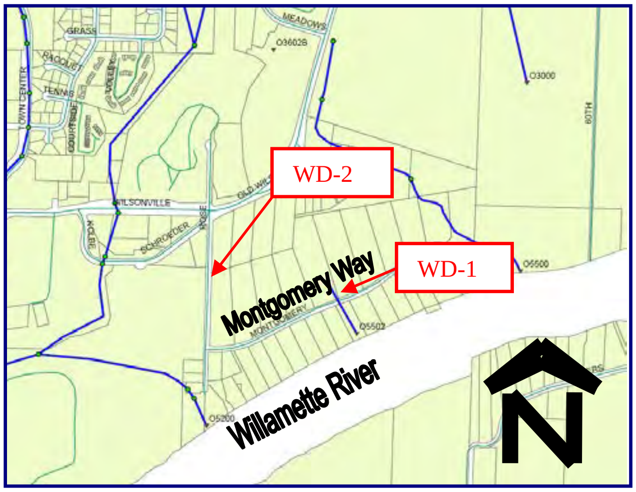
Proposed Solution: It is recommended to increase the diameter of the culvert to 36 inches, and raise the roadway in the area to alleviate flooding.

Project Benefits: Alleviate flooding

Cost estimate: $51,254



Aerial view of Projects WD-1 & WD-2



Map view of Projects WD-1 & WD-2

8.1.2 Restoration Projects

Restoration projects include stream and wetland restoration and enhancement. These projects were identified in two ways: by reviewing projects recommended in the 2001 Stormwater Master Plan and evaluating the ability to expand on these projects; and new projects were identified based on field evaluations. Appendix A provides a listing of CIP projects identified in the 2001 Stormwater Master Plan and updates on projects that were constructed, those that were eliminated and those that remain as viable CIP projects. Viable CIP projects were updated to include new regulatory requirements and are included in this Stormwater Master Plan. Restoration and enhancement projects involving streams and wetlands were evaluated for the ability to meet goals for water quality, shade and habitat, and are incorporated into this Stormwater Master Plan. Brief descriptions of projects are provided in this Section. Additional details are located in Appendix F.

Two projects, CLC-1 and BC-1, provide detention for upstream drainage areas in addition to wetlands enhancement and will likely be constructed in conjunction with new development. Restoration and enhancement projects are designed to maximize the ability of drainage to meander through the project site, to maximize plantings to address shade and to mimic natural conditions as much as possible.

CLC-1 – Detention/Wetland Facility near Tributary to Basalt Creek

Project Location: Northwest of Commerce Circle and north of Day Road in the northern portion of the City, where Basalt Creek crosses underneath Day Road. The exact location will be dependant upon the future planning of the Coffee Creek North Industrial Area north of Day Road.

Existing Conditions: Basalt Creek receives flows from an area to the north, including a 645-acre area that was recently added to the UGB, as well as a small portion of the City of Tualatin UGB, which is currently used as agricultural land. As described in Section 4.4.1, this area near Commerce Circle experiences flooding from moderate storm events. As the drainage area develops from agricultural land use to industrial (as it is currently zoned) more runoff will be produced. This will increase the flooding issues already experienced near Commerce Circle.

Proposed Solution: Construction of a wetland for stormwater detention. Reducing flows and velocities in the creek will result in decreased flows to Basalt Creek, reduced flooding near Commerce Circle, and reduced erosion potential in the creek.

Project Benefits: Water quality; habitat restoration; flooding mitigation; reduce erosion

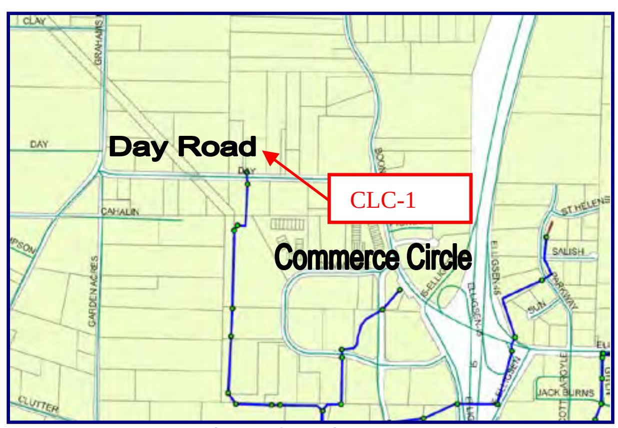
Potential Constraints: A portion of the project may be located under BPA power lines (according to the 2001 Stormwater Master Plan). The City of Wilsonville will need to develop a plan for addressing the portion of the Tualatin UGB that will be drained by the facility.

Cost estimate: $3,516,900

Flow Comparison at Project Location:

Storm Event	Existing Condition Flow Rate (cfs)	Future Condition Flow Rate (cfs)
2-year	46.5	240.7
10-year	64.9	328.1
25-year	74.3	378.1

Aerial view of Project CLC-1



Map view of Project CLC-1

CLC-2 – SW Parkway Avenue Stream Restoration

Project Location: Stream between SW Parkway Avenue and I-5, south of the intersection of SW Salish Lane and Parkway Avenue

Existing Conditions: The incised east–west stream flows west just north of the La Quinta Inn's swimming pool and just north of an office building at SW Sun Place. A short portion of the channel is in a culvert. Wetlands are on the north side of the stream. The site contains a mix of trees and shrubs, with significant areas of blackberry bushes.

Proposed Solution: Excavate a low terrace adjacent to the northern side of the channel along the northerly Sun Place lots to create flood storage capacity. Enhance the riparian vegetation with trees and shrubs and create in-channel vegetation to improve water quality.

Project Benefits: Water quality; temperature TMDL; habitat restoration; recreation (if trail access is provided)

Potential Constraints: The site is privately owned. Terrace excavation must be designed to prevent adverse impacts to nearby wetlands.

Cost Estimate: $279,420

Aerial view of Project CLC-2

Looking downstream along creek at Project CLC-2

CLC-3 – Commerce Circle Channel Restoration

Project Location: Southwest of Commerce Circle and north of Ridder Road.

Existing Conditions: The northern portion of Basalt Creek (a tributary to Coffee Lake Creek) is contained within a straightened, incised channel and flows due south on the western edge of the SW Commerce Circle industrial area. The stream turns to flow due east along the southern edge of the industrial area, still within a straightened, incised channel. Additional detail of this problem is provided under problem P1 in Section 4.4.1.

Proposed Solution: Create a more naturalistic and ecologically valuable waterway on both portions of the stream, through channel widening, channel meandering, and laying back the stream bank on the western side of the north–south reach and on the southern side of the east–west reach.

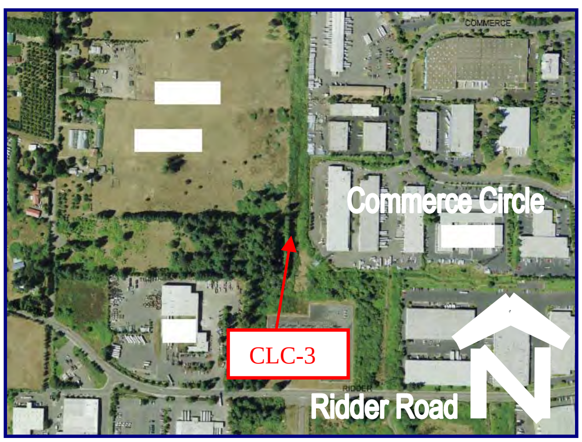
Project Benefits: Water quality; temperature TMDL; habitat restoration; flood control; improved high-flow conveyance

Potential Constraints: The conceptual plan may include property that is under private ownership, has set-back constraints, is located under high-voltage power lines (limiting the types of trees that can be planted within the riparian buffer), and portions of the temperature TMDL buffer consist of impervious surfaces limiting the area available for re-vegetation.

Flow Comparison at Project Location:

Storm Event	Existing Condition Flow Rate (cfs)[1]	Future Condition Flow Rate (cfs)
2-year	46.5	240.7
10-year	64.9	328.1
25-year	74.3	378.1

Cost Estimate: $564,071



Aerial view of Project CLC-3


Looking east along the east-west reach of Basalt Creek

[1] Model predicts flows are overcapacity for channel dimensions. Flows are compared for the contributing basin in order to properly compare flows from existing and projected future conditions.

CLC-4 – RIdder Road Wetland Restoration

Project Location: A reach of the North Tributary to Coffee Lake Creek that flows in a straightened channel for approximately 450 feet from a culvert under I-5 toward the southwest to a corridor between parking lots.

Existing Conditions: Currently, the channel area is approximately 12 to 15 feet wide and is mostly vegetated with reed canary grass. Both north and south banks have slopes of approximately 2:1. On the southern side, a grassy field is approximately 4 feet higher than the channel, while on the northern side, a grassy field is approximately 8 feet higher than the channel.

Proposed Solution: Create a new floodplain terrace along the south side of the channel and realign the channel for approximately 120 feet to create a meander north of the existing channel. Construct a water quality manhole at the outlet to function as a spill control facility.

Project Benefits: Water quality; temperature TMDL; habitat restoration; more naturalistic channel path; potential spill containment.

Potential Constraints:
Project is on private property and would require a BPA easement.

Cost Estimate: $283,778

Flow Comparison at Project Location:

Storm Event	Existing Condition Flow Rate (cfs)	Future Condition Flow Rate (cfs)
2-year	39.7	40.9
10-year	53.0	54.6
25-year	59.6	61.4

Aerial view of Project CLC-4

Looking west at stream at Project CLC-4

CLC-5 – Coffee Lake Creek Stream and Riparian Enhancement

Project Location: West of I-5, north of the Wilsonville Nissan dealership, and east of SW 95th Avenue.

Existing Conditions: An unnamed tributary to Basalt Creek flows from east to west through an incised, straightened channel on the northern edge of this narrow, rectangular property.

Proposed Solution: Widen the channel to create a meandering bank line, and excavate and re-contour the entire western half of the site to create a low floodplain terrace south of the channel. Vegetate with trees and shrubs on the terrace and the adjacent upland to provide wildlife habitat and summer shade for the stream. Create a trail for recreational activity. There is also potential for a spill control facility.

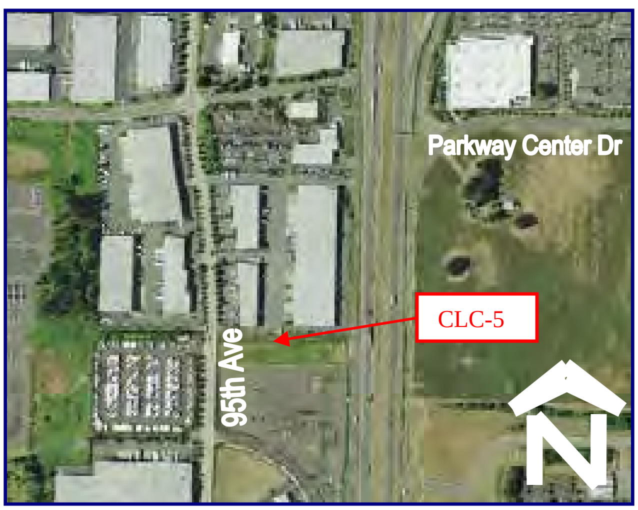
Project Benefits: Water quality; temperature TMDL; increased flood storage; habitat restoration; recreation

Potential Constraints: The site is privately owned. The plan will need BPA approval. No excavation can occur within 62.5 feet from the center point of the tower. Shrubs but no trees will be allowed in the BPA right-of-way.

Flow Comparison at Project Location:

Storm Event	Existing Condition Flow Rate (cfs)	Future Condition Flow Rate (cfs)
2-year	22.3	25.7
10-year	27.9	32.5
25-year	29.3	35.2

Cost Estimate: $ 339,844



Aerial view of Project CLC-5

Looking west along stream at Project CLC-5

BC-1 – Wiedeman Road Regional Stormwater Detention/Stream Enhancement

Project Location: Within and adjacent to the Wiedeman Road right-of-way west of Canyon Creek Road and east of Parkway Avenue, along the western side of the Sysco facility.

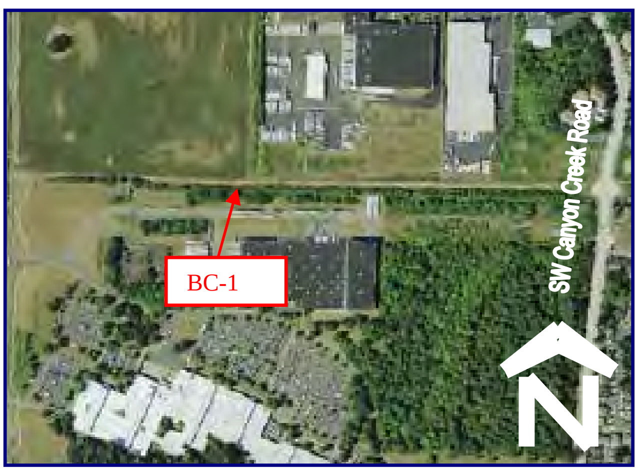
Existing Conditions: The northern portion of the stream is a straightened, incised channel that flows due south along the western side of the Sysco facility. Just north of the Wiedeman Road right-of-way, the stream flows into a culvert under the right-of-way, and the channel turns due east, still within a straightened, incised channel.

Proposed Solution: Throughout, the channel will be widened and the banks sloped back, and to the extent that the private property can be used, the north–south channel will be realigned to form a meander path. Terraces will be created along the channel. Trees, shrubs, and herbaceous plants will be planted to improve water quality within the channel, to provide diverse habitat, and to create shade. This site may include a regional stormwater detention feature, with detention volumes to be determined by the City.

Project Benefits: Water quality; temperature TMDL; habitat restoration; flood control

Potential Constraints: The property on the west side of the north-south reach of the ditch is privately owned, and the area immediately east of the north–south reach is developed and offers limited space. If the regional detention facility is included in the project, regulatory agency permits would be required. A portion of the project may be located under the BPA power lines.

Cost Estimate: $5,446,350



Aerial view of Project BC-1

Looking west at the potential site of a stormwater detention pond

CLC-6 – Coffee Lake Creek South Tributary Wetland Enlargement

Project Location: East of SW Parkway Avenue and north of SW Maxine Lane on the South Tributary to Coffee Lake Creek.

Existing Conditions: Small existing wetlands adjacent to creek.

Proposed Solution: Enhance existing wetlands and create wetlands adjacent to the existing stream and wetlands. The site is large enough to allow a mix of wetland and upland plant communities, which will enhance wildlife habitat. Depending on nature of the runoff entering the site, water quality features may be incorporated into the wetland design**.**

Project Benefits: Water quality; temperature TMDL; habitat restoration

Potential Constraints: The site is privately owned.

Cost Estimate: $490,286

Flow Comparison at Project Location:

Storm Event	Existing Condition Flow Rate (cfs)	Future Condition Flow Rate (cfs)
2-year	34.5	35.1
10-year	42.7	43.6
25-year	46.9	48.0

Aerial view of Project CLC-6

Looking north at existing wetland

CLC-7 – Coffee Lake Creek South Tributary Stream Restoration

Project Location: South Tributary to Coffee Lake Creek, between Boberg Road and Coffee Lake Creek

Existing Conditions: The channel is incised and has been straightened, and the site slopes to the west and is covered with trees, shrubs, and blackberries.

Proposed Solution: Re-shape the channel between Boberg Road and the railroad tracks to create meanders and provide a more naturalistic flow path; widen the channel and re-contour the banks to a shallower slope; add large woody debris for wildlife habitat improvement; remove invasive plants throughout the entire east–west reach of the stream, and plant native trees and shrubs in the riparian area. Establish different vegetation communities to provide additional habitat diversity. The site has the potential for a spill control facility. This project could be done in conjunction with the culvert replacements described as projects SD4021 and SD4022.

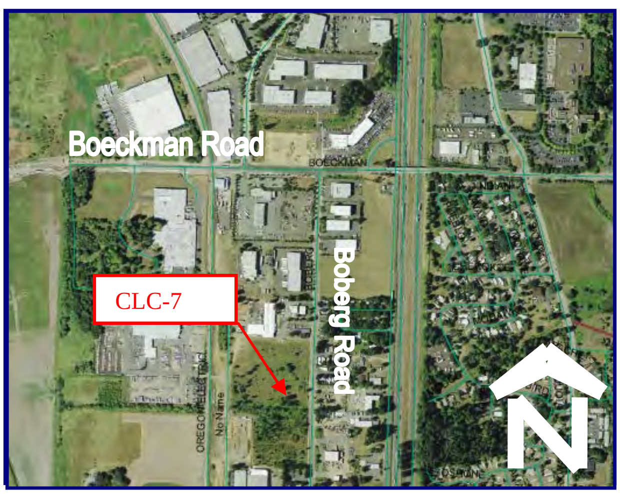
Project Benefits: Water quality; temperature TMDL; habitat restoration.

Potential Constraints: Enhancement is limited to the area already within the Wilsonville Significant Resource Overlay Zone.

Cost Estimate: $496,114

Flow Comparison at Project Location[1]:

Storm Event	Existing Condition Flow Rate (cfs)	Future Condition Flow Rate (cfs)
2-year	56.5	80.5
10-year	73.6	82.0
25-year	73.2	81.8



Aerial view of Project CLC-7


Looking west along stream at Project CLC-7

[1] The model predicts flows for the existing 25-year condition and future conditions for all events are inhibited by downstream restrictions due to the geometry of the channel. The model will better be able to predict these flows once surveying of the channels has been conducted (see ST-3 in Section 8.1.4).

CLC-8 – Coffee Lake Creek Restoration

Project Location: Coffee Lake Creek (along Industrial Way between Wilsonville Road and Ore Pac Avenue)

Existing Conditions: The channel is incised, with bank elevations approximately 8 feet above the ordinary high water level. There are very few trees or shrubs of a size or density to provide shade to the stream, and invasive blackberries and reed canary grass are found throughout the entire project reach. Construction activities are planned in this area, including a field on the east side of the channel that is slated for development, and the removal of Industrial Way (when a new through-street is created within the development area east of the channel).

Proposed Solution: The City's 2003 Transportation Systems Plan recommends the removal of Industrial Way and connecting all properties south of Wilsonville Road to Kinsman Road. If Kinsman is extended to the south, realign the central portion of Coffee Lake Creek into a new channel to the west between Wilsonville Road and SW Ore Pac Avenue, upon the removal of Industrial Way. Convert Industrial Way into a pedestrian/bike trail beginning at Wilsonville Road and extending south. The area between the realigned stream channel and the future trail will be excavated to create a floodplain for Coffee Lake Creek.

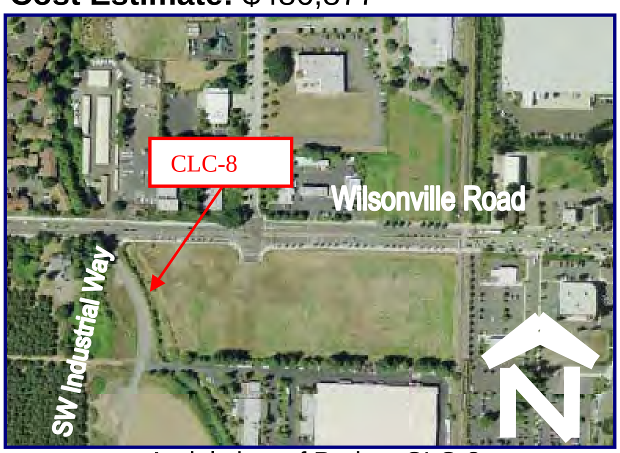
Flow Comparison at Project Location:

Storm Event	Existing Condition Flow Rate (cfs)	Future Condition Flow Rate (cfs)
2-year	577.1	600.4
10-year	593.0	602.9
25-year	649.4	687.2

Project Benefits: Water quality; temperature TMDL; habitat restoration; floodplain expansion; recreation.

Potential Constraints: The project cannot begin until Industrial Way is abandoned. The area east of Coffee Lake Creek is slated for development and is not available for expanding the floodplain. A portion of the project may be located under the BPA power lines.

Cost Estimate: $486,877



Aerial view of Project CLC-8


Looking south along Seely Ditch from Wilsonville Road

BC-4 – Gesellschaft Water Well Channel Restoration

Project Location: Boeckman Creek riparian area, south end of Cascade Loop

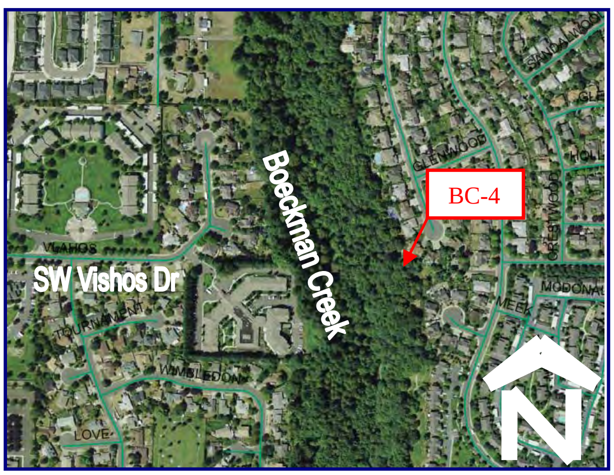
Existing Conditions: Severe erosion is occurring in the drainage channel due to weekly discharges of the drinking water well and excess stormwater runoff from a group of developments totaling approximately 25 acres. Additional detail of this problem is provided under problem P9 in Section 4.4.1.

Proposed Solution: Bypass the channel entirely by piping the weekly discharge from the well to the bottom of the slope. Restore the eroded area through installation of coir log check dams, coir matting, and re-vegetating with native trees and shrubs.

Project Benefits: Reduced erosion within the drainage channel; reduced sediment loading within Boeckman Creek; temperature TMDL; water quality.

Potential Constraints: Limited access for construction

Cost Estimate: $135,774



Aerial view of Project BC-4


Bank erosion downstream from the Gesellschaft well

BC-7 – Boeckman Creek Realignment

Project Location: Boeckman Creek at Wilsonville Road Bridge

Existing Conditions: This site corresponds with problem area P17 in Section 4.4.1. The main channel runs beneath the Wilsonville Road Bridge and crosses between two sets of pile caps. The site contains a mix of natural and man-made features such as off-channel ponded areas, berms created by side-cast spoils, and historic channels. The main channel is somewhat incised but it overflows regularly into its floodplain. A sewer line is located in the low, riparian area just east of the creek. Bank erosion occurs in several locations where surface flows and drain pipes discharge into the creek's floodplain.

Proposed Solution: Relocate the channel beneath the bridge where the stream makes a westerly turn near the base of one of the concrete bridge pilings and realign the channel to flow between two pilings to eliminate risk to bridge or damage from bank erosion. Fill and grade a portion of the existing pond to become part of the regularly inundated floodplain. Remove the berms to allow a more even spread of water onto the floodplain, and armor the surface drainage discharge sites to reduce erosion. Bury armoring around pile caps to allow free meandering of creek without causing disturbance of caps.

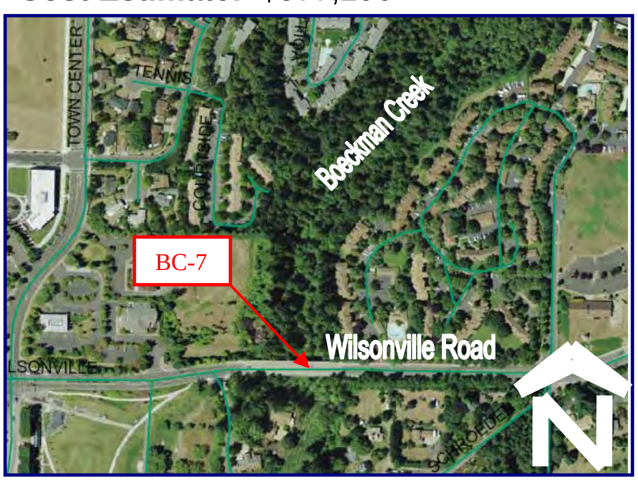
Project Benefits: Bridge piling protection; water quality; temperature TMDL; habitat restoration; increased floodplain area.

Potential Constraints: Protecting the pilings of the Wilsonville Road bridge will drive the design of the channel realignment and the creation of a new, high-flow channel. Regulatory permits will be needed.

Flow Comparison at Project Location:

Storm Event	Existing Condition Flow Rate (cfs)	Future Condition Flow Rate (cfs)
2-year	138.5	150.4
10-year	182.9	190.9
25-year	200.6	207.6

Cost Estimate: $577,296



Aerial view of Project BC-7

Bank erosion near Wilsonville Road piling

URS

BC-9 – Memorial Drive Pathway and Storm Drain Repair

Project Location: Vegetated swale along Memorial Drive in Memorial Park.

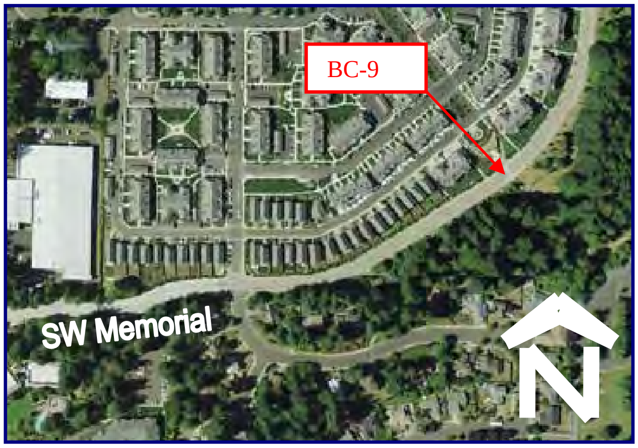
Existing Conditions: Existing French drain tile and vegetated swale adjacent to the roadway are insufficient for current drainage needs. The outfall structure in the swale often plugs with debris, causing overtopping and erosion of the swale.

Proposed Solution: This project involves installing check dams in the swale for sediment removal, installing a secondary higher emergency overflow inlet, retrofitting the outfall to provide energy dissipation and erosion control, and enhancing vegetation with native plants.

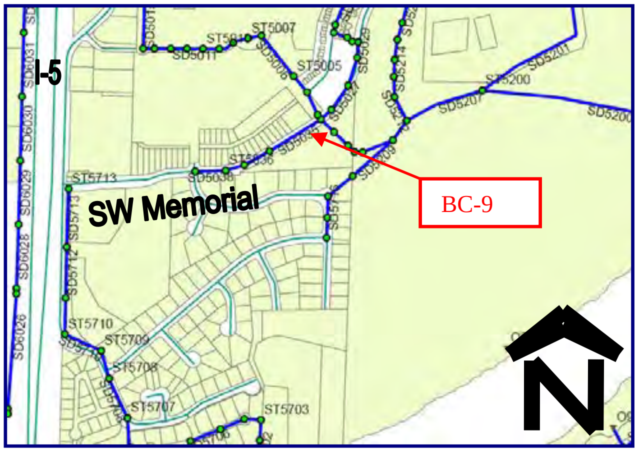
Project Benefits: Water quality, temperature TMDL, habitat restoration

Potential Constraints: There are no constraints to the proposed project.

Cost Estimate: $111,720



Aerial view of Project BC-9



Map view of Project BC-9

BC-10 – Memorial Park Stream and Wetland Enhancement

Project Location: Channel located on the north side of Memorial Park, adjacent to an existing sanitary lift station.

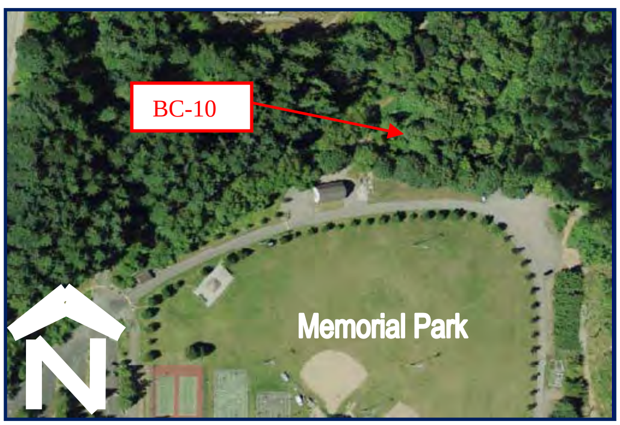
Existing Conditions: An existing channel that drains to Boeckman Creek conveys drainage from the Town Center Loop and an upstream subdivision. The channel has not been maintained and is degraded with invasive species.

Proposed Solution: Create a more naturalistic and ecologically valuable conveyance channel by removing invasive species, planting native vegetation, providing ongoing maintenance, and creating educational materials, such as project signs.

Project Benefits: Water quality, temperature TMDL, habitat restoration

Potential Constraints: There are no constraints to the proposed project.

Cost Estimate: $84,360



Aerial view of Project BC-10

Existing channel at Project BC-10

WD-3 – Rivergreen Repair Project

Project Location: Rivergreen Subdivision south of the intersection of Willamette Way West and Willamette Way East

Existing Conditions: In 2008-2009, the City reconstructed the stormwater outfall below Willamette Way West at the Rivergreen subdivision due to severe erosion along the riverbank. Stormwater runoff was conveyed 300 feet to the east of the original outfall in a grassy swale which eventually discharges through a series of drop pools to the Willamette River. In addition, the eroded riverbank was repaired with bioengineering techniques. In fall 2009, ponding issues in the swale and erosional issues within the drop pools began to manifest.

Proposed Solution: Retrofit the grassy swale and drop pools to prevent stormwater from ponding in the swale and extend the drop pools below the Ordinary High Water mark of the Willamette River, which will stabilize the channel slopes and prevent future erosion.

Project Benefits: Channel restoration, water quality, reduce erosion.

Project Constraints: There are no constraints to the proposed project.

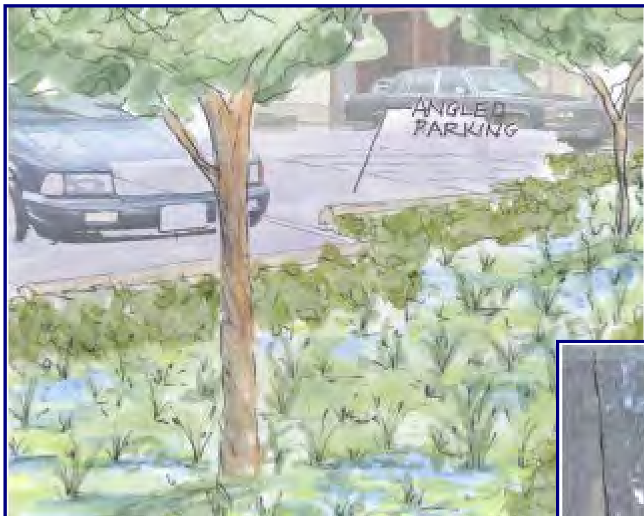
Cost Estimate: $285,000

Aerial view of Project WD-3

Looking southeast at Project WD-3

8.1.3 Low Impact Development Projects

The most effective treatment of stormwater for both quantity and water quality is to manage the water on site, as described in detail in Chapter 1. Low Impact Development techniques are an effective means of addressing stormwater on site. Seven Low Impact Development projects were identified for this Stormwater Master Plan. Brief descriptions of projects are provided in this Section. Additional details are located in Appendix F.



LID1 – Memorial Park Parking Lot Vegetated Swales (3)

Project Location: Memorial Park

Existing Conditions: This is a public parking lot that currently has several oversized travel/back-up aisles as well as a general inefficient use of asphalt space.

Proposed Solution: Reduce travel/back-up aisles and tighten the efficiency of the site. The remaining space can be converted into stormwater swales. Depending on how much space is available, another design option is to convert the angled parking into 90 degree head in parking which may yield additional parking spaces along with the stormwater improvements.

Project Benefits: Water quality, impervious area reduction, TMDL, flow reduction, volume reduction (depending on infiltration rates)

Potential Constraints: There are no constraints currently identified.

Cost Estimate: $203,148

Existing Parking Lot Conditions

Proposed Retrofit Condition Concept Sketch

LID2 – SW Hillman Green Street Stormwater Curb Extensions

Project Location: SW Hillman Street

Existing Conditions: This is a relatively wide street with parking on only one side. The street currently drains towards the curbs, and stormwater is collected into the storm drain system. There is a curb tight sidewalk on the parking side of the street.

Proposed Solution: Two options are proposed:
(1) Place a series of stormwater curb extensions within the parking zone of the street to capture runoff, allowing some on-street parking to remain; or
(2) Install stormwater curb extensions on the parking zone of the street and install a continuous stormwater swale on the non-parking side of the street.

Project Benefits: Water quality; impervious area reduction; TMDL; flow reduction; volume reduction (depending on infiltration rates).

Potential Constraints: Loss of parking and increased landscape maintenance.

Cost Estimate: $236,938

Existing Street Conditions

Example of Curb Extensions

LID3 – SW Camelot Green Street Mid-Block Curb Extensions (20 Extensions)

Project Location: SW Camelot Street

Existing Conditions: This is a relatively wide residential street in an established neighborhood. The street has on-street parking and curb-tight sidewalks on both sides of the street. The street currently drains to storm drain inlets along the existing curbs. Residents report that vehicles sometimes speed along this street.

Proposed Solution: Convert portions of the street's parking zone into mid-block stormwater curb extensions to capture stormwater runoff. It is also recommended that the curb extensions along the street be staggered to provide a traffic calming benefit.

Project Benefits: Water quality; impervious area reduction; TMDL; flow reduction; volume reduction (depending on infiltration rates); reduced vehicle speed through the residential neighborhood.

Potential Constraints: Loss of parking and increased landscape maintenance.

Cost Estimate: $584,820

Existing Street Conditions

Example of Mid-Block Curb Extension

URS

LID4 – SW Costa Circle Vegetated Swale and Stormwater Curb Extension

Project Location: SW Costa Circle

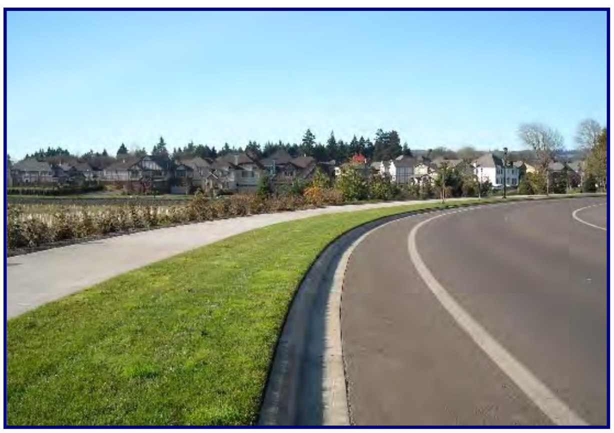
Existing Conditions: Grass is currently planted on an existing 7-foot or wider landscape strip to the south of SW Costa Circle that has no street trees. Stormwater drainage is currently collected into catch basins located along the adjacent curb. The parking zone on the north side of the street is sparsely used.

Proposed Solution: Convert the lawn strip on the south side of the street into a stormwater swale. Re-grade and re-plant the landscape strip with appropriate plant species and introduce several curb cuts to allow water to flow into the new stormwater swale. On the north side, strategically place one or more stormwater curb extensions to capture runoff.

Project Benefits: Water quality; impervious area reduction; TMDL; flow reduction; volume reduction (depending on infiltration rates).

Potential Constraints: This is a newly built street and there may be little incentive to undertake a street retrofit; loss of parking and increased landscape maintenance.

Cost Estimate: $70,817



Existing Street Conditions

Example of Vegetated Swale along Street

LID5 – Wood Middle School Parking Lot Green Street

Project Location: North of SW Wilsonville Road, east of SW Willamette Way East

Existing Conditions: The parking bays in the parking lot are laid out inefficiently with overly long head-in parking and travel/backup aisles. Stormwater runoff currently drains to the center of the parking lot where it is collected by a series of catch basins.

Proposed Solution: Several retrofit options are available at this site. For both of the proposed options, the parking lot should reduce parking stall lengths to 15 feet long and travel aisles to 22 feet wide. The two options proposed are:

(1) Redesign the site so that new stormwater planters are placed at the low points of the parking lot.
(2) Redesign the parking lot layout to include a long rain garden at the center of the parking lot.

Project Benefits: Water quality; impervious area reduction; TMDL; flow reduction; volume reduction (depending on infiltration rates); potential environmental education opportunity involving CREST.

Potential Constraints: School District property condition is difficult to fund and assure quality of future maintenance. Need to provide for adequate pedestrian/school bus circulation and increased landscape maintenance.

Cost Estimate: $203,148

Existing Parking Lot Conditions

Example of Stormwater Planters in Parking Lot

LID6 –Boones Ferry Primary School Parking Lot Green Gutters and Pervious Paving

Project Location: North of SW Wilsonville Road, at SW Willamette Way East

Existing Conditions: Currently several of the parking lot's stalls are inefficiently laid out with overly long head-in parking. Stormwater runoff currently drains to the edge of an existing landscaped area; however, the runoff is collected by catch basins along an existing curb edge.

Proposed Solution: Re-stripe the existing parking lot stalls so that they are 15 feet long. Allow the remainder of the space in the front of the parking stalls to be converted into a shallow green gutter that is 3 feet wide or wider. Further stormwater management can be achieved by introducing pervious paving on the uphill side of the parking lot's stalls.

Project Benefits: Water quality; impervious area reduction; TMDL; flow reduction; volume reduction (depending on infiltration rates); potential environmental education opportunity involving CREST.

Potential Constraints: School District property condition is difficult to fund and assure quality of future maintenance; need to provide for increased landscape maintenance.

Cost Estimate: $130,945

Existing Parking Lot Conditions

Example of a Green Gutter in a Parking Lot

LID7 – SW Wilsonville Road Stormwater Planters

Project Location: SW Wilsonville Road on west side of City

Existing Conditions: This arterial street is a two-lane road with a landscape strip 6 feet wide or wider that separates the bike lanes and sidewalk zone. Existing street trees are placed at a regular spacing within the landscape strip. Stormwater runoff from the roadway is collected in a series of catch basins along the street curb.

Proposed Solution: Install stormwater planters between the existing street trees to accept stormwater runoff from the roadway. Install wide curb cuts to allow water to freely enter and exit the stormwater planters. The spacing and number of stormwater planters can vary depending on the overall stormwater goal.

Project Benefits: Water quality; impervious area reduction; TMDL; flow reduction; volume reduction (depending on infiltration rates).

Potential Constraints: The root zones of existing trees will need to be protected and there may be increased landscape maintenance.

Cost Estimate: $362,794

Existing Street Conditions

Example of Stormwater Planters with Trees

8.1.4 Studies

A number of projects are included in the CIP that require funding and do not involve design and construction. These projects vary from purchasing essential software to evaluating the infrastructure needs of a neighborhood. Summarized in the table below are nine projects that were identified generally as “Studies”. The order of projects listed below is not an indication of priority. See Table 9-1 for prioritization criteria and results.

Table 8-1
Studies

Project ID	Description	Additional Detail	Cost Estimate
Study ST-1	Study to analyze area north of Elligsen Rd/East of I-5	See description below.	$57,000
Study ST-2	Advance Road School Site Study	Evaluate options to provide the best approach for extending stormwater services, including drainage and water quality controls, to a new proposed school.	$57,000
Study ST-3	Survey of Open Channel Conveyance	Generalized assumptions of existing drainage channel sizes and shape were made for modeling purposes associated with this Master Plan. Surveying the channels will provide the City with greater accuracy in future stormwater modeling.	$57,000
Study ST-4	Master Plan and Model Update	An update to the Stormwater Master Plan and model is necessary to capture new improvements, increase accuracy of the model and re-evaluate CIP projects and priorities.	$342,000
Study ST-5	Low Impact Development Design Standards and Implementation Guide	Stormwater regulations are increasingly focused on Low Impact Development, an area of increasing interest to the City. Development of Design Standards and an Implementation Guide will allow developers to design low impact facilities into their projects and provide the City with guidelines to review these projects.	$57,000
Study ST-6	Charbonneau Infrastructure Replacement Study	Infrastructure in the Charbonneau District is in need of repair or reconstruction. A study is needed to evaluate how to most effectively provide services to Charbonneau and to coordinate the work with other utilities in the District.	$142,500
Study ST-7	Boeckman Creek at Boeckman Road Stormwater Study	Boeckman Creek at Boeckman Road is currently being used as a water control structure for upstream developments. Boeckman Road may be replaced with a bridge structure, which would affect the detention facility. This study would	$57,000

Project ID	Description	Additional Detail	Cost Estimate
		evaluate options and identify alternatives for regional detention for upstream drainage.	
Study ST-8	Install Two Permanent Stormwater Flow Monitoring Stations and Two Rain Gauges	Two permanent stormwater flow monitoring stations and rain gauges will provide the City with data to update the calibration of the InfoSWMM model developed for this Master Plan. This information will assure the City of accurate flow for future development and verify that CIP projects are not over or under designed for future development conditions.	$45,486
Study ST-9	Purchase InfoSWMM Model	Acquisition of the InfoSWMM model will allow the City to use the model developed for this Master Plan effort. The model is needed for regular updates to the stormwater system, evaluating new development proposals and improved calibration resulting from flow monitoring data collected in Study ST-8.	$18,240

Study ST-1

As described in problem P14 in Section 4.4.1, a recent 25-year storm on January 1, 2009, resulted in flooded conditions at the northeastern corner of I-5 and Elligsen Road. The basement of a hotel and the parking lot area were flooded. The model does not predict flooding in this area; however, the detailed topography and groundwater conditions are unclear. The hotel has a sump pump to clear the basement of water and there is a detention facility along the northern end of Elligsen Road. One pipe under I-5 needs to be evaluated to verify the location, size, configuration through the interchange, and its condition. A focused study will provide further information on the hydrology and hydraulics of the area to enable the City to determine an appropriate course of action, particularly as new development occurs in the upstream drainage area.

8.1.5 Future Projects

One additional category of projects to be included in the CIP is defined generally as “Future Projects”. This category is to provide funding for unforeseeable conditions including emergencies and opportunities that arise during the operation and maintenance of a stormwater program.

FP – Future Project Development and Implementation

Project Description: Provides funding for the development and implementation of unplanned or critical repair and maintenance projects that arise throughout the year.

Cost Estimate: $50,000/year

8.2 CIP PROJECT SUMMARY

Table 8-2 on the following page summarizes proposed CIP projects, along with cost estimates and annual maintenance estimates.

Table 8-2
Proposed CIP Projects

Project ID	Location	Land Acquisition Required? (Yes or No)	Total Cost Estimate[1]	Annual Maintenance Cost Estimate
	Pipe Projects			
CLC-9	Jobsey Lane Culvert Replacement	No	$ 115,028	$ 2,200
SD4021 & SD4022	Boberg Road Culvert Replacement	No	$ 65,393	$ 2,200
SD4208 & SD4209	Barber Street Pipe Replacement	No	$ 213,196	$ 1,200
SD4025 - SD4028	Boberg Road Pipe Replacement	No	$ 733,590	$ 2,200
SD5707, 5709, 5714, 5719	SW Parkway Pipes Replacement	No	$ 497,405	$ 2,200
BC-8	Canyon Creek Estates Pipe Removal	No	$ 129,504	$ 1,500
SD9000-9012	Miley Road in S Charbonneau Pipe Replacement	No	$ 3,198,175	$ 3,900
SD9013-9021; 9060	French Prairie Road in NE Charbonneau Pipe Replacement	No	$ 1,680,563	$ 2,800
SD9022-9029	Old Farm Road in NE Charbonneau Pipe Replacement	No	$ 1,015,021	$ 1,600
SD9030-9037	Edgewater Drive E and French Praire Road in NE Charbonneau Pipe Replacement	No	$ 996,254	$ 1,700
SD9038; 9045; 9046; 9054-9058	French Prairie Road in NW Charbonneau Pipe Replacement	No	$ 867,417	$ 1,500
SD9039; 9044; 9047; 9051	Boones Bend Road in NW Charbonneau Pipe Replacement	No	$ 855,395	$ 1,600
SD9052; 9053; 9059; 9061-9069	Curry Drive and French Prairie Road in NW Charbonneau Pipe Replacement	No	$ 1,043,501	$ 2,100
BC-2	Boeckman Creek Outfall Rehabilitation	Maybe	$ 167,580	$ 1,500
BC-3	Cascade Loop Detention Pipe Installation	No	$ 810,109	$ 1,100
BC-5	Boeckman Creek Outfall Realignment	No	$ 38,441	$ 1,300
BC-6	Multiple Detention Pipe Installation	No	$ 2,419,380	$ 1,100
WD-1	Montgomery Way Culvert Replacement	No	$ 44,354	$ 600
WD-2	Rose Lane Culvert Replacement	No	$ 51,254	$ 1,100
Pipe Projects	**Subtotal**	**-**	**$ 14,941,560**	**$ 33,400**

[1] Total Cost Includes land acquisition costs and is in 2009 dollars.

Project ID	Location	Land Acquisition Required? (Yes or No)	Total Cost Estimate[1]	Annual Maintenance Cost Estimate
	Restoration Projects			
CLC-1	Detention/Wetland Facility near Tributary to Basalt Creek	Yes	$ 3,516,900	$ 4,900
CLC-2	SW Parkway Avenue Stream Restoration	Yes	$ 279,420	$ 4,900
CLC-3	Commerce Circle Channel Restoration	No	$ 564,071	$ 5,700
CLC-4	Ridder Road Wetland Restoration	Yes	$ 283,778	$ 2,900
CLC-5	Coffee Lake Creek Stream and Riparian Enhancement	Yes	$ 339,844	$ 2,900
BC-1	Wiedeman Road Regional Stormwater Detention/ Stream Enhancement	Yes	$ 5,446,350	$ 4,900
CLC-6	Coffee Lake Creek South Tributary Wetland Enlargement	Yes	$ 490,286	$ 2,900
CLC-7	Coffee Lake Creek South Tributary Stream Restoration	Yes	$ 496,114	$ 2,900
CLC-8	Coffee Lake Creek Restoration	Yes	$ 486,877	$ 4,300
BC-4	Gesellschaft Water Well Channel Restoration	No	$ 135,774	$ 1,800
BC-7	Boeckman Creek Realignment	No	$ 577,296	$ 2,200
BC-9	Memorial Drive Pathway and Storm Drain Repair	No	$ 111,720	NA
BC-10	Memorial Park Stream and Wetland Enhancement	No	$ 84,360	$ 2,900
WD-3	Rivergreen Repair Project	No	$ 285,000	$ 2,200
Restoration Projects	**Subtotal**	**-**	**$ 13,097,790**	**$ 45,400**
	Low Impact Development Projects			
LID1	Memorial Park Parking Lot Vegetated Swales (3)	No	$ 203,148	$ 6,500
LID2	SW Hillman Green Street Stormwater Curb Extensions	No	$ 236,938	$ 4,000
LID3	SW Camelot Green Street Mid-Block Curb Extensions (20 extensions)	No	$ 584,820	$ 53,000
LID4	SW Costa Circle Vegetated Swale and Stormwater Curb Extension	No	$ 70,817	$ 6,300

Project ID	Location	Land Acquisition Required? (Yes or No)	Total Cost Estimate[1]	Annual Maintenance Cost Estimate
LID5	Wood Middle School Parking Lot Green Street	No	$ 203,148	NA
LID6	Boones Ferry Primary School Parking Lot Green Gutters and Pervious Paving	No	$ 130,945	NA
LID7	SW Wilsonville Road Stormwater Planters	No	$ 362,794	$ 6,700
Low Impact Development Projects	**Subtotal**	**-**	**$ 1,792,610**	**$ 76,500**
Studies				
ST-1	Study to analyze area north of Elligsen Rd/East of I-5	No	$ 57,000	NA
ST-2	Advance Road School Site Study	No	$ 57,000	NA
ST-3	Survey of Open Channel Conveyance	No	$ 57,000	NA
ST-4	Master Plan and Model Update	No	$ 342,000	NA
ST-5	Low Impact Development Design Standards and Implementation Guide	No	$ 57,000	NA
ST-6	Charbonneau Infrastructure Replacement Study	No	$ 142,500	NA
ST-7	Boeckman Creek at Boeckman Road Stormwater Study	No	$ 57,000	NA
ST-8	Install Two Permanent Stormwater Flow Monitoring Stations and Two Rain Gauges	No	$ 45,486	NA
ST-9	Purchase InfoSWMM Model	No	$ 18,240	NA
Study Projects	**Subtotal**	**-**	**$ 833,226**	**NA**
Future Projects				
FP	Future Project Development and Implementation	No	$570,000	N/A
Future Projects	**Subtotal**	-	$570,000	N/A
All CIP Projects	**Total CIP Projects**	**-**	**$ 31,235,186**	**$155,300**

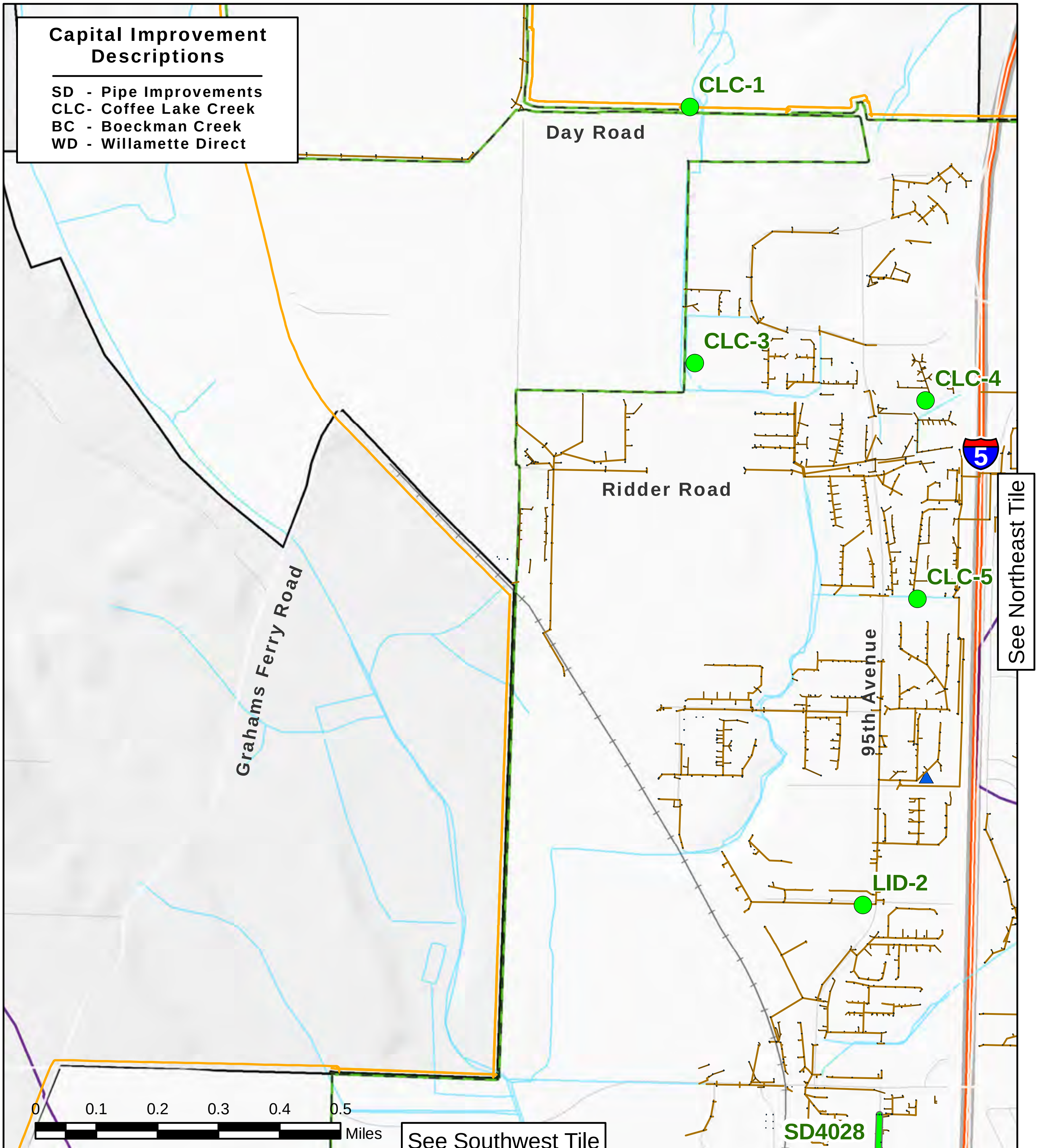


Figure 8-1 Northwest Capital Improvement Projects

City of Wilsonville
Stormwater Master Plan

N

March 2012

- Capital Improvement Locations
- Capital Improvement Conduits
- Stormwater Lines
- Stormwater Structures
- Detention Ponds
- Study Area
- Streams
- UGB Boundary
- City Limits
- Watershed Boundaries

File Path: O:\25696563 Wilsonville SWMP Update\4000 Deliverables\STORMWATER MASTER PLAN\CD\Disc 3 - GIS\Figure 8-1 Capital Improvement Projects_MapBook_URS.mxd

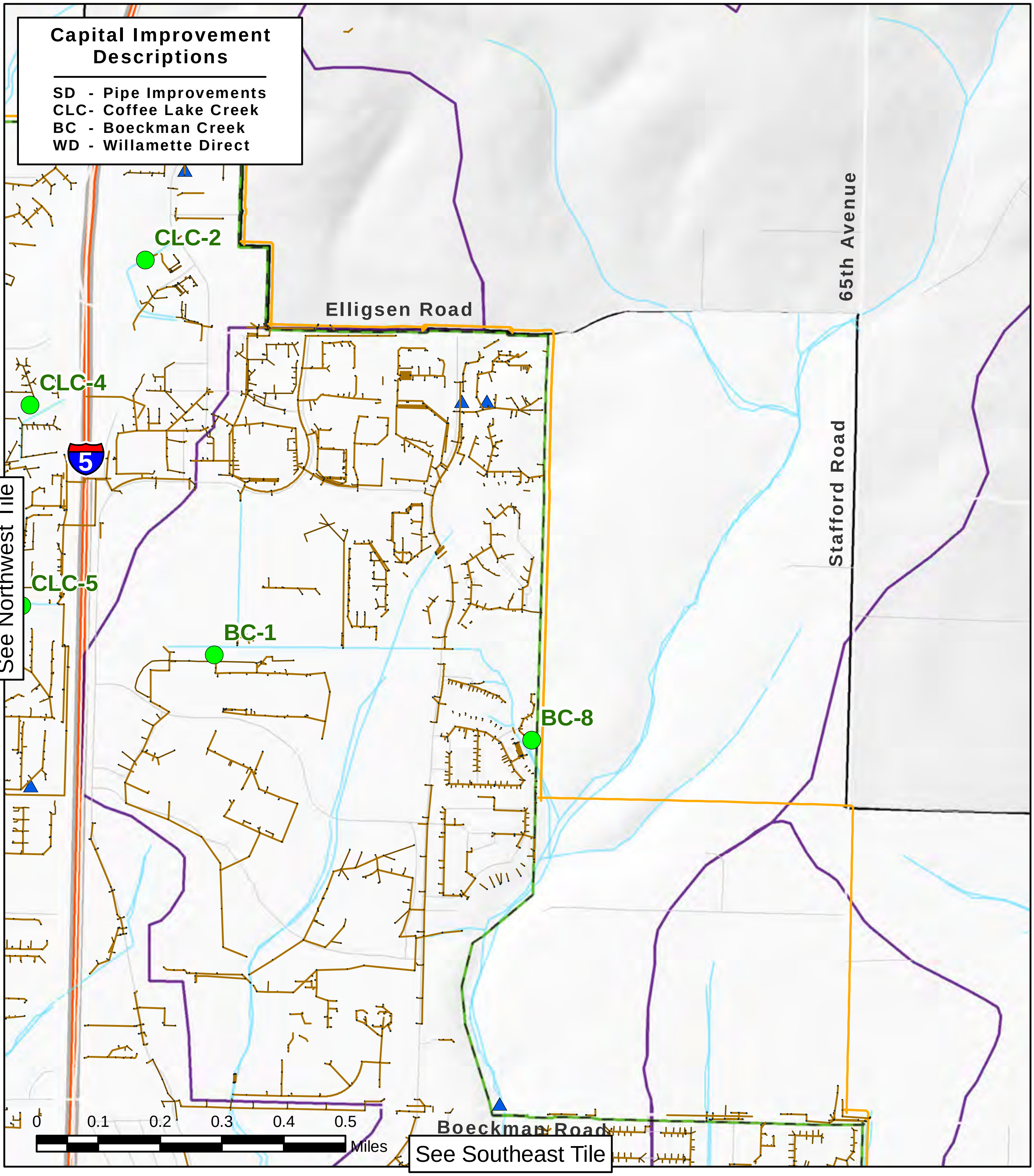


Figure 8-1 Northeast Capital Improvement Projects

City of Wilsonville
Stormwater Master Plan

N

March 2012

- Capital Improvement Locations
- Capital Improvement Conduits
- Stormwater Lines
- Stormwater Structures
- Detention Ponds
- Study Area
- Streams
- UGB Boundary
- City Limits
- Watershed Boundaries

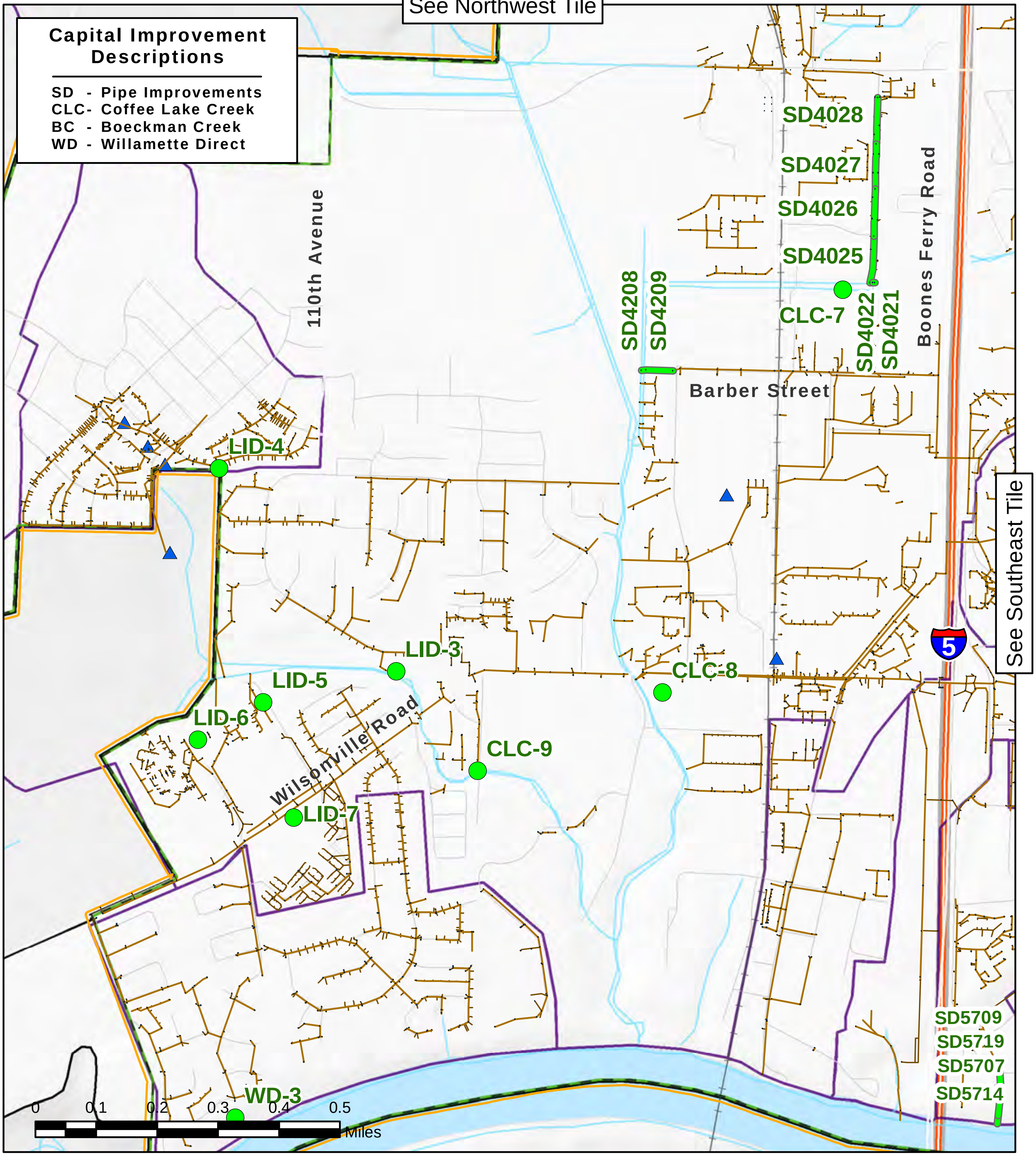


Figure 8-1 Southwest Capital Improvement Projects

City of Wilsonville
Stormwater Master Plan

March 2012

- Capital Improvement Locations
- Capital Improvement Conduits
- Stormwater Lines
- Stormwater Structures
- Detention Ponds
- Study Area
- Streams
- UGB Boundary
- City Limits
- Watershed Boundaries

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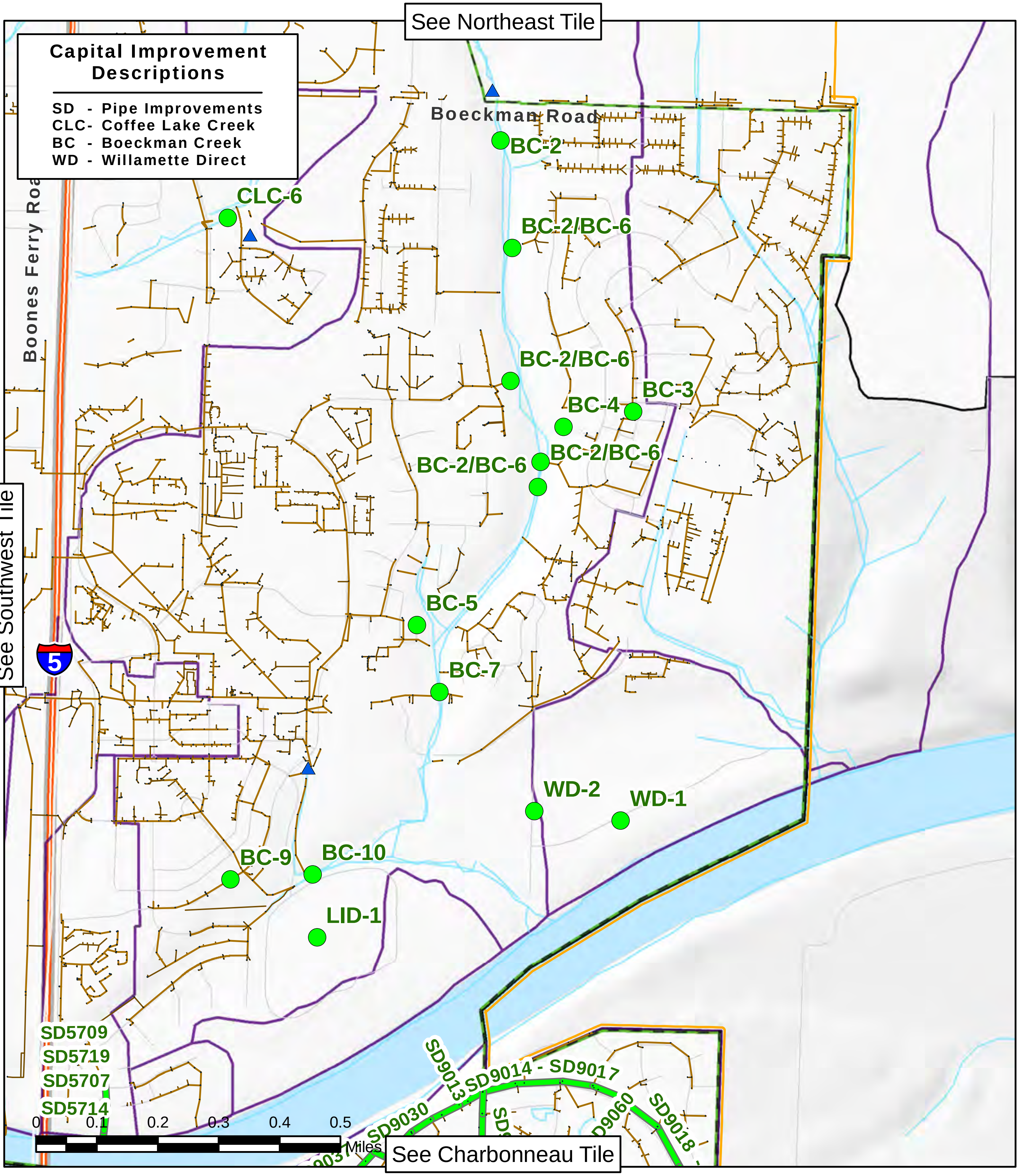


Figure 8-1 Southeast
Capital Improvement Projects

City of Wilsonville
Stormwater Master Plan

March 2012

N

- Capital Improvement Locations
- Capital Improvement Conduits
- Stormwater Lines
- Stormwater Structures
- Detention Ponds
- Study Area
- Streams
- UGB Boundary
- City Limits
- Watershed Boundaries

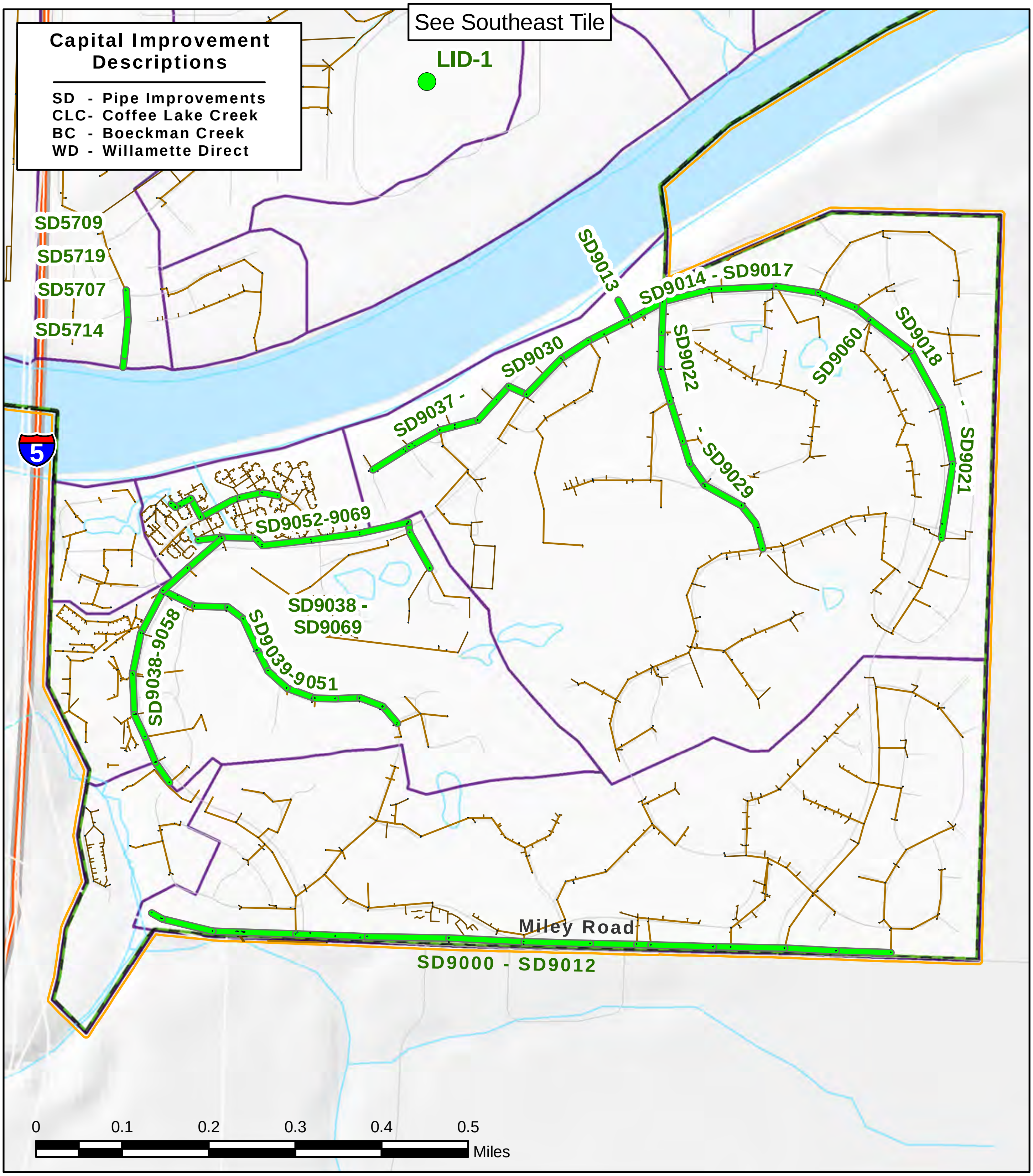


Figure 8-1 Charbonneau Capital Improvement Projects

City of Wilsonville
Stormwater Master Plan

N

March 2012

- Capital Improvement Locations
- Capital Improvement Conduits
- Stormwater Lines
- Stormwater Structures
- Detention Ponds
- Study Area
- Streams
- UGB Boundary
- City Limits
- Watershed Boundaries

9.0 PRIORITIZED CAPITAL IMPROVEMENT PROGRAM

9.1 PRIORITIZATION PROCESS

9.2 PRIORITIZED PROJECTS IN CAPITAL IMPROVEMENT PROGRAM

9.0 PRIORITIZED CAPITAL IMPROVEMENT PROGRAM

CIP projects developed in the previous section were prepared to address both existing and future problems for water quality, water quantity, and habitat. The CIP projects were sorted into three categories to meet the City's current and future needs: short-term, mid-term, and long-term. Short-term CIP projects are planned to be implemented within 5 years; mid-term projects in 5 to 10 years, and long-term projects in 10 to 20 years. One additional category of unfunded projects has been included. These projects were identified to be a low priority and require additional information and study prior to incorporation into the funded CIP.

Prioritized CIP projects are presented along with cost estimates for each project and estimated annual maintenance costs. Appendix E includes assumptions for restoration projects and pipe upgrades and improvements.

9.1 PRIORITIZATION PROCESS

The prioritization process involved evaluating each project against significance criteria identified by the City to determine the importance and urgency of each project. A numerical value was established for each project, based on the value of the benefits; the short-term projects are those with the highest total numerical value. Point range values of 0-5 were given to criteria that are important but not critical to public health and safety. Critical criteria to protect the public were give point range values between 0 and 10. Prioritization criteria are shown in Table 9-1 and fall into the following four categories:

- **Site Issues** – physical constraints at the site
  - Current Problem Flooding or Facility Failure – CIP project is addressing an existing problem, such as flooding, a facility failure, or a water quality problem. Flooding can also be categorized as significant or nuisance flooding. A high value for this criterion indicates the severity of the problem being addressed, such as significant flooding versus occasional flooding, or a significant water quality problem, such as high erosion. (0-10 points)
  - Future Flood Control - Modeling identified some projects as needed for future development. These projects were identified as CIP projects that pose a potential future problem. (0-10 points).
- **Compliance** – regulatory concerns for water quality and habitat
  - Water Quality – Erosion control problems at outfalls and along Boeckman Creek were the major water quality problems identified. Some erosion receives fewer points; conditions of serious erosion are given many points. High scores indicate an urgent need to address the situation to prevent further water quality problems. (0-5 points)
  - Temperature TMDL – In the interests of combining regulatory requirements and integrating different programs, projects that provide additional shading as required by the Willamette TMDL for temperature

may receive more points. Projects that provide no shading, such as pipe upgrades, may receive few or even 0 points. Large amounts of planting, such as wetland restoration, would receive the most points. (0-5 points)

- Habitat - Title 13 – This criterion addresses the integration of regulations and programs for habitat, planning, and water quality. For projects that enhance habitat for wildlife, more points may be given. Projects that do not include habitat improvements may receive low scores. (0-5 points)

- **Cost Efficiency** – feasibility of construction and long-term maintenance.
  - Combined with Other Projects - Projects that can be combined with other projects received higher scores due to the potential of receiving funding from alternate sources, and/or decreasing costs due to sharing equipment or mobilization costs, for example. Pipe upgrades that can be combined with road improvements, for example, may receive more points. Other projects that might be combined with these projects include walking and general purpose trails identified in Wilsonville's Bicycle and Pedestrian Master Plan. If projects can be combined with transportation, wastewater, or drinking water projects, they may receive higher points. (0-5 points)
  - Facility Failure – Projects that are not completed in a timely fashion may result in additional costs to the City due to failure of the project components and offsite impacts resulting from the failure. For example, repair of a pipe or drainage way that is delayed could result in excessive downstream erosion. Additional damage to other systems would increase overall costs to the City. High scores for this component indicate a high potential for increasing costs to the City for delaying the project. (0-10 points)
  - Land Ownership – Projects that do not require the City to purchase right-of-way received more points than projects that require either easements or property acquisition. Property acquisition can be costly and time consuming, therefore, these projects may receive fewer points. Projects within an SROZ protected area may receive a medium number of points. These areas may only require an easement due to the existing SROZ protections. (0-5 points)
  - Maintenance – Maintenance is an important component for the City. Taking into account the need to maintain facilities that are constructed in order to maintain proper function and viability of the facility, this criterion addresses the difficulty and expense of maintenance. Facilities requiring higher levels of maintenance may receive fewer points and facilities with less need for ongoing maintenance could receive more points. (0-5 points)
- **Other** – unique issues important to the City
  - Livability – Mindful of the need for educating the public on the benefit of the stormwater program and the costs for constructing CIP projects, the City identified this criterion to give more points to projects that are highly visible to the public, particularly to improve the aesthetics of an area. These are projects that the public can see, perhaps have access to, and can be used as educational tools by the City. (0-5 points)

The list of CIP projects identified in Section 8 is shown in Table 9-1 with the numerical values for each project based on the criteria described above.

Table 9-1
Rankings of Proposed Capital Improvement Projects

Project ID	Location	Ranking of Benefits										
		Site Issues		Compliance			Cost Efficiency				Other	Total Points
		Current Problem - Flooding or Facility Failure (0-10)	Future Flood Control (0-10)	Water Quality (0-5)	Temper-ature – TMDL (0-5)	Habitat - Title 13 (0-5)	Combined with other project (0-5)	Potential Cost for Facility Failure (0-10)	Land Owner-ship (0-5)	Maint-enance (0-5)	Liveability (0-5)	
Pipe Projects												
CLC-9	Jobsey Lane Culvert Replacement	5	10	0	0	0	0	7	5	3	2	32
SD4021 & SD4022	Boberg Road Culvert Replacement	1	1	0	0	0	5	4	5	3	0	19
SD4208 & SD4209	Barber Street Pipe Replacement	5	10	0	0	0	5	10	5	5	0	40
SD4025 - SD4028	Boberg Road Pipe Replacement	3	5	0	0	0	5	1	3	2	0	19
SD5707, 5709, 5714, 5719	SW Parkway Pipes Replacement	5	10	0	0	0	0	10	2	2	0	29
BC-8	Canyon Creek Estates Pipe Removal	10	5	5	3	2	0	5	5	4	5	44

Project ID	Location	Ranking of Benefits										
		Site Issues		Compliance			Cost Efficiency				Other	Total Points
		Current Problem - Flooding or Facility Failure (0-10)	Future Flood Control (0-10)	Water Quality (0-5)	Temper-ature – TMDL (0-5)	Habitat - Title 13 (0-5)	Combined with other project (0-5)	Potential Cost for Facility Failure (0-10)	Land Owner-ship (0-5)	Maint-enance (0-5)	Liveability (0-5)	
SD9000-9012	Miley Road in South Charbonneau Pipe Replacement	2	2	2	0	0	2	5	2	2	0	17
SD9013-9021; 9060	French Prairie Road in NE Charbonneau Pipe Replacement	2	2	2	0	0	2	5	2	2	0	17
SD9022-9029	Old Farm Road in NE Charbonneau Pipe Replacement	2	2	2	0	0	2	5	2	2	0	17
SD9030-9037	Edgewater Drive E and French Prairie Road in NE Charbonneau Pipe Replacement	2	2	2	0	0	2	5	2	2	0	17
SD9038; 9049-9046;9054-9058	French Prairie Road in NW Charbonneau Pipe Replacement	5	5	1	0	0	5	5	2	2	0	25
SD9039-9044; 9047-9051	Boones Bend Road in NW Charbonneau Pipe Replacement	2	2	2	0	0	2	5	2	2	0	17
SD9052-9053; 9059; 9061-9069	Curry Drive and French Prairie Road in NW Charbonneau Pipe Replacement	5	5	1	0	0	5	5	2	2	0	25

Project ID	Location	Ranking of Benefits										
		Site Issues		Compliance			Cost Efficiency				Other	Total Points
		Current Problem - Flooding or Facility Failure (0-10)	Future Flood Control (0-10)	Water Quality (0-5)	Temper-ature – TMDL (0-5)	Habitat - Title 13 (0-5)	Combined with other project (0-5)	Potential Cost for Facility Failure (0-10)	Land Owner-ship (0-5)	Maint-enance (0-5)	Liveability (0-5)	
BC-2	Boeckman Creek Outfall Rehabilitiation	8	2	3	3	3	5	5	5	3	0	37
BC-3	Cascade Loop Detention Pipe Installation	10	10	0	0	0	5	5	5	2	0	37
BC-5	Boeckman Creek Outfall Realignment	8	2	3	3	3	5	5	5	3	0	37
BC-6	Multiple Detention Pipes Installation	10	10	0	0	0	5	5	5	2	0	37
BC-6	Multiple Detention Pipes Installation – Bridge Creek Apartments	1	2	0	0	0	5	4	5	2	0	19
WD-1	Montgomery Way Culvert Replacement	2	2	2	0	0	2	5	2	2	0	17
WD-2	Rose Lane Culvert Replacement	2	2	2	0	0	2	5	2	2	0	17
Restoration Projects												
CLC-1	Detention/Wetland Facility near Tributary to Basalt Creek	5	5	3	0	3	0	5	2	2	0	25

Project ID	Location	Ranking of Benefits										
		Site Issues		Compliance			Cost Efficiency				Other	Total Points
		Current Problem - Flooding or Facility Failure (0-10)	Future Flood Control (0-10)	Water Quality (0-5)	Temper-ature – TMDL (0-5)	Habitat - Title 13 (0-5)	Combined with other project (0-5)	Potential Cost for Facility Failure (0-10)	Land Owner-ship (0-5)	Maint-enance (0-5)	Liveability (0-5)	
CLC-2	SW Parkway Avenue Stream Restoration	5	3	5	5	5	0	2	2	2	5	34
CLC-3	Commerce Circle Channel Restoration	10	10	2	5	2	4	7	0	0	0	40
CLC-4	Ridder Road Wetland Restoration	0	0	5	5	5	0	0	0	3	3	21
CLC-5	Coffee Lake Creek Stream and Riparian Enhancement	0	0	5	5	5	0	0	0	3	3	21
BC-1	Wiedeman Road Regional Stormwater Detention/Stream Enhancement	3	3	2	2	2	0	3	5	2	0	22
CLC-6	Coffee Lake Creek South Tributary Wetland Enlargement	0	0	5	5	5	0	0	0	3	3	21
CLC-7	Coffee Lake Creek South Tributary Stream Restoration	0	0	5	5	5	0	0	2	1	3	21

Project ID	Location	Ranking of Benefits										
		Site Issues		Compliance			Cost Efficiency				Other	Total Points
		Current Problem - Flooding or Facility Failure (0-10)	Future Flood Control (0-10)	Water Quality (0-5)	Temper-ature – TMDL (0-5)	Habitat - Title 13 (0-5)	Combined with other project (0-5)	Potential Cost for Facility Failure (0-10)	Land Owner-ship (0-5)	Maint-enance (0-5)	Liveability (0-5)	
CLC-8	Coffee Lake Creek Restoration	0	0	5	5	3	3	0	2	0	3	21
BC-4	Gesellschaft Water Well Channel Restoration	10	7	5	3	5	2	6	5	2	1	46
BC-7	Boeckman Creek Realignment	10	10	5	5	5	5	10	5	3	4	62
BC-9	Memorial Drive Pathway and Storm Drain Repair	5	3	5	5	5	0	2	5	3	2	35
BC-10	Memorial Park Stream and Wetland Enhancement	5	3	5	5	5	2	1	5	2	3	36
WD-3	Rivergreen Repair Project	10	10	5	5	5	5	10	5	3	5	63
Low Impact Development Projects												

Project ID	Location	Ranking of Benefits										
		Site Issues		Compliance			Cost Efficiency				Other	Total Points
		Current Problem - Flooding or Facility Failure (0-10)	Future Flood Control (0-10)	Water Quality (0-5)	Temper-ature – TMDL (0-5)	Habitat - Title 13 (0-5)	Combined with other project (0-5)	Potential Cost for Facility Failure (0-10)	Land Owner-ship (0-5)	Maint-enance (0-5)	Liveability (0-5)	
LID1	Memorial Park Parking Lot - Vegetated Swales (3)	8	5	3	3	5	3	5	5	3	5	45
LID2	SW Hillman Green Street - Stormwater Curb Extensions	0	0	5	5	5	0	0	3	2	1	21
LID3	SW Camelot Green Street - Mid Block Curb Extensions (2 extensions)	6	0	5	5	5	5	1	5	3	5	40
LID3	SW Camelot Green Street - Mid Block Curb Extensions (18 extensions)	5	0	5	5	5	4	0	5	1	5	35
LID4	SW Costa Circle - Vegetated Swale and Stormwater Curb Extension	2	2	2	2	2	2	0	0	0	5	17
LID5	Wood Middle School Parking Lot Green Street	1	1	2	2	2	2	0	2	2	3	17
LID6	Boones Ferry Primary School Parking Lot - Green Gutters and Pervious Paving	1	1	2	2	2	2	0	0	2	5	17

Project ID	Location	Ranking of Benefits										
		Site Issues		Compliance			Cost Efficiency				Other	Total Points
		Current Problem - Flooding or Facility Failure (0-10)	Future Flood Control (0-10)	Water Quality (0-5)	Temper-ature – TMDL (0-5)	Habitat - Title 13 (0-5)	Combined with other project (0-5)	Potential Cost for Facility Failure (0-10)	Land Owner-ship (0-5)	Maint-enance (0-5)	Liveability (0-5)	
LID7	SW Wilsonville Rd. - Stormwater Planter	5	0	5	5	5	4	0	5	1	5	35

Project ID	Location	Ranking of Benefits										
		Site Issues		Compliance			Cost Efficiency				Other	Total Points
		Current Problem - Flooding or Facility Failure (0-10)	Future Flood Control (0-10)	Water Quality (0-5)	Temper-ature – TMDL (0-5)	Habitat - Title 13 (0-5)	Combined with other project (0-5)	Potential Cost for Facility Failure (0-10)	Land Owner-ship (0-5)	Maint-enance (0-5)	Liveability (0-5)	
Studies												
ST-1	Study to analyze area north of Elligsen Rd/East of I-5	10	10	2	2	2	4	3	1	5	0	39
ST-2	Advance Road School Site Study	0	5	3	1	1	3	3	3	5	3	27
ST-3	Survey of Open Channel Conveyance	0	10	0	0	0	5	5	3	0	0	23
ST-4	Master Plan and Model Update	0	4	5	3	3	0	3	0	3	3	24
ST-5	Low Impact Development Design Standards and Implementation Guide	10	10	5	5	5	5	10	3	3	5	61
ST-6	Charbonneau Infrastructure Replacement Study	8	8	5	3	3	5	10	3	3	2	50
ST-7	Boeckman Creek at Boeckman Road Stormwater Study	0	0	0	0	0	5	5	5	5	0	20

Project ID	Location	Ranking of Benefits										
		Site Issues		Compliance			Cost Efficiency				Other	Total Points
		Current Problem - Flooding or Facility Failure (0-10)	Future Flood Control (0-10)	Water Quality (0-5)	Temper-ature – TMDL (0-5)	Habitat - Title 13 (0-5)	Combined with other project (0-5)	Potential Cost for Facility Failure (0-10)	Land Owner-ship (0-5)	Maint-enance (0-5)	Liveability (0-5)	
ST-8	Install Two Permanent Stormwater Flow Monitoring Stations and Two Rain Gauges	10	10	5	2	0	5	10	5	3	0	50
ST-9	Purchase InfoSWMM Model	10	10	5	5	5	5	10	0	0	0	50

Note: Prioritization table does not include FP future projects

9.2 PRIORITIZED PROJECTS IN CAPITAL IMPROVEMENT PROGRAM

CIP projects were prioritized based on the scores shown in Table 9-1. Short-term projects scored 39 and above. Mid-term projects received scores between 38 and 25. Long-term projects received scores between 24 and 19. The remaining projects are considered unfunded projects. Table 9-2 provides the prioritized project list.

Estimated total costs for all projects within the sets of short-, mid-, and long-term CIP projects as well as unfunded projects are as follows:

Short-term projects: $ 2,771,697
Mid-term projects: $10,129,961
Long-term projects: $10,087,602
Unfunded projects: $ 8,245,926
Total $31,235,186

Table 9-2
Prioritized CIP Projects

Project ID	Location	Land Acquisition Required? (Yes or No)	Total Cost Estimate[1]	Annual Maintenance Cost Estimate
Short-Term Projects – Implementation in 0 to 5 Years				
WD-3	Rivergreen Repair Project	No	$ 285,000	$ 2,200
BC-7	Boeckman Creek Realignment	No	$ 577,296	$ 2,200
ST-5	Low Impact Development Design Standards and Implementation Guide	No	$ 57,000	NA
ST-8	Install Two Permanent Stormwater Flow Monitoring Stations and Two Rain Gauges	No	$ 45,486	NA
ST-9	Purchase InfoSWMM Model	No	$ 18,240	NA
ST-6	Charbonneau Infrastructure Replacement Study	No	$ 142,500	NA
BC-4	Gesellschaft Water Well Channel Restoration	No	$ 135,774	$ 1,800
LID1	Memorial Park Parking Lot Vegetated Swales (3)	No	$ 203,148	$ 6,500
BC-8	Canyon Creek Estates Pipe Removal	No	$ 129,504	$ 1,500
SD4208 & SD4209	Barber Street Pipe Replacement	No	$ 213,196	$ 1,200

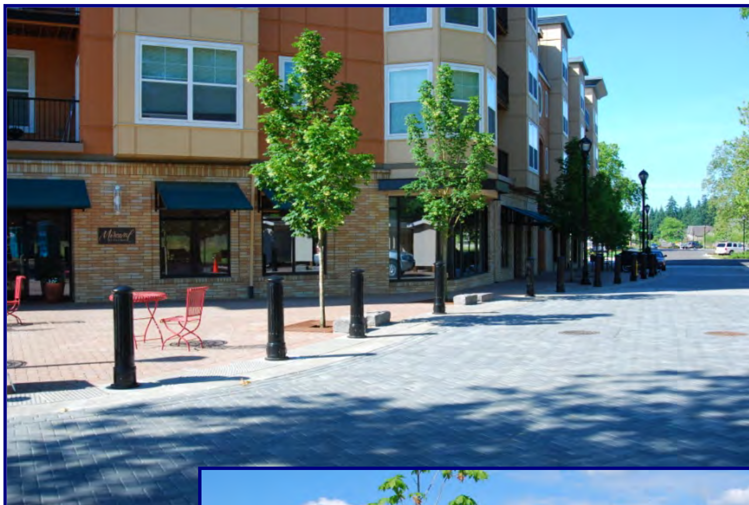
[1] Total Cost Includes land acquisition costs and is in 2009 dollars.

Project ID	Location	Land Acquisition Required? (Yes or No)	Total Cost Estimate[1]	Annual Maintenance Cost Estimate
LID3	SW Camelot Green Street Mid-Block Curb Extensions (2 extensions)	No	$ 58,482	$ 5,300
CLC-3	Commerce Circle Channel Restoration	No	$ 564,071	$ 5,700
ST-1	Study to analyze area north of Elligsen Rd/East of I-5	No	$ 57,000	NA
FP	Future Project Development and Implementation	No	$285,000	N/A
Short-Term Projects	**Subtotal**	**-**	**$2,771,697**	**$26,400**
Mid-Term Projects – Implementation 5 to 10 Years				
BC-2	Boeckman Creek Outfall Rehabilitation	Maybe	$ 167,580	$ 1,500
BC-6	Multiple Detention Pipe Installation	No	$ 1,366,948	$ 1,100
BC-5	Boeckman Creek Outfall Realignment	No	$ 38,441	$ 1,300
BC-3	Cascade Loop Detention Pipe Installation	No	$ 810,109	$ 1,100
BC-10	Memorial Park Stream and Wetland Enhancement	No	$ 84,360	$ 2,900
BC-9	Memorial Drive Pathway and Storm Drain Repair	No	$ 111,720	NA
LID3	SW Camelot Green Street Mid-Block Curb Extensions (18 extensions)	No	$ 526,338	$ 47,700
LID7	SW Wilsonville Road Stormwater Planters	No	$ 362,794	$ 6,700
CLC-2	SW Parkway Avenue Stream Restoration	Yes	$ 279,420	$ 4,900
CLC-9	Jobsey Lane Culvert Replacement	No	$ 115,028	$ 2,200
SD5707, 5709, 5714, 5719	SW Parkway Pipes Replacement	No	$ 497,405	$ 2,200
ST-2	Advance Road School Site Study	No	$ 57,000	NA
CLC-1	Detention/Wetland Facility near Tributary to Basalt Creek	Yes	$ 3,516,900	$ 4,900
SD9038; 9045; 9046; 9054-9058	French Prairie Road in NW Charbonneau Pipe Replacement	No	$ 867,417	$ 1,500
SD9052; 9053; 9059; 9061-9069	Curry Drive and French Prairie Road in NW Charbonneau Pipe Replacement	No	$ 1,043,501	$ 2,100
FP	Future Project Development and Implementation	No	$285,000	N/A

Project ID	Location	Land Acquisition Required? (Yes or No)	Total Cost Estimate[1]	Annual Maintenance Cost Estimate
Mid-Term Projects	**Subtotal**	**-**	**$10,129,961**	**$80,100**
Long-Term Projects – Implementation in 10 to 20 Years				
ST-4	Master Plan and Model Update	No	$ 342,000	NA
ST-3	Survey of Open Channel Conveyance	No	$ 57,000	NA
BC-1	Wiedeman Road Regional Stormwater Detention/ Stream Enhancement	Yes	$ 5,446,350	$ 4,900
CLC-4	Ridder Road Wetland Restoration	Yes	$ 283,778	$ 2,900
LID2	SW Hillman Green Street Stormwater Curb Extensions	No	$ 236,938	$ 4,000
CLC-5	Coffee Lake Creek Stream and Riparian Enhancement	Yes	$ 339,844	$ 2,900
CLC-6	Coffee Lake Creek South Tributary Wetland Enlargement	Yes	$ 490,286	$ 2,900
CLC-7	Coffee Lake Creek South Tributary Stream Restoration	Yes	$ 496,114	$ 2,900
SD4021 & SD4022	Boberg Road Culvert Replacement	No	$ 65,393	$ 2,200
CLC-8	Coffee Lake Creek Restoration	Yes	$ 486,877	$ 4,300
ST-7	Boeckman Creek at Boeckman Road Stormwater Study	No	$ 57,000	NA
SD4025 - SD4028	Boberg Road Pipe Replacement	No	$ 733,590	$ 2,200
BC-6	Multiple Detention Pipe Installation – Bridge Creek Apartments	No	$1,052,432	$1,100
Long-Term Projects	**Subtotal**	**-**	**$10,087,602**	**$29,200**
Unfunded Projects				
SD9000-9012	Miley Road in S Charbonneau Pipe Replacement	No	$ 3,198,175	$ 3,900
SD9013-9021; 9060	French Prairie Road in NE Charbonneau Pipe Replacement	No	$ 1,680,563	$ 2,800
SD9022-9029	Old Farm Road in NE Charbonneau Pipe Replacement	No	$ 1,015,021	$ 1,600
SD9030-9037	Edgewater Drive E and French Prairie Road in NE Charbonneau Pipe Replacement	No	$ 996,254	$ 1,700
SD9039; 9044; 9047; 9051	Boones Bend Road in NW Charbonneau Pipe Replacement	No	$ 855,395	$ 1,600
LID4	SW Costa Circle Vegetated Swale and Stormwater Curb Extension	No	$ 70,817	$ 6,300

Project ID	Location	Land Acquisition Required? (Yes or No)	Total Cost Estimate[1]	Annual Maintenance Cost Estimate
LID5	Wood Middle School Parking Lot Green Street	No	$ 203,148	NA
LID6	Boones Ferry Primary School Parking Lot Green Gutters and Pervious Paving	No	$ 130,945	NA
WD-1	Montgomery Way Culvert Replacement	No	$ 44,354	$ 600
WD-2	Rose Lane Culvert Replacement	No	$ 51,254	$ 1,100
Unfunded Projects	**Subtotal**	**-**	**$8,245,926**	**$19,600**
All CIP Projects	**Total CIPs**	**-**	**$31,235,186**	**$155,300**

10.0 FINANCIAL ANALYSIS



10.0 FINANCIAL ANALYSIS

10.1 INTRODUCTION

Stormwater management services within Wilsonville are provided through two City departments, Public Works and Community Development. City staff are responsible for managing both the quantity and quality of stormwater runoff while ensuring there is adequate stormwater drainage capacity. These activities are performed in a manner consistent with the City's goal of protecting local streams and habitat to ensure that connections to the stormwater system are constructed and maintained in compliance with all federal and state water quality regulations. Stormwater staff is responsible for the operation and maintenance of all publically owned catch basins, pipes, sedimentation manholes along with water quality facilities and stormwater detention ponds. All of these stormwater services are funded through the Stormwater Utility fee which is also referred to as the City's "stormwater surcharge" in some of Wilsonville's documentation.

10.2 STORMWATER UTILITY FEE

Stormwater management utilities are authorized by Oregon statute as enterprise funds within a City's budget structure. They are defined as being financially self-sufficient and can be designed to furnish a comprehensive set of services related to stormwater quantity and quality management. Services that stormwater management utilities provide include not only the construction and maintenance of facilities necessary to control flooding and improve the character of surface runoff, but also implementation of best management practices (BMPs) designed to address nonpoint source pollution. These BMPs may include water quality sampling, public education and plan review, stormwater system maintenance, site inspections and basin planning. All of these program elements are part of the National Pollutant Discharge Elimination System (NPDES) permit requirements.

Wilsonville's current Stormwater Utility fee (see Resolution No. 1732) is applied to customers based on an "equivalent residential units" (ERU) approach. Under this structure, single-family homes are counted as one ERU and, on average, contain 2,750 square feet of impervious area. All non single-family residential customers are charged based on their measured impervious surface area for each developed property which is then divided by the ERU value of 2,750 square feet of impervious surface. This determines the total number of ERUs billed to that non single-family residential customer. The City's current monthly stormwater rate is $3.72 per ERU.

10.3 STORMWATER RATE MODEL

The technical analysis contained in Wilsonville's Stormwater Master Plan produced operations, maintenance and capital improvement program activities and costs. This financial review assesses the impact of the program on the City's Stormwater Utility rates and SDCs. A funding model was developed as an electronic spreadsheet-based (Excel) work product. This model simulates the fiscal management of the City's Stormwater Utility and accommodates the following conditions:

- A 20-year forecast horizon (the current start year is fiscal 2012)
- A Capital Projects Fund where capital improvement projects are budgeted
- A Stormwater SDC Fund where system development charges are budgeted
- An Operating Fund where revenues and expenses are budgeted
- Issuing and servicing debt to fund capital improvements
- Rate-making based on the revenue requirements for the utility during each forecast year.

The model then calculates monthly user charges (rates) based on variable inputs for inflation, operating costs, customer base (i.e., number of ERUs) and capital improvements. The model is designed as an integrated set of spreadsheets that also provides toggles for various input assumptions. These are summarized in Table 10-1.

Table 10-1
Summary of Modeling Assumptions

MODEL INPUTS		
	User Inputs Required	**Purpose**
Financing Assumptions	Type of debt financing to be used, term of indenture, interest rates, etc. In Wilsonville's case the debt is issued through revenue bonds	Debt sizing and servicing
Capital Improvement Projects and Schedule	Project cost, description, year of implementation, CIP inflation rate	CIP costing
Operating Revenues and Expenses	Start year budgeted revenues and expenses by line item, billable ERUs, general cost inflation index, projected growth in ERU (as a percent)	Cash flow and income statement for the utility
ERUs	Growth in ERUs through the planning period	Forecast of estimating billable ERUs

10.3.1 Assumptions

Key modeling assumptions were developed over multiple meetings with City staff and are summarized below:

- 20-year revenue bonding at an interest rate of 5.0%

- A coverage factor of 1.25 times maximum annual debt service
- Level debt service
- An Operating Fund balance @ no less than $200,000
- ERU growth of 1 ¾ % per year
- Cost escalation generally at 3% with the exception of 4.5% for personal services and 4.5% for transfers.

10.3.2 Model Outputs and Reports

The model has a series of standard reports which include:

- **Schedule of financing assumptions -** This report itemizes the user inputs that are required by the model to create debt issuances and bond proceeds that will be used to pay for capital improvements. It is always assumed that debt proceeds are only used to pay for capital improvement projects and related coverage, issuance and reserve funding requirements. This disallows use of bond proceeds to fund the cost of operations and maintenance expenses. These costs are assumed to be funded through user charges (rates).
- **Debt sizing and servicing report -** This report itemizes the calculated amount of annual debt service for each forecast year. The analysis is based on the level of capital improvement spending in any forecast year and the revenue bond debt funding costs including principal, interest, coverage and reserve funding requirements.
- **Listing of capital projects and construction fund activity -** This report itemizes the capital improvement projects (last edition October 2011) over the planning period. The model adjusts project costs for the effects of inflation as future projects are scheduled for implementation. This report also tracks the activity within the capital projects fund for transfers, interest earnings on fund balance and beginning and ending fund balances.
- **Schedule of revenue requirements and monthly rates -** The rate-making results are displayed in this report. The model uses two tests to solve for rates. The first is for the sufficiency of cash flows to fund operations and debt service. The second is a test of bonded debt coverage requirements. After solving for each of these tests in each forecast year, the model calculates a user charge that will be sufficient to fund the more stringent test.
- **Statement of revenues and expenses -** This report calculates the results of operations for each forecast year prior to rate adjustments. Based on a start-year level of operating revenues and expenses, the model forecasts the net utility income if revenues and expenses are

incurred as projected based on inflation assumptions and customer base growth.

- **Debt service worksheet; revenue bonds—**This worksheet shows the debt servicing for revenue bonds by year and by issuance. The model assumes level debt service for all revenue bonds that are issued over the forecast horizon. The purpose of this report is to show the total debt service in any year, but also to see how much of the total service consists of interest and principal repayment.

10.4 GENERAL ECONOMIC AND PLANNING ASSUMPTIONS

The model assigns independent inflation factors for various categories of costs. These are noted in Table 10-2:

Table 10-2

Inflation and Economic Forecasting Assumptions

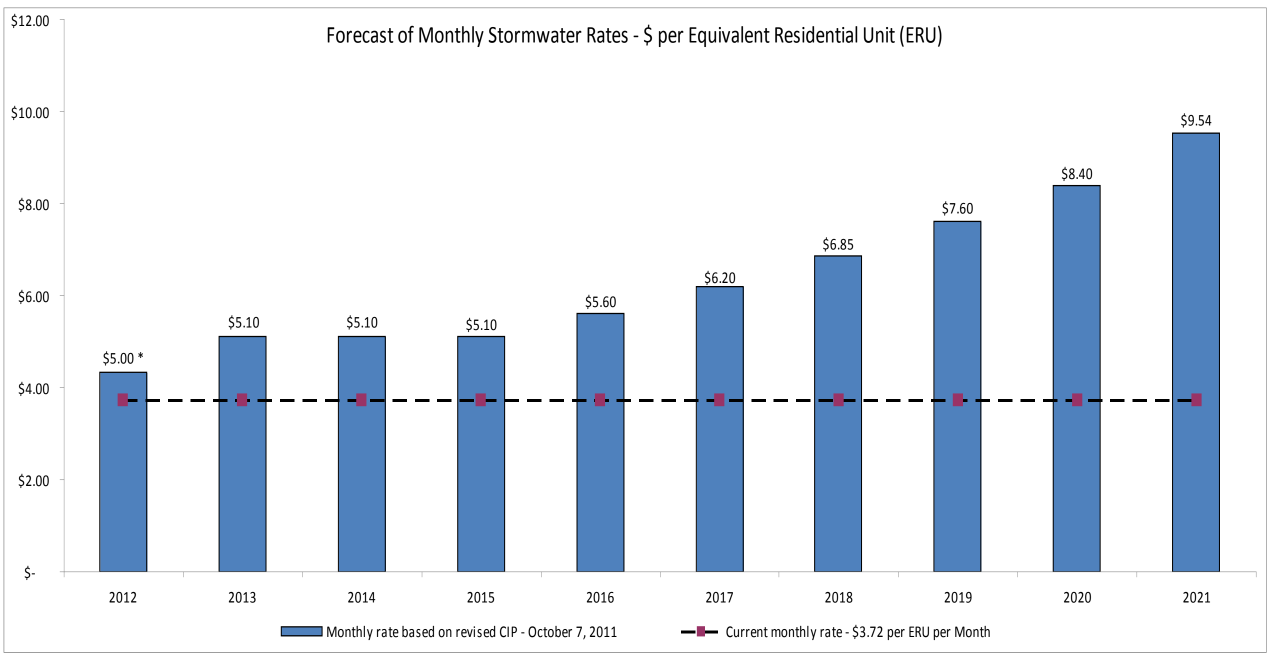
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Inflation Forecast:										
Personal services	Budget	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
Materials and services	Budget	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Capital outlays	Budget	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Transfers to other funds	Budget	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
Revenue Growth Forecast:										
Intergovernmental	Budget	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Transfers from other funds	Budget	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Investment income	Budget	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
Miscellaneous	Budget	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Growth Customer Base	1.74%	1.74%	1.74%	1.74%	1.74%	1.74%	1.74%	1.74%	1.74%	1.74%
Unit SWM SDC	$ 492	$ 780	$ 1,068	$ 1,356	$ 1,356	$ 1,356	$ 1,356	$ 1,356	$ 1,356	$ 1,356
ERU forecast:										
Estimated ERUs beginning	20,172	20,524	20,882	21,246	21,616	21,993	22,376	22,766	23,163	23,567
Annual additions	352	358	364	370	377	383	390	397	404	411
Estimated ERUs ending	20,524	20,882	21,246	21,616	21,993	22,376	22,766	23,163	23,567	23,978

10.5 STORMWATER SDC FUND

- The Stormwater SDC Fund receives revenues collected from the City's SDCs and, when required, transfers money to the Stormwater Capital Projects Fund to pay for construction. Historically, annual revenues from SDCs have varied from a high of $402,000 in 2008 (actual) to $91,233 (actual) in 2010. For forecast purposes based on 1¾ % growth and the proposed phasing in of the full SDC through 2015, annual SDC revenues are expected to be more in the $400,000 per year range. The forecast does not anticipate the issuance of any long term debt for the first five (5) years to finance capital needs. Internally generated free cash flows are assumed to be sufficient to meet SWM system capital investing needs over this first five years of the forecast. The forecast does assume the City will be issuing revenue bonds in years six through fourteen to meet the funding requirements of the capital improvement plan. Starting in 2013, the increasing capital needs and escalating operating costs in excess of customer growth will require increases in rates (see Table 10-3).

- Two funding sources for capital construction will be revenues from the Stormwater SDC Fund and the Stormwater Operating Fund which will be transferred to the Stormwater Capital Projects Fund.
- The estimated FY 2011 ending fund balance in the Stormwater SDC Fund was $411,844 (see Table 10-4). Over the forecast horizon, this balance is drawn down to zero and held at that level. In each forecast year, all cash entering the Stormwater SDC Fund is transferred to the Stormwater Capital Projects Fund to support master plan construction work. In addition to these resources, the Stormwater Capital Projects fund receives cash transfers from the Stormwater Operating Fund in excess of $100,000 per year in each of the forecast years FY2012-2022.

Table 10-3
Forecast of Monthly Stormwater Rates



* assumes a rate increase to $5.00/ERU effective 1/1/12

Table 10-4
Forecast of Stormwater SDC Fund Cash Flows

City of Wilsonville
Analysis of Stormwater SDC Fund Cash Flow

	Budget 2011	Budget 2012	Forecast 2013	2014	2015	2016	2017	2018	2019	2020	2021
Resources:											
Beginning Fund Balance	673,247	608,432	475,002	-	-	-	-	-	-	-	-
Sales and Services:											
System Development Charges	256,588	293,227	279,016	388,701	502,122	510,867	519,776	528,828	538,045	547,428	556,976
Interest Income	13,000	5,000	4,750	-	-	-	-	-	-	-	-
Miscellaneous	-	-	-	-	-	-	-	-	-	-	-
Total Resources	$ 942,835	$ 906,659	$ 758,768	$ 388,701	$ 502,122	$ 510,867	$ 519,776	$ 528,828	$ 538,045	$ 547,428	$ 556,976
Requirements:											
Materials and Services	1,430	1,430	1,473	1,517	1,563	1,609	1,658	1,707	1,759	1,811	1,866
Transfers OUT:											
Streets Capital Projects Fund	-	-	-	-	-	-	-	-	-	-	-
Storm Water Capital Projects Fund	332,973	430,227	757,295	387,184	500,560	509,257	518,119	527,121	536,287	545,616	555,110
Subtotal Transfers OUT	332,973	430,227	757,295	387,184	500,560	509,257	518,119	527,121	536,287	545,616	555,110
Contingency	196,588	-	-	-	-	-	-	-	-	-	-
Ending Fund Balance	411,844	475,002	-	-	-	-	-	-	-	-	-
Total Requirements	$ 942,835	$ 906,659	$ 758,768	$ 388,701	$ 502,122	$ 510,867	$ 519,776	$ 528,828	$ 538,045	$ 547,428	$ 556,976

10.6 STORMWATER CAPITAL PROJECTS FUND

The Stormwater Master Plan produced the capital improvement program and schedule summarized in Table 10-5:

Table 10-5
Schedule of Capital Improvement Projects

City of Wilsonville
Summary of Stormwater System Capital Improvement Plan

Cost Escalation Rate 3.00%

MP Rank	Cost in FY 2011	Year	Project	Annual Maintenance Cost	Project Number
			High Priority Projects - 0-5 Years		
	285,000	2012	Rivergreen Repair Project	2,200	Retrofit
	577,296	2012	Boeckman Creek Realignment	2,200	BC-7
	57,000	2012	Low Impact Development Design Standards and Implementation Guide	0	Study ST-5
	45,486	2013	Install Two Permanent Stormwater Flow Monitoring Stations and Two Rain Gages	0	Study ST-8
	18,240	2013	Purchase InfoSWMM Model	0	Study ST-9
	142,500	2013	Charbonneau Infrastructure Replacement Study	0	Study ST-6
	135,774	2014	Gesellschaft Water Well Channel Restoration	1,800	BC-4
	203,148	2014	Memorial Park Parking Lot Vegetated Swales (3)	6,500	LID1
	129,504	2014	Canyon Creek Estates Pipe Removal	1,500	BC-8
	213,196	2015	Barber Street Pipe Replacement	1,200	SD4208 & SD4209
	58,482	2015	SW Camelot Green Street Mid-Block Curb Extentions (2 extensions)	5,300	LID3
	564,071	2015	Commerce Circle Channel Restoration	5,700	CLC-3
	57,000	2016	Study to analyze area north of Elligsen Rd/East of I-5	0	Study ST-1
	285,000	2016	Future Project Development and Implementation	0	FP
			Medium Priority Projects - 5-10 Years		
	167,580	2017	Boeckman Creek Outfall Rehabilitation	1,500	BC-2
	1,366,948	2017	Multiple Detention Pipe Installation	1,100	BC-6
	38,441	2017	Boeckman Creek Outfall Realignment	1,300	BC-5
	810,109	2018	Cascade Loop Detention Pipe Installation	1,100	BC-3
	84,360	2018	Memorial Park Stream and Wetland Enhancement	2,900	BC-10
	111,720	2018	Memorial Drive Pathway and Storm Drain Repair	0	BC-9
	526,338	2019	SW Camelot Green Street Mid-Block Curb Extentions (18 extensions)	47,700	LID3
	362,794	2019	SW Wilsonville Road Stormwater Planters	6,700	LID7
	279,420	2019	SW Parkway Avenue Stream Restoration	4,900	CLC-2
	115,028	2020	Jobsey Lane Culvert Replacement	2,200	CLC-9
	497,405	2020	SW Parkway Pipes Replacement	2,200	SD5707, 5709, 5714, 5719
	57,000	2020	Advance Road School Site Study	0	Study ST-2
	3,516,900	2021	Detention/Wetland Enhancement near Tributary to Basalt Creek	4,900	CLC-1
	867,417	2021	French Prairie Road in NW Charbonneau Pipe Replacement	1,500	SD9038
	1,043,501	2021	Curry Drive and French Prairie Road in NW Charbonneau Pipe Replacement	2,100	SD9052
	285,000	2021	Future Project Development and Implementation	0	FP
			Low Priority Projects - 10-20 Years		
	342,000	2022	Master Plan and Model Update	0	Study ST-4
	57,000	2022	Survey of Open Channel Conveyance	0	Study ST-3
	5,446,350	2022	Wiedeman Road Regional Stormwater Detention/Stream Enhancement	4,900	BC-1
	283,778	2023	Ridder Road Wetland Restoration	2,900	CLC-4
	236,938	2023	SW Hillman Green Street Stormwater Curb Extensions	4,000	LID2
	339,844	2023	Coffee Lake Creek Stream and Riparian Enhancement	2,900	CLC-5
	490,286	2024	Coffee Lake Creek South Tributary Weltand Enlargement	2,900	CLC-6
	496,114	2024	Coffee Lake Creek South Tributary Stream Restoration	2,900	CLC-7
	65,393	2024	Boberg Road Culvert Replacement	2,200	SD4021 & SD4022
	486,877	2025	Coffee Lake Creek Restoration	4,300	CLC-8
	57,000	2025	Boeckman Creek at Boeckman Road Stormwater Study	0	Study ST-7
	733,590	2025	Boberg Road Pipe Replacement	2,200	SD4025 - SD4028
	1,052,432	2025	Multiple Dention Pipe Installation - Bridge Creek Apartments	1,100	BC-6
	$22,989,260		Net Construction Cost	$136,800	

The total cost for the high priority projects (years 0 – 5) is $2,771,697 or $3,014,636 (inflated). These high priority projects are to be funded from a combination of cash on hand and future internally generated cash. No long term debt issuances are expected to be used to fund these high priority projects. Contributions are anticipated in 2013 from the Stormwater SDC Fund of $757,295 and from the Stormwater Operating Fund of $130,000. Stormwater SDC Fund transfers will drop to about $500,000 per year after 2013 while the analysis assumes continued use of Operating Fund resources at about $400,000 per year through 2022.

The total cost of the medium priority projects is $10,129,961 (years 5 – 10) ($13,146,987 inflated). The total cost of the low priority projects (years 10 – 20) is

$10,087,602 ($14,387,059 inflated). In order to fund the medium and long term priority projects, it is assumed the City will issue revenue bonds starting in fiscal 2017. The modeling assumes long term debt will be issued in each forecast year from fiscal 2017 to fiscal 2025. As discussed above, it is assumed the City will be contributing free cash flows in support of these future construction costs. Over the 2017 to 2025 time frame, modeling indicates the City will contribute $7,075,000 in support of these medium and low priority master plan projects.

Also, over this time frame, the modeling indicates the City will borrow a total of $22,488,464. This total exceeds the net inflated cost of the projects (i.e., inflated costs of projects less equity contributions from the City) because of issuance costs and upsizing of borrowings to fund anticipated revenue bond reserve account requirements. This highlights the need to bundle projects (and debt) to minimize issuance costs.

Bond covenants require that stormwater user fees be set at a rate sufficient to recover at least 1.25 times the actual amount of current bonded debt service in addition to operating expenses, and require a reserve equal to the highest principal and interest payments due in any future year. The stormwater financial model takes these coverage and reserve requirements into account and tests for sufficiency in every year of the forecast. Table 10-6 shows the forecast of annual costs for the high priority projects.

Table 10-6
Annual Master Plan High Priority Capital Improvement Costs (years 0-5)

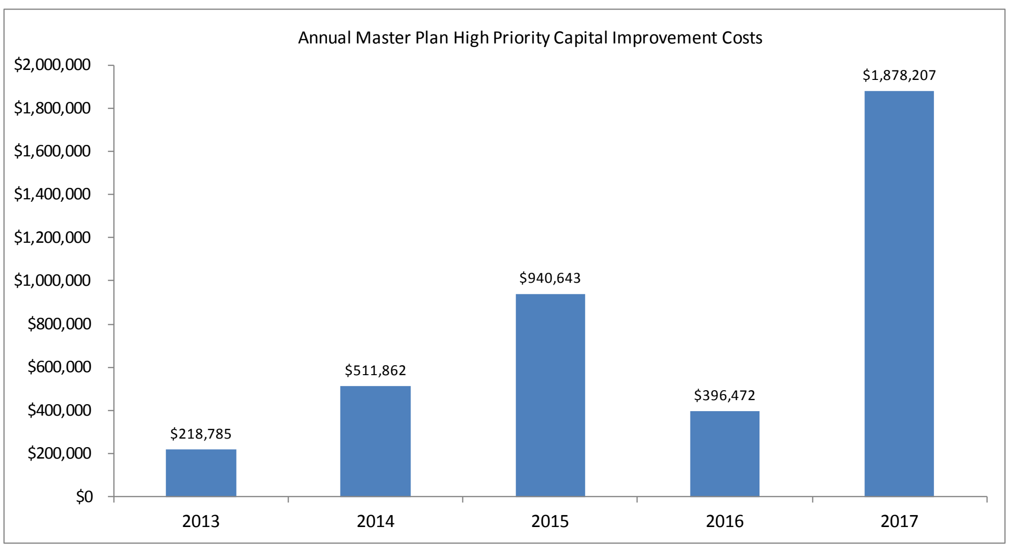


Table 10-7
Forecast of Stormwater Capital Projects Fund Cash Flows

City of Wilsonville
Analysis of Stormwater Capital Projects Fund Cash Flow

	Budget	Budget	Forecast								
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Resources:											
Beginning Fund Balance	11,272	10,272	10,272	555,993	445,453	515,623	753,324	392,245	721,959	1,078,661	1,449,305
Revenues:											
Intergovernmental	-	410,000	-	-	-	-	-	-	-	-	-
Investment income	1,000	-	103	5,560	4,455	5,156	7,533	3,922	7,220	10,787	14,493
Contributions	500,000	-	-	-	-	-	-	-	-	-	-
Subtotal revenues	501,000	410,000	103	5,560	4,455	5,156	7,533	3,922	7,220	10,787	14,493
Transfers from other funds - IN:											
Stormwater Operating Fund	159,760	252,373	130,000	137,000	640,000	260,000	400,000	550,000	550,000	775,000	400,000
Stormwater SDC Fund	332,973	430,227	757,295	387,184	500,560	509,257	518,119	527,121	536,287	545,616	555,110
Subtotal transfers IN	492,733	682,600	887,295	524,184	1,140,560	769,257	918,119	1,077,121	1,086,287	1,320,616	955,110
Bond proceeds:											
Oregon DEQ revolving loans	-	-	-	-	-	-	-	-	-	-	-
New revenue bonds - reserve requirement	-	-	-	-	-	-	59,819	51,818	73,233	6,479	644,101
New revenue bonds - project funding	-	-	-	-	-	-	678,207	587,486	830,287	73,458	7,302,550
Subtotal bond proceeds	-	-	-	-	-	-	738,027	639,303	903,520	79,937	7,946,650
Total Resources	$ 1,005,005	$ 1,102,872	$ 897,670	$ 1,085,737	$ 1,590,467	$ 1,290,036	$ 2,417,003	$ 2,112,591	$ 2,718,985	$ 2,490,002	$ 10,365,558
Requirements:											
Expenditures:											
Capital projects	873,450	975,000	218,785	511,862	940,643	396,472	1,878,207	1,237,486	1,480,287	873,458	7,677,550
Transfers to other funds - OUT:											
General Fund	8,469	11,300	11,809	12,340	12,895	13,475	14,082	14,716	15,378	16,070	16,793
Community Development Fund	110,814	106,300	111,084	116,082	121,306	126,765	132,469	138,430	144,660	151,169	157,972
Subtotal transfers to other funds - OUT	119,283	117,600	122,892	128,422	134,201	140,240	146,551	153,146	160,037	167,239	174,765
Contingency	12,272	-	-	-	-	-	-	-	-	-	-
New revenue bonds - reserve requirement	-	-	-	-	-	-	59,819	111,637	184,870	191,349	835,450
Unappropriated ending fund balance	-	10,272	555,993	445,453	515,623	753,324	332,425	610,323	893,791	1,257,955	1,677,794
Total Requirements	$ 1,005,005	$ 1,102,872	$ 897,670	$ 1,085,737	$ 1,590,467	$ 1,290,036	$ 2,417,003	$ 2,112,591	$ 2,718,985	$ 2,490,002	$ 10,365,558

It should also be noted that there are annual transfers out of the Stormwater Capital Projects Fund (see Table 10-7) to the General Fund ($11,300) and to the Community Development Fund ($106,300). These have been included in this analysis.

10.7 STORMWATER OPERATING FUND

- The estimated 2012 Stormwater Operating Fund beginning balance is $497,712. As reflected in this rate forecast, the Operating Fund receives approximately $1,000,000 annually from stormwater service charges. The Fund's major expenses are for personal services at $236,000; materials and services at $487,000 and, as estimated in the Master Plan, additional maintenance costs related to the recommended new facilities of between $10,000 and $144,000 annually (see line item "materials and services – new CIP" in Operating Fund detail sheet).
- Transfers Out – The second largest financial requirement of the Stormwater Operating Fund (see Table 10-8) is cash transfers to other funds. The financial model fully funds all required transfers out including the following (2012 budget):

  General Fund..$166,700

  Community Development Fund $77,000

  Stormwater Capital Projects Fund $252,373
- Contingency and unappropriated ending fund balances – For the base case forecast, it has been assumed that future rates will be set to meet all financial requirements, and keep an ending fund balance at a threshold of not less than $200,000.

Table 10-8
Forecast of Stormwater Operating Fund Cash Flows

City of Wilsonville
Analysis of Stormwater Operating Fund Cash Flow

	Budget 2011	Budget 2012	Forecast 2013	2014	2015	2016	2017	2018	2019	2020	2021
Resources:											
Beginning Fund Balance	653,450	497,712	353,767	501,767	617,767	202,767	277,767	292,767	263,767	281,767	274,767
Revenues:											
Stormwater utility charges	955,000	1,073,816	1,278,072	1,299,621	1,323,204	1,478,701	1,665,250	1,872,462	2,112,575	2,375,116	2,745,174
Intergovernmental	-	-	-	-	-	-	-	-	-	-	-
Investment income	10,000	2,000	3,538	5,018	6,178	2,028	2,778	2,928	2,638	2,818	2,748
Miscellaneous	-	-	-	-	-	-	-	-	-	-	-
Subtotal revenues	965,000	1,075,816	1,281,609	1,304,638	1,329,381	1,480,729	1,668,027	1,875,390	2,115,213	2,377,934	2,747,922
Total Resources	$ 1,618,450	$ 1,573,528	$ 1,635,376	$ 1,806,405	$ 1,947,148	$ 1,683,496	$ 1,945,794	$ 2,168,156	$ 2,378,980	$ 2,659,701	$ 3,022,689
Requirements:											
Expenditures:											
Personal services	219,440	236,290	246,923	258,035	269,646	281,780	294,460	307,711	321,558	336,028	351,149
Materials and services - base line	502,338	487,398	502,020	517,081	532,593	548,571	565,028	581,979	599,438	617,421	635,944
Materials and services - on new CIP	-	-	-	10,397	24,040	24,761	30,025	35,702	109,705	118,570	133,217
Capital outlays	2,500	-	-	-	-	-	-	-	-	-	-
Subtotal expenditures	724,278	723,688	748,943	785,512	826,279	855,112	889,513	925,392	1,030,701	1,072,019	1,120,311
Transfers to other funds - OUT											
General Fund	163,700	166,700	174,202	182,041	190,232	198,793	207,739	217,087	226,856	237,064	247,732
Community Development Fund	73,000	77,000	80,465	84,086	87,870	91,824	95,956	100,274	104,786	109,502	114,429
Stormwater Capital Projects Fund	159,760	252,373	130,000	137,000	640,000	260,000	400,000	550,000	550,000	775,000	400,000
Subtotal transfers to other funds	396,460	496,073	384,667	403,126	918,102	550,617	703,695	867,361	881,642	1,121,566	762,161
Debt service:											
DEQ revolving loans	-	-	-	-	-	-	-	-	-	-	-
New Revenue bonds	-	-	-	-	-	-	59,819	111,637	184,870	191,349	835,450
Subtotal debt service	-	-	-	-	-	-	59,819	111,637	184,870	191,349	835,450
Contingencies/Designations	50,170	272,563									
Unappropriated ending fund balance	447,542	81,204	501,767	617,767	202,767	277,767	292,767	263,767	281,767	274,767	304,767
Total Requirements	$ 1,618,450	$ 1,573,528	$ 1,635,376	$ 1,806,405	$ 1,947,148	$ 1,683,496	$ 1,945,794	$ 2,168,156	$ 2,378,980	$ 2,659,701	$ 3,022,689

10.7.1 Analysis of Revenue Requirements

This task calculates the revenue needed from rates. It is driven by utility cash flow or income requirements, constraints of bond covenants and specific fiscal policies related to the development, operation and maintenance of a "stand alone" stormwater management utility. Based on cost and planning information discussed above, and shared with City Staff, the following forecast, displayed in Table 10-9, of future stormwater revenue requirements was developed:

Table 10-9
Forecast of Stormwater System Revenue Requirements

City of Wilsonville
Projection of Stormwater Operating Fund Revenue Requirements

Line Item Description	Budget 2012	Forecast 2013	2014	2015	2016	2017	2018	2019	2020	2021
Projection of Cash Flow:										
Revenues:										
Stormwater utility charges	1,073,816	1,073,816	1,278,072	1,299,621	1,323,204	1,478,701	1,665,250	1,872,462	2,112,575	2,375,116
Intergovernmental	-	-	-	-	-	-	-	-	-	-
Investment income	2,000	3,538	5,018	6,178	2,028	2,778	2,928	2,638	2,818	2,748
Miscellaneous	-	-	-	-	-	-	-	-	-	-
Subtotal revenues	1,075,816	1,077,353	1,283,089	1,305,798	1,325,231	1,481,479	1,668,177	1,875,100	2,115,393	2,377,864
Expenditures:										
Operations and maintenance	723,688	748,943	785,512	826,279	855,112	889,513	925,392	1,030,701	1,072,019	1,120,311
Transfers to Other Funds - excluding SWM construction fund	243,700	254,667	266,126	278,102	290,617	303,695	317,361	331,642	346,566	362,161
Debt service	-	-	-	-	-	59,819	111,637	184,870	191,349	835,450
Use of Operating Fund balance	100,580	278,000	253,000	225,000	335,000	415,000	521,000	568,000	768,000	430,000
Subtotal expenditures	1,067,968	1,281,609	1,304,638	1,329,381	1,480,729	1,668,027	1,875,390	2,115,213	2,377,934	2,747,922
Net Cash	7,848	(204,256)	(21,549)	(23,583)	(155,498)	(186,548)	(207,212)	(240,113)	(262,541)	(370,058)
Net Deficiency/(Surplus)	(7,848)	204,256	21,549	23,583	155,498	186,548	207,212	240,113	262,541	370,058
Test of Coverage Requirement:										
Operating Revenues:										
Stormwater utility charges	1,073,816	1,073,816	1,278,072	1,299,621	1,323,204	1,478,701	1,665,250	1,872,462	2,112,575	2,375,116
Intergovernmental	-	-	-	-	-	-	-	-	-	-
System Development Charges	293,227	279,016	388,701	502,122	510,867	519,776	528,828	538,045	547,428	556,976
Transfers (To) From Rate Stabilization Account	-	-	-	-	-	-	-	-	-	-
Total Operating Revenues	1,367,043	1,352,832	1,666,773	1,801,743	1,834,070	1,998,478	2,194,078	2,410,507	2,660,003	2,932,092
Operating Expenses:										
Operations & Maintenance Expense	723,688	748,943	785,512	826,279	855,112	889,513	925,392	1,030,701	1,072,019	1,120,311
Transfers to Other Funds	243,700	254,667	266,126	278,102	290,617	303,695	317,361	331,642	346,566	362,161
Total Operating Expenses	967,388	1,003,609	1,051,638	1,104,381	1,145,729	1,193,208	1,242,753	1,362,343	1,418,585	1,482,472
Net Operating Income	399,655	349,222	615,135	697,362	688,341	805,270	951,325	1,048,164	1,241,418	1,449,620
Nonoperating Income (Expense):										
Interest Income:										
Stormwater Operating Fund	2,000	3,538	5,018	6,178	2,028	2,778	2,928	2,638	2,818	2,748
Stormwater Capital Projects Fund	-	103	5,560	4,455	5,156	7,533	3,922	7,220	10,787	14,493
Stormwater SDC Fund	5,000	4,750	-	-	-	-	-	-	-	-
Other Nonoperating Income (expense)										
Miscellaneous	-	-	-	-	-	-	-	-	-	-
Total Nonoperating Income	7,000	8,390	10,578	10,632	7,184	10,311	6,850	9,857	13,604	17,241
Total Net Revenues Available for Debt Service	406,655	357,613	625,712	707,994	695,525	815,581	958,175	1,058,022	1,255,022	1,466,861
Debt Service:										
Senior Lien Parity Obligations:										
Oregon DEQ Revolving Loan	-	-	-	-	-	-	-	-	-	-
New revenue bonds	-	-	-	-	-	59,819	111,637	184,870	191,349	835,450
Total Senior Lien Parity Obligations	-	-	-	-	-	59,819	111,637	184,870	191,349	835,450
Senior Lien Parity Obligations Coverage Recognized	N/A	N/A	N/A	N/A	N/A	13.63	8.58	5.72	6.56	1.76
Senior Lien Parity Obligations Coverage Required	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Senior Lien Coverage Deficiency	-	-	-	-	-	-	-	-	-	-
Net Deficiency/(Surplus)	-	-	-	-	-	-	-	-	-	-
Projection of Revenue Sufficiency:										
Maximum Deficiency	-	204,256	21,549	23,583	155,498	186,548	207,212	240,113	262,541	370,058
Percent Increase Required Over Current Rate Revenues	**0.00%**	**19.02%**	**1.69%**	**1.81%**	**11.75%**	**12.62%**	**12.44%**	**12.82%**	**12.43%**	**15.58%**
Stormwater rates reconciliation:										
Revenues recognized from current rates	1,073,816	1,073,816	1,278,072	1,299,621	1,323,204	1,478,701	1,665,250	1,872,462	2,112,575	2,375,116
Add revenues from rate increase	-	204,256	21,549	23,583	155,498	186,548	207,212	240,113	262,541	370,058
Total revenues recognized from rate increase	1,073,816	1,278,072	1,299,621	1,323,204	1,478,701	1,665,250	1,872,462	2,112,575	2,375,116	2,745,174

10.8 RATE ANALYSIS

In Wilsonville, service charges for stormwater management reflect a rationale that those who contribute runoff to the stormwater system should proportionately contribute to the costs of providing services. This approach is now regarded by most administrators and the courts as an appropriate technique for financing stormwater programs. A basic assumption in this rate analysis is that services will continue to be billed on the basis of impervious surface. For single family residential property owners, the average amount of impervious area on a developed residential lot is 2,750 square feet. This value provides the basis for and equates to one ERU. Non-residential property owners are billed based on their measured impervious area divided by 2,750 which is then multiplied by the rate per ERU of $3.72 (current rate). The base case forecast has assumed that the percentage change in revenue requirements in any forecast year will be applied to the prior year's rate to arrive at that year's calculated rate per ERU. Table 10-10 shows the rate forecast per ERU over the forecast horizon.

Note: the budgeted rate for fiscal 2012 is $4.33; the forecast assumes a rate increase to $5.00 effective 1/1/12.

Table 10-10
Forecast of Monthly Stormwater Rates per ERU

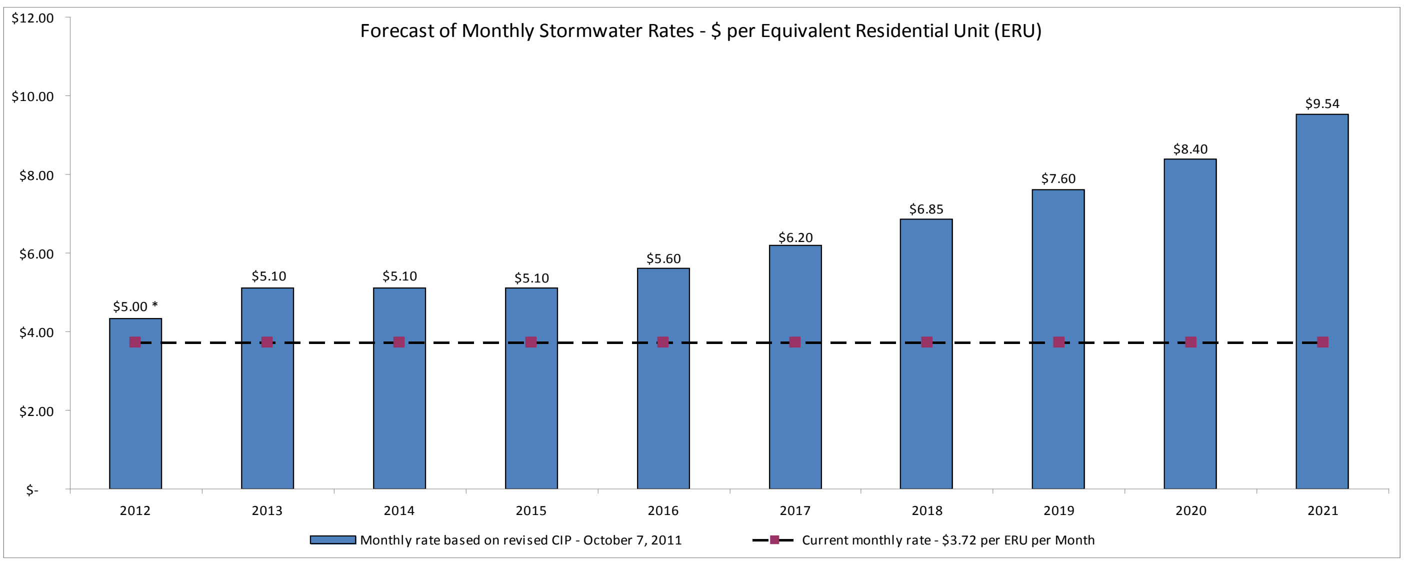
City of Wilsonville
Projection of Stormwater Operating Fund Revenue Requirements and Derivation of Monthly Rates per ERU

	Budget	Forecast								
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Gross revenues required from rates:										
Operations and maintenance expense	723,688	748,943	785,512	826,279	855,112	889,513	925,392	1,030,701	1,072,019	1,120,311
Operating fund capital outlays	-	-	-	-	-	-	-	-	-	-
Transfers to other funds - less transfers to construction	243,700	254,667	266,126	278,102	290,617	303,695	317,361	331,642	346,566	362,161
Debt service	-	-	-	-	-	59,819	111,637	184,870	191,349	835,450
(Use)/Replacement of Operating Fund balance	100,580	278,000	253,000	225,000	335,000	415,000	521,000	568,000	768,000	430,000
Subtotal gross revenues required from rates	1,067,968	1,281,609	1,304,638	1,329,381	1,480,729	1,668,027	1,875,390	2,115,213	2,377,934	2,747,922
Revenue offsets to cost of service:										
Intergovernmental	-	-	-	-	-	-	-	-	-	-
Investment income	2,000	3,538	5,018	6,178	2,028	2,778	2,928	2,638	2,818	2,748
Miscellaneous	-	-	-	-	-	-	-	-	-	-
Subtotal revenue offsets to cost of service	2,000	3,538	5,018	6,178	2,028	2,778	2,928	2,638	2,818	2,748
Net revenues required from rates	1,065,968	1,278,072	1,299,621	1,323,204	1,478,701	1,665,250	1,872,462	2,112,575	2,375,116	2,745,174
Forecasted billable retail ERUs	20,524	20,882	21,246	21,616	21,993	22,376	22,766	23,163	23,567	23,978
Current monthly rate - $3.72 per ERU per Month	$ 3.72	$ 3.72	$ 3.72	$ 3.72	$ 3.72	$ 3.72	$ 3.72	$ 3.72	$ 3.72	$ 3.72
Monthly rate based on revised CIP - October 7, 2011	$ 4.33	$ 5.10	$ 5.10	$ 5.10	$ 5.60	$ 6.20	$ 6.85	$ 7.60	$ 8.40	$ 9.54

As the data in Table 10-11 shows, the longer range rate forecast shows significant increases as the cumulative effect of issuing revenue bonds to pay for the capital improvements is reflected in the rate. This forecast also assumes that the City will use available resources within its Stormwater SDC and Operating Funds to support identified capital needs during the initial phase of capital construction. These rate projections and specifically the rate effects related to capital funding are also based on increasing the City's current Stormwater SDC of $492 per ERU based on the following step increases:

- July 1, 2012 - $780 per ERU
- July 1, 2013 - $1,068 per ERU
- July 1, 2014 - $1,356 per ERU

Table 10-11
Long Range Forecast of Monthly Stormwater Rates per ERU



10.8.1 Service Charge Credits

Implementation of a stormwater funding structure requires policy direction regarding whether specific classifications of property or uses of such property will qualify for service charge exemption or credit. The amount of a property's service charge must be linked to its proportionate share of stormwater program costs. Issues of equity or legal defensibility arise when exemption or credit policies move away from this utility rate making premise. Service charges must be fair and reasonable and bear a substantial relationship to the cost of providing services and facilities.

Many basic policy decisions revolve around "who pays" when a stormwater service charge is applied to individual properties. The ERU approach is based on impervious area and would, therefore, exempt undeveloped properties which, by definition, do not have impervious area. If truly undeveloped i.e., left in its natural state, it is difficult to include undeveloped land in a rate structure based on impervious area and contribution of runoff factors.

Most stormwater service charge structures do not consider property ownership in establishing rates. Instead, charges are based on property conditions/improvements which affect runoff in some manner. One exception is publicly owned properties where a variety of policies have been implemented. Some utilities apply stormwater service charges to public properties in the same manner as private properties. Others do not charge public properties because it is believed that the process only takes money from one City fund and transfers it to another. However, the method most often employed is to bill all public owned facilities (schools, city buildings, etc.) but exempt publicly owned streets. The logic supporting the exemption for streets being that they are designed and operated as part of the City's stormwater conveyance system.

Another question in the stormwater rate is exemption or reduction of the charge based on social issues of low income or elderly. No general rule has been set which enables service charge reductions based solely on ability to pay or age making this issue one established by local policy. The stormwater charge should be consistent with the City's other rate structures.

The issue of tax-exempt properties being excluded from the service charge is legally straightforward. For the sake of maintaining consistency with legal requirements of service charges, the stormwater fee should be applied to properties owned by churches, non-profit agencies and others having tax exempt status.

Most stormwater utilities do provide for credits against service charges to recognize the effects of on-site detention, water quality mitigation or other means of stormwater control. Wilsonville's stormwater rate is related to each property's contribution of runoff to the system. The objective of a service charge credit system is to provide incentives for developers to meet or exceed stormwater quantity/quality requirements. The level of credit should reflect the reduced effect a property with on-site controls has over a similar property lacking this mitigation. The amount of reduction is a function of the service charge rate structure. Under the impervious surface approach, the credit results in a reduction of the equivalent units attributable to the property.

The next question is how much of the service charge should be made available for credit. The case for making the entire charge available for credit would assume that if the site totally retains stormwater runoff, that customer is not being served by any of the programs or services offered by the utility. However, given the fact that access to the property is available during storm events and those stormwater utility activities such as water quality management, channel maintenance, regulatory compliance and public information will continue to benefit all the City's customers, it is questionable whether any property is left totally unserved by the program. Based on this logic, it is generally accepted that some level of the fee remain in place regardless of the on-site facility constructed by the customer. The level of credit available is then a function of allocating program costs to "base" versus "use" factors. Base can be defined as program costs that are largely unaffected by storm water flows. These typically include water quality management, regulatory compliance and billing/administration. Use costs are those that are related to storm water flow and may include budget categories such as maintenance and some capital improvements.

A final consideration deals with the calculation of the credit itself. There are a number of variations all of which revolve around the desired level of simplicity, equity and administrative ease. At its simplest, a service charge credit is calculated as a percentage reduction based on the type of facility. A detention facility equals a certain percentage reduction; a retention facility another percentage; sumps another percentage. A higher level of accuracy is achieved when the calculation is based on a case by case comparison of pre and post development flows from the site.

The City's current Resolution No. 1732 (Part III Article I.A) stipulates the following regarding eligibility for a reduction in the stormwater service charge:

> *The applicant must show to the Department of Public Work's (DPW) satisfaction, the amount of permanent reduction to the total run-off or run-off coefficient for the property. Extra capacity facilities or improvements above the requirements as described in the Stormwater Master Plan as described in Part II Definitions of this Resolution that are installed and maintained by the applicant may be used to show the amount of permanent reduction to the total runoff or runoff coefficient.*

This credit procedure does provide the City with the mechanism to establish rate incentives for upsizing or providing levels of treatment that go beyond the requirements established for the stormwater program. However, the Resolution could be improved by including a more specific calculation of how the oversizing or other stormwater improvements on the property are translated into a reduction of the rate. It is assumed that the current methodology applies the same percentage reduction of flows from the site as the basis for a percentage reduction of the service charge applied to the site.

10.9 SYSTEM DEVELOPMENT CHARGE METHODOLOGY

10.9.1 Background

This update of Wilsonville's system development charges (SDC) for stormwater was done in conjunction with completion of the Stormwater Master Plan. As part of this update process, issues related to the current stormwater SDC structure were addressed through Wilsonville's Finance and Community Development Departments. These groups, working with the URS Project Team, established the proposed direction on the structure and calculation of the draft stormwater SDCs.

For this SDC update, Wilsonville established a number of objectives:

- Review the basis for the SDCs to ensure a consistent methodology;
- Develop a reimbursement element of the SDC; and
- Consider possible revisions to the structure or basis of the charge that might improve equity or proportionality to demand.

The City's current stormwater SDC is $492 per ERU. This SDC was established in 2001 (CIP costs have been escalated over time but the basis for the charge has not been updated since 2001). The sole basis for the SDC is future project costs allocated to growth which in 2001 were valued at $4,543,981. This cost base was allocated over planned future growth in ERUs of 9,189. The City then applied a "debt service reduction" of $74 per ERU which resulted in a total SDC of $421 in 2001. Again, as capital costs have been adjusted over time, this rate has increased to the current $492.

This Stormwater Master Plan also identified a new category of project referred to as low impact development (LID) which are projects oriented toward improved stormwater quality. Because of the overall benefit to the City's stormwater program these water quality projects will provide, it was not possible to apportion specific projects or elements of projects to growth. Rather, the approach was to take the total LID project cost of $1,387,700 and divide that amount by total ERUs (current and future) in the system of 28,502. This proportionately allocates these LID costs over the entire stormwater customer base as opposed to specific project allocations to growth in ERUs.

Finally, the City requested that a reimbursement element of the stormwater SDC also be evaluated as part of this project. Based on the City's fixed asset schedule, the costs for existing stormwater facilities were identified. From this base all developer contributions and grant funded improvements were subtracted from that total as contributed capital not eligible for SDC reimbursement. As is the case for the LID projects, there was no attempt to allocate specific assets to growth. Rather, the overall stormwater system assets (less contributed capital) provide capacity to new connections, the cost of which has been paid by the City and its ratepayers. These costs should be proportionately shared by new connections to the system. Therefore, the book value of stormwater system assets (less contributed capital and less depreciation) of $13,693,030 is divided by the total ERUs in the system (current and future) of 28,502 to derive the reimbursement SDC of $480.

Table 10-12 summarizes the elements of the proposed stormwater SDC:

Table 10-12
Summary of Proposed Stormwater SDCs

City of Wilsonville
Stormwater - System Development Charge Analysis
Summary of Fee Components

Reimbursement fee		$ 480
Improvement fee:		
Water quantity	827	
Water quality	49	
Total improvement fee	876	876
Total System Development Fee		$ 1,356

10.10 STATUTORY REQUIREMENTS

Wilsonville's Resolution No. 1732 Article III establishes the Stormwater SDC for the City. While indexed to reflect current construction costs indices, the Resolution was last updated in November 2001. The intent of the City through this proposed stormwater SDC is to ensure that each project contained in the Stormwater Master Plan is evaluated in order to determine whether or to what extent each project is eligible to be included in the SDC cost base. The evaluation of these stormwater projects for SDC eligibility employed the following guidelines:

ORS 223 Requirements:

1. Capital improvements mean the facilities or assets used for stormwater management. This definition DOES NOT ALLOW costs for operation or routine maintenance of the improvements.
2. The SDC improvement fee shall consider the cost of projected capital improvements needed to increase the capacity of the stormwater system to accommodate future growth.

3. An increase in system capacity is established if a capital improvement increases the "level of performance or service" provided by existing facilities or provides new facilities in order to accommodate anticipated growth.

Under this approach, the following rules were followed:

1. Repair costs are not included;
2. Replacement costs will not be included unless the replacement includes an upsizing of stormwater system capacity;
3. Costs will not be included which bring deficient systems up to established standards.

Wilsonville's Stormwater Utility service charge and SDC are based on measured impervious surface area. The average amount of impervious area on a single family residential developed lot within the City is set at 2,750 square feet. This equates to one ERU. Both rates and SDCs are calculated as a function of ERUs meaning that each property's fee is calculated as follows: Measured Impervious Surface / 2,750 Sq Ft. = # of ERUs. The number of ERUs is then multiplied by the unit rate to determine the service charge or SDC amount.

The number of ERUs currently connected to the City's system is 20,524 as established through the City's Stormwater Utility billing records. Based on growth projections of 1¾ % per year, the total number of ERUs in Wilsonville at the end of the forecast period will be 28,502. This reflects growth of 7,978 ERUs.

10.11 SDC STRUCTURE

Under ORS 223.297-.314, there are two elements to an SDC:

The **reimbursement fee** considers the cost of existing facilities, prior contributions by existing users of those facilities, the value of the unused/available capacity, and generally accepted ratemaking principles (see Table 10-13). The objective is that "future system users contribute no more than an equitable share to the cost of existing facilities." The calculation of the reimbursement fee is based on the original cost of stormwater system facilities identified in the City's fixed asset schedule. An original cost base better reflects the fact that most stormwater infrastructure is not mechanical in nature and prone to the same level of depreciation as are water and sewer systems. Any outstanding principal on debt for these facilities has been removed to more accurately reflect the actual investment made by the City and its stormwater customers. Accordingly, any grant funded facility costs were also removed from the reimbursement fee calculation.

Table 10-13
Stormwater Reimbursement SDC Components

City of Wilsonville
Stormwater - System Development Charge Analysis
Reimbursement Fee Calculation

	Original Cost	(-) Accumulated Depreciation	(=) Book Value
Total SWM utility plant-in-service balance	$ 41,276,993	$ 21,118,799	$ 20,158,194
less projects funded from:			
Grants	338,033	4,225	333,807
Contributed capital	6,278,174	407,217	5,870,957
System Development Charges	275,937	15,536	260,401
Total	6,892,144	426,979	6,465,165
Rate base funded utility plant-in-service balance	$ 34,384,850	$ 20,691,820	$ 13,693,030
Total current and future ERUs			28,502
Calculated reimbursement fee			$ 480

The **improvement fee** is based on the cost of planned future facilities that expand the stormwater system's capacity or increase its level of performance to accommodate growth. In developing an analysis of the improvement portion of the fee, each project in the City's capital improvement plan was reviewed to exclude costs related to correcting existing system deficiencies or upgrading for historical lack of capacity. The improvement SDC is calculated as a function of the estimated number of additional ERUs to be served by the City's facilities over the planning period. There are two elements to the proposed improvement fee, water quality and water quantity. Table 10-14 shows the water quality improvements identified through the Stormwater Master Plan project and allocates these costs proportionally by including the total stormwater customer base in the allocation.

Table 10-14
Stormwater Quality Improvement SDC

City of Wilsonville
Stormwater - System Development Charge Analysis
Water Quality Improvement Fee Calculation

Project Number	Location	Estimated Project Cost
LID1	Memorial Park Parking Lot Vegetated Swales (3)	203,148
LID3	SW Camelot Green Street Mid-Block Curb Extensions (2 extensions)	58,482
LID3	SW Camelot Green Street Mid-Block Curb Extensions (18 extensions)	526,338
LID7	SW Wilsonville Road Stormwater Planters	362,794
LID2	SW Hillman Green Street Stormwater Curb Extensions	236,938
	Total Low Impact Development Projects Cost	$ 1,387,700
	Total Existing and Future ERUs (2012-2031)	28,502
	Unit Water Quality Improvement Fee	$ 49

The second element of the improvement SDC is related to future stormwater projects which were individually evaluated as part of the master planning process in terms of growth vs. non growth related capacity allocation. The resulting growth related costs are allocated only to future ERU growth in the City's stormwater utility/system. These results are shown in Table 10-15.

Table 10-15
Stormwater Quantity Improvement SDC

City of Wilsonville
Stormwater - System Development Charge Analysis
Water Quantity Improvement Fee Calculation

Project Number	Location	Estimated Project Cost	SDC Eligibility Percent	SDC Eligibility Cost
Retrofit	Rivergreen Repair Project	285,000	NA	-
BC-7	Boeckman Creek Realignment	577,296	46%	265,556
Study ST-5	Low Impact Development Design Standards and Implementation Guide	57,000	NA	-
Study ST-8	Install Two Permanent Stormwater Flow Monitoring Stations and Two Rain Gages	45,486	NA	-
Study ST-9	Purchase InfoSWMM Model	18,240	NA	-
Study ST-6	Charbonneau Infrastructure Replacement Study	142,500	NA	-
BC-4	Gesellschaft Water Well Channel Restoration	135,774	0%	-
			0%	
BC-8	Canyon Creek Estates Pipe Removal	129,504	24%	31,081
SD4208 & SD4209	Barber Street Pipe Replacement	213,196	11%	23,452
			0%	
CLC-3	Commerce Circle Channel Restoration	564,071	98%	552,790
Study ST-1	Study to analyze area north of Elligsen Rd/East of I-5	57,000	NA	-
FP	Future Project Development and Implementation	285,000	NA	-
	Subtotal - High Priority Projects -0-5 years	$ 2,510,067		$ 872,878
BC-2	Boeckman Creek Outfall Rehabilitation	167,580	NA	-
BC-6	Multiple Detention Pipe Installation	2,419,380	18%	435,488
BC-5	Boeckman Creek Outfall Realignment	38,441	3%	1,153
BC-3	Cascade Loop Detention Pipe Installation	810,109	0%	-
BC-10	Memorial Park Stream and Wetland Enhancement	84,360	24%	20,246
BC-9	Memorial Drive Pathway and Storm Drain Repair	111,720	0%	-
CLC-2	SW Parkway Avenue Stream Restoration	279,420	9%	25,148
CLC-9	Jobsey Lane Culvert Replacement	115,028	7%	8,052
SD5707, 5709, 5714, 5719	SW Parkway Pipes Replacement	497,405	0%	-
Study ST-2	Advance Road School Site Study	57,000	NA	-
CLC-1	Detention/Wetland Enhancement near Tributary to Basalt Creek	3,516,900	98%	3,446,562
SD9038	French Prairie Road in NW Charbonneau Pipe Replacement	867,417	0%	-
SD9052	Curry Drive and French Prairie Road in NW Charbonneau Pipe Replacement	1,043,501	0%	-
FP	Future Project Development and Implementation	285,000	NA	-
	Subtotal - Medium Priority Projects -5-10 years	$ 10,293,261		$ 3,936,650
Study ST-4	Master Plan and Model Update	342,000	NA	-
Study ST-3	Survey of Open Channel Conveyance	57,000	NA	-
BC-1	Wiedeman Road Regional Stormwater Detention/Stream Enhancement	5,446,350	21%	1,143,734
CLC-4	Ridder Road Wetland Restoration	283,778	3%	8,513
CLC-5	Coffee Lake Creek Stream and Riparian Enhancement	339,844	5%	16,992
CLC-6	Coffee Lake Creek South Tributary Wetland Enlargement	490,286	39%	191,212
CLC-7	Coffee Lake Creek South Tributary Stream Restoration	496,114	19%	94,262
SD4021 & SD4022	Boberg Road Culvert Replacement	65,393	20%	13,079
CLC-8	Coffee Lake Creek Restoration	486,877	48%	233,701
Study ST-7	Boeckman Creek at Boeckman Road Stormwater Study	57,000	NA	-
SD4025 - SD4028	Boberg Road Pipe Replacement	733,590	12%	88,031
	Subtotal - Low Priority Projects -10-15 years	$ 8,798,232		$ 1,789,523
	Total All Priority Projects	$ 21,601,560	31%	$ 6,599,051

Total future capital expenditures incurred to serve future customers (2009-2025)	$6,599,051
Estimated future ERUs added (2012-2031)	7,978
Calculated improvement fee SDC	$ 827