SURFACE WATER MANAGEMENT COMPREHENSIVE PLAN

City of Lynnwood

Prepared for

City of Lynnwood
Public Works Department

September 2009

SURFACE WATER MANAGEMENT COMPREHENSIVE PLAN

City of Lynnwood

Prepared for

City of Lynnwood
Public Works Department
19100 44th Avenue W.
Lynnwood, Washington 98036

Prepared by

Herrera Environmental Consultants
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
Telephone: 206.441.9080

September 17, 2009

Contents

Tables

Figures

Acknowledgements

This Surface Water Management Comprehensive Plan was adopted by the City Council on July 27, 2009, subject to final revisions reflected herein. This plan represents a substantial update to the City of Lynnwood Comprehensive Flood and Drainage Management Plan prepared in 1998. This plan was partially funded by a grant from the Washington State Department of Ecology and produced through the combined efforts, ideas, and cooperation of Lynnwood citizens and the following City staff and appointed and elected officials.

Elected Officials:

Don Gough, Mayor
Ruth Ross, Council President
Ted Hikel, Councilmember
Loren Simmonds, Councilmember
Jim Smith, Councilmember
Mark Smith, Councilmember
Lisa Utter, Councilmember
Stephanie Wright, Councilmember

Public Works Department:

William Franz, Director
Jeff Elekes, Deputy Director
Jared Bond, Environmental and Surface Water Manager
Les Rubstello, Transportation and Utilities Manager
Arnold Kay, Development Services Supervisor
Norm Nesting, Engineer Tech 1
Steve Swain, Street Department/Storm Utility Supervisor

Community Development Department:

Paul Krauss, Director
Dave Osaki, Deputy Director
Kevin Garrett, Planning Manager
Keith Maw, Senior Planner

Economic Development Department:

David Kleitsch, Director

Acronyms and Abbreviations

BMP	Best Management Practice
BPCP	Bacterial Pollution Control Plan
CIP	Capital Improvement Program
City	City of Lynnwood
Ecology	Washington State Department of Ecology
FTE	Full Time Equivalent
IDDE	Illicit Discharge Detection and Elimination
LID	Low Impact Development
LMC	Lynnwood Municipal Code
MUGA	Municipal Urban Growth Area
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
PCHB	Pollution Control Hearings Board (of the state of Washington)
QAPP	Quality Assurance Project Plan
SEPA	State Environmental Policy Act
SR	State Route
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load

1.0 Executive Summary

The City of Lynnwood, located in southwest Snohomish County, covers approximately 7.8 square miles and has a population of 36,400. Since its founding in 1959, the City has transformed from a quiet rural community to a modern thriving commercial and residential community environment that includes zoning for dense residential, commercial, and light industrial land uses. This development has affected the quantity and quality of surface water within and downstream of the City limits, increasing peak stormwater flow rates and pollutant loadings. The City manages stormwater runoff to protect public health, safety and general welfare, and the natural surface water environment.

This Surface Water Management Comprehensive Plan (plan) guides the City of Lynnwood's (City) surface water management program. The City faces many challenges in implementing its surface water management program, including increasing regulatory requirements, requirements for low impact development (LID) stormwater management techniques, development and redevelopment of the Lynnwood City Center, needs associated with annexation of unincorporated portions of Snohomish County, and mitigating existing flooding and pollution problems in streams and lakes. This plan presents a comprehensive set of solutions for implementing policies, program components, capital improvement projects, and studies that address these challenges.

1.1 Purpose of the Surface Water Management Comprehensive Plan

The purpose of this plan is to meet regulatory requirements and address drainage and water quality problems in a way that aligns with the vision for the City's future, as described in the City's 2020 Comprehensive Plan (Lynnwood 2008a). The recommendations in this plan support the goals, objectives, and policies expressed in the 2020 Comprehensive Plan, especially those contained in the Capital Facilities and Utilities Element, Environmental Resources Element, and portions of the Energy and Sustainability Element.

This plan is a substantial update to the Comprehensive Flood and Drainage Management Plan, prepared by the City in 1998 (RW Beck 1998). The 1998 plan focused on identifying and implementing capital projects for flood control and water quality improvements, in addition to maintenance of the stormwater system. Since 1998, the City has made progress by expanding stormwater program coverage and constructing several capital improvement projects. Since many of the recommendations in the 1998 plan have not been fully implemented, this 2009 update builds upon previous recommendations and takes a broader look at the components of the City's surface water management program in light of recent regulatory developments and the potential for stormwater to affect surface water quality and quantity.

1.2 Challenges for the Surface Water Management Program

The City's Surface Water Utility manages a large and complex storm drainage system in the public right of way, and also addresses flooding and water quality issues in streams and lakes that lie beyond the limits of the public right of way. Table 1-1 summarizes the facilities that comprise the storm and surface water systems in the city, as well as other important facts and figures that are relevant to the surface water management program.

Table 1-1. City of Lynnwood storm and surface water facilities, facts, and figures.

Item	Quantity	Units
City of Lynnwood Storm and Surface Water Facilities [a]		
Catch Basins, Manholes, and Inlets	4,700	each
Ditches	42,200	LF
Meadowdale Facility	1	each
North Scriber Creek Detention Facility	1	each
Regional Detention Ponds	5	each
Small Detention Ponds	30	each
Underground Detention Tanks	5	each
Underground Detention Pipes	80	each
Streams	6,530	LF
Oil Water Separators	2	each
Scriber Lake Inflow/Outflow	1	each
Pipes	484,800	LF
Stormwater Decant Facility	1	each
Streets (Routes [b])	8	each
City of Lynnwood Storm and Surface Water Facts		
Impervious Surface Area Coverage in the City of Lynnwood[c]	49	%
Impervious Surface Area Coverage in the Phase 1 Annexation Area[c]	32	%
Impervious Surface Area Coverage in the Phase 2 Annexation Area[c]	21	%
Surface Area of Lakes[d]	40	acres
Homes Known to be Operating on Septic Systems[e]	223	each
Major Drainage Basins	10	each
City of Lynnwood Surface Water Utility Figures		
Projected Surface Water Utility Income for 2009	1,890.000	$
Projected Surface Water Utility Income for 2010 [f]	2,202,000	$
Projected Surface Water Utility Income for 2011 [f]	2,521,000	$
Projected Surface Water Utility Income for 2012 [f]	2,885,000	$
Monthly Stormwater Rate per Equivalent Residential Unit for 2009 [g]	5.84	$
Number of Stormwater Management Program Staff	1.625	FTE [h]
Number of Stormwater Operations and Maintenance Staff	5.1	FTE [h]

Notes:

[a] Source: City of Lynnwood staff and Cartêgraph database.

[b] City streets are divided up into 8 units called routes. Sweeping proceeds on a route-by-route basis.

[c] Impervious area calculated using information from MRLC (2001).

[d] Surface water area calculated using information from Snohomish County (2003).

[e] The Maple precinct is reported to have 60-80 homes operating on septic systems; however, these addresses have not been documented.

[f] This estimate does not include any income that may be received from areas that are annexed into the City of Lynnwood in the future.

[g] See the City of Lynnwood website for the approved stormwater rate schedule through 2012.

[h] Full time equivalent staff (FTE).

Recently, the City has been affected by increasing state and federal stormwater quality regulations. These include the federal Endangered Species Act, the Swamp Creek Total Maximum Daily Load (TMDL) allocation for fecal coliform bacteria imposed by the Washington State Department of Ecology, and the National Pollutant Discharge Elimination System (NPDES) Phase II municipal stormwater permit issued to the City by the Department of Ecology. These regulations require the City to "ramp up" its stormwater management program, which is a major component of the Surface Water Utility's work, to achieve compliance. This plan focuses on regulatory compliance, especially compliance with the NPDES Phase II permit, while also addressing flood control and other stormwater issues unique to Lynnwood and its residents.

The stormwater regulatory requirements imposed on the City serve to address numerous water quality, stream channel erosion, sedimentation, and habitat problems in the streams and lakes receiving runoff from public and private lands within Lynnwood. All surface water bodies that receive City runoff are stressed by degraded water quality, and many exhibit damaged and poorly functioning fish and wildlife habitat.

There are several drainage problem areas in the City that are in need of solutions that will minimize property damage and closure of heavily used roadways. There are also several regional problems, such as water quality degradation in Swamp Creek; water quality and quantity problems in the Hall Lake, Lake Ballinger, and McAleer Creek Watershed; and erosion and downstream sedimentation in Perrinville Creek, that are occurring due to stormwater runoff from Lynnwood and other neighboring cities and portions of unincorporated Snohomish County. Effective management of stormwater runoff is a regional concern extending far beyond Lynnwood city limits.

Over the coming years, the City will seek to expand the use of LID stormwater management techniques in City-funded projects and in private development and redevelopment projects alike. This is in response to increasing information in the region that LID offers greater potential to mitigate the adverse effects of urban stormwater runoff on receiving waters compared to many conventional stormwater management techniques, while being cost-effective at the individual site scale. LID can also improve pedestrian accessibility and increase the amenity value of stormwater infrastructure. Because promotion and implementation of LID within the City has been limited, the City code and associated stormwater management guidance will need to be refined to address consideration of LID, and additional tools will be needed to make implementation of LID techniques more accessible and cost effective to the development community. The City will have numerous opportunities to incorporate such innovative stormwater management techniques in areas such as the City Center, the Sub-Regional Urban Center, and Highway 99 revitalization.

The City is also interested in annexing large areas of unincorporated Snohomish County. Because similar problems are occurring in and downstream of these proposed annexation areas, annexation is expected to increase the burden on the City's stormwater program. The Community Development Department is taking an integrated look at how annexation will affect all aspects of the City's level of service. This plan supports that work by identifying many of the storm and surface water issues associated with the proposed annexations, reinforcing the importance of comprehensive, cost effective stormwater management planning.

1.3 Recommendations

Historically, the City's stormwater management focus has been on collecting runoff from developed areas and conveying that to receiving waters (lakes and streams). In response to increasing flooding and water quality problems not addressed due to lack of funding, the City established a Surface Water Utility in 1991. The Utility provides a dependable source of funds to meet the goals, objectives, and policies of the City's 2020 Comprehensive Plan by implementing stormwater programs, capital improvement projects, and related surface water protection and enhancement efforts.

According to the 2020 Comprehensive Plan, the primary goal of the Surface Water Utility is to establish and maintain "capital facilities, regulations, policies, and procedures which serve the needs of current and future residences and businesses, property owners, and commuters by providing utility services which meet basic level of service standards". This goal is to be met by continually making progress towards objectives for planning, maintenance and operation, interjurisdictional relations, capital facilities, and coordination with the land use plan. The recommendations of this Surface Water Management Comprehensive Plan include development of new and expanded stormwater management program activities, City code revisions, and staffing increases to meet the requirements of the NPDES Phase II permit and the objectives and policies in the 2020 Comprehensive Plan. Recommendations in this plan also include new capital facilities projects and studies to address drainage and water quality problems, specific requirements of the NPDES Phase II permit, and the specific commitments in the 2020 Comprehensive Plan.

1.3.1 Stormwater Management Program, City Code, and Staffing

Table 1-2 summarizes the work that will be necessary to ensure that the Stormwater Management Program, City code, and staffing levels support NPDES Phase II permit compliance while also meeting the goals, objectives, and policies in the 2020 Comprehensive Plan. These recommendations are described in more detail in sections 5 and 6 and Appendix G of this plan.

1.3.2 Capital Facilities Projects and Studies

Tables 1-3 and 1-4 present recommended lists of Capital Improvement Program (CIP) projects and focused studies, respectively, that are needed to address drainage and water quality problems, meet the requirements of the NPDES Phase II permit, and meet the following objectives and policies from the Capital Facilities and Utilities Section of the 2020 Comprehensive Plan:

- Planning Objectives SWM-1.3, SWM-1.4, SWM-1.5, and SWM-1.6
- Maintenance and Operations Objectives SWM-2.4 and SWM-2.5
- Capital Facilities Policies 1.3 and 1.4
- Capital Facilities Plans and Projects Policies 2.1, 2.3, and 2.4
- Environmental Compatibility Policies 4.1, 4.2, and 4.3
- Coordination with Other Jurisdictions and Service Providers Policy 5.1
- Related Design Standards and Programs Policies 7.8 and 7.9

Table 1-2. Recommendations related to City code and stormwater management program staffing.

Recommendations	Related 2020 Comprehensive Plan Objectives and Policies	Related NPDES Phase II Permit Section
Increase use of public education materials and measure effectiveness of the public education program	SWM-1.3	S5.C.1.b
Revise public education program based on measurement of effectiveness	SWM-1.3	S5.C.1.b
Create a formal mechanism for public input on the stormwater management program	SWM-1.3	S5.C.2.a
Increase stormwater information on the City's website, including public involvement contact information	SWM-1.3	S5.C.2
Gather public input during annual stormwater management program reporting and incorporate this input into stormwater program decision making	SWM-1.3	S5.C.2.a
Develop and adopt an illicit discharge detection and elimination (IDDE) ordinance	SWM-1.3, SWM-1.4, SWM-2.2	S5.C.3.b
Develop and implement a written IDDE plan, including stormwater system mapping, an IDDE hotline, training for applicable staff, prioritization of water bodies, field evaluation of outfalls, and procedures to assess program effectiveness.	SWM-1.3	S5.C.3
Formally adopt the Department of Ecology's Stormwater Management Manual for Western Washington, or an approved equivalent manual, through modifications to City code	SWM-1.3, SWM-1.4, SWM-2.2	S5.C.4.a
Develop provisions to encourage low impact development (LID) techniques for managing stormwater in new development and redevelopment projects	SWM-1.3, SWM-1.4, SWM-2.2	S5.C.4.a.iv
Incorporate innovative infrastructure options, sustainable design, green technologies, and systems alternatives in the City Center, the Sub-Regional Center, and Highway 99 revitalization.	SWM-1.3, SWM-1.4, SWM-2.2	S5.C.4.a.iv
Develop a City-specific addendum to the Stormwater Management Manual for Western Washington, or an approved equivalent manual, to provide additional clarity on requirements that apply to individual projects and to highlight stormwater management techniques that are best suited to Lynnwood	SWM-1.3, SWM-1.4, SWM-2.2	S5.C.4
Revise the City's development permit review procedures to correspond with the Stormwater Management Manual for Western Washington, or an approved equivalent manual,	SWM-1.3	S5.C.4.b
Train City staff responsible for implementing the new development code and procedures	SWM-1.3	S5.C.4.f
Evaluate the potential options for inspecting privately owned stormwater facilities and enforcing compliance with maintenance standards	SWM-1.3	S5.C.4.c

Table 1-2 (continued). Recommendations related to City code and stormwater management program staffing.

Recommendations	Related 2020 Comprehensive Plan Objectives and Policies	Related NPDES Phase II Permit Section
Develop a plan for inspecting privately owned flow control and water quality treatment stormwater facilities and enforcing maintenance requirements	SWM-1.3	S5.C.4.c
Update the City's draft Municipal Stormwater Pollution Prevention Plan to include Parks Department facilities	SWM-1.3	S5.C.5.i
Develop an operations and maintenance (O&M) plan for municipal stormwater facilities that stipulates a level of service that will meet the requirements of the NPDES Phase II permit	SWM-1.3, SWM-2.3	S5.C.5
Conduct maintenance in accordance with the O&M plan	SWM-1.3, SWM-2.3	S5.C.5
Increase the staff dedicated to stormwater management program development and implementation by 1.4 full time equivalent employees during 2009	SWM-1.3, SWM-1.6	S5.C
Increase stormwater operations and maintenance staff by approximately 2.0 full time equivalent employees by 2010 to address inspection and maintenance needs at public stormwater facilities within the current City limits to meet NPDES permit requirements	SWM-1.3, SWM-1.6, SWM-2.3	S5.C.5
Continue participating in interjurisdictional projects that address common stormwater management problems, including the forum for the Hall Lake, Lake Ballinger, and McAleer Creek watershed	SWM-3.1	

Table 1-3. Recommended capital improvement projects to be funded by the Surface Water Utility.

Project ID	Project/Study Title	Estimated Design, Permitting, and Construction Cost (2009 dollars)
FL-1	Scriber Creek culvert replacement at 188th Street SW	$630,000
FL-2	Scriber Creek culvert replacement at 189th Street SW	$410,000
FL-3	Scriber Creek culvert replacement at 190th Street SW	$520,000
FL-4	Scriber Creek culvert replacement at 191st Street SW	$450,000
FL-5	Raising the roadway at 44th Avenue W	$4,500,000
FL-6	Flood study at Maple Road and Ash Way	$150,000
FL-7[a]	Scriber Creek culvert replacement at Casa Del Rey condominiums driveway	$570,000
FL-8[a]	Install backflow preventers and construct berms upstream of 200th Street SW and 50th Ave W	$410,000
ER-1	Stabilize approximately 200 linear feet of stream channel between 191st Street SW and 193rd Place SW with grade control structures made of logs and boulders.	$290,000
ER-2[a]	Stabilize approximately 1,000 linear feet of streambank using bioengineering techniques.	$1,250,000
WQ-1A	Aeration system retrofit for Scriber Lake (not needed if project WQ-1B is constructed)	$ 90,000
WQ-1B	Floating island treatment system for Scriber Lake (not needed if project WQ-1A is constructed)	$140,000
WQ-2	Street edge runoff treatment retrofits in the Hall Lake basin	$2,130,000
WQ-3A	Drainage ditch retrofit to a create a bioretention swale in the Golde Creek basin	$120,000
WQ-3B	Installation of a street edge or parking lot treatment system such as a Bacterra™ bioretention system.	$90,000
WQ-4	Conversion of existing unimproved ditch to a bioretention swale along 180th Avenue SW between State Route (SR) 99 and Scriber Creek	$120,000
Total Cost		$11,780,000

Notes:
[a] Problem and solution are on private property.

Table 1-4. Recommended studies to address specific drainage and water quality problems, and to develop area-specific stormwater management strategies.

Study	Estimated Cost
Scriber Creek drainage basin stormwater management standards and strategies	$30,000
Lund's Gulch drainage basin stormwater management standards and strategies [a]	$30,000
Perrinville Creek drainage basin stormwater management standards and strategies [a]	$30,000
Private stormwater facility O&M study	$25,000
LID pilot program	$50,000
City Center LID guidelines	$10,000
Develop citywide surface water management design guidelines and recommendations	$75,000
Small sites stormwater facility sizing tools	$25,000
Total Cost	$275,000

Notes:
[a] Study should be performed in coordination with neighboring jurisdictions.

More detailed information on the CIP projects listed in Table 1-3 can be found in Appendices D and E. More detailed information on the studies listed in Table 1-4 can be found in Section 5 of this plan.

1.4 Implementation

Implementation of this plan requires a committed effort by all City departments, working together with guidance from and leadership by the Public Works Department. The City's Surface Water Utility will need increased funding to implement the Plan, and to respond to evolving regulatory requirements and long term surface water problems. Frequent communication and partnering with neighboring jurisdictions that face many of the same issues will benefit the City as it implements this plan.

2.0 Introduction

2.1 Stormwater Runoff and Its Effects

Lynnwood uses an extensive system of drainage pipes and ditches to convey stormwater runoff to streams and lakes, and to prevent and minimize damage to private property, city streets, and other infrastructure. Due to extensive alteration of the natural landscape in most areas of Lynnwood, the amount of runoff that occurs in larger storm events is substantial, and runoff in all storm events carries a variety of pollutants to receiving waters. The City is faced with the challenge of conveying stormwater runoff safely and cost-effectively, while preventing or minimizing adverse high flow impacts (erosion, flooding, and sediment deposition) and water quality degradation in lakes and streams that receive runoff.

In 1991, the City established a Surface Water Utility to create a funding source to address stormwater and receiving water management issues citywide. The Surface Water Utility is funded by residential, commercial and industrial ratepayers. State and federal regulations related to stormwater have been increasingly imposed upon the City in recent years, making it difficult to address all issues while balancing the cost borne by utility ratepayers. Because of the many stormwater challenges facing the City, it must implement and continually improve upon a comprehensive plan for stormwater management.

2.2 Purpose of This Plan

This plan is a major revision to the City's Comprehensive Flood and Drainage Management Plan that was last updated in 1998. This plan revision satisfies objectives SWM-1.5 and SWM-2.4 and Policies 2.1 and 2.9 from the 2020 Comprehensive Plan, and sets a course for stormwater programs and capital projects for years to come. This plan addresses current and anticipated regulatory requirements, future land use designations, emerging stormwater management technologies, existing flooding and water quality problems, and the resources needed for the City to fully implement the plan. Funding for this plan update was provided by a grant from the Washington State Department of Ecology and funds from the Surface Water Utility Fund 411 budget.

2.3 Information Used to Develop the 2009 Surface Water Management Comprehensive Plan

Significant research was conducted to develop this Plan. Past studies were reviewed for information on drainage and water quality problems and to evaluate the existing surface water management program. To supplement existing information on drainage and water quality problems and recent documentation of the status of the City's stormwater program, a workshop was conducted with City staff on February 6, 2008 at the City of Lynnwood Public Works Department office to discuss issues pertinent to this Plan. A stormwater management program status survey was used to facilitate the workshop. A copy of the status survey and a list of workshop attendees are provided in Appendix G. Several follow-up meetings and telephone conversations were held with City staff after the workshop. In addition, several technical meetings were held with City staff to research specific stormwater program elements, such as the operations and maintenance program. Facility inspections were also performed at the Utility Maintenance Center and the Wastewater Treatment Plan to review industrial activity at these facilities. A meeting involving representatives of the departments of Community Development, Economic Development, and Public Works was held on February 12, 2009 to discuss comments on the first draft of this plan.

The following City staff provided important input throughout the development of this plan:

- Jared Bond , Environmental and Surface Water Manager
- Les Rubstello, Transportation and Utilities Manager
- Steve Swain, Street Department/Storm Utility Supervisor,
- Norm Nesting, Engineer Tech 1
- Arnold Kay, Development Services Supervisor

The following sources were reviewed during the preparation of this plan to obtain information on pertinent City plans, City code, the City's storm drainage systems, and streams and surface water bodies within the City:

2.3.1 City Programs

- City of Lynnwood 2020 Comprehensive Plan (Lynnwood 2008a)
- City Center Sub-Area Plans (Lynnwood 2007a)
- Utility Rate Study (FCS Group 2007)
- 2008-2013 Capital Facilities Plan (Lynnwood 2007b)
- City of Lynnwood Comprehensive Flood and Drainage Management Plan (R.W. Beck 1998)

2.3.2 Lynnwood Municipal Code

- Lynnwood Municipal Code (LMC) 13.40 Drainage Plans
- LMC 16.46 Flood Hazard Area Regulations
- LMC 17.02 State Environmental Policy Act
- LMC 17.05 General Policy

- LMC 17.10 Environmentally Critical Areas
- LMC 6.02.160 Owner responsibility to remove animal manure

2.3.3 Stormwater Systems Within the City

- City of Lynnwood Comprehensive Flood and Drainage Management Plan (R.W. Beck 1998)
- Stormdrain Facilities Database (private stormwater facilities) (Lynnwood 2000)
- GIS data: City of Lynnwood drainage infrastructure and zoning (Lynnwood 2008c)

2.3.4 Surface Water Bodies Within the City

- Scriber Creek Watershed Management Plan (Snohomish County, City of Lynnwood, and City of Brier 1989)
- Swamp Creek Watershed Management Plan (Swamp Creek Watershed Management Committee and Snohomish County Public Works, Surface Water Management Division 1994)
- Swamp Creek Fecal Coliform Bacteria Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan (Ecology 2006)
- Swamp Creek Fecal Coliform Bacteria Total Maximum Daily Load Water Quality Study Design (Quality Assurance Project Plan) for the City of Lynnwood (Lynnwood 2008b)
- Stream Habitat Assessment (Jones and Stokes 2000)
- Lower Scriber Creek Study (Gray and Osborne 2002a)
- Scriber Lake Restoration Project (URS 1992)
- Scriber Lake Study (Gray and Osborne 2002b)
- Hall Lake Water Quality and Quantity (Gray and Osborne 2002c)

2.4 Accomplishments of the Surface Water Management Program

Since the Surface Water Utility was founded in 1991, the City has made significant progress in reducing detrimental effects of stormwater runoff on receiving waters in and around Lynnwood. The City has built many capital improvement projects to alleviate drainage problems, and conducted technical analyses of other problems to better understand necessary actions. The City has also adopted ordinances, provided public education, and implemented a monitoring program in the Swamp Creek drainage basin to address water quality problems.

The City's stormwater management program, which is a major component of the overall surface water management program (the definition of which is important for NPDES permit compliance), has strengths in the areas of public education and outreach; controlling runoff from new development, redevelopment, and construction sites; and municipal operations and maintenance (see Appendix G). Table 2-1 lists major accomplishments of the City's surface water management program since completion of the 1998 Comprehensive Flood and Drainage Management Plan (R.W. Beck 1998). Figures 2-1 through 2-3 illustrate some of the City's Surface Water Management Program accomplishments and ongoing activities.

2.5 Opportunities and Constraints

The City's stormwater management program is building at a time when a wealth of information is becoming available in the region on cost-effective ways to manage stormwater runoff. This solid base of regional information, the focused work related to this plan, and funding provided by the Surface Water Utility should allow the City to implement a strong stormwater management program in the future. However, as documented in this Plan, the evolving regulatory environment, as well as best practices, requires the City to expand its stormwater program. This expansion requires additional funds, and means that stormwater issues will increasingly affect other City business. The success of the City's stormwater management efforts will in part be a result of how well the City addresses funding and administrative constraints to successfully implement the recommendations in this Plan.

2.6 Public Involvement Conducted for this Plan

Public involvement was conducted during the development of this plan in June and July of 2009. Public notice was provided on the City website, at all City-owned public buildings, and in the City's official news publication on June 18, 2009 to inform residents where to find copies of the draft plan and how to provide feedback to the City. Identified stakeholders were specifically notified of the new plan during June. A public review draft was provided electronically on the City website, and hard copies were made available at the City Library and at City Hall starting on June 18 2009. Comments were accepted between June 18, 2009 and the public hearing on July 27, 2009. Meetings were scheduled throughout June and July 2009 to introduce the plan and answer questions from the general public, the identified stakeholders, the City's Planning

Table 2-1. Summary of accomplishments of the City of Lynnwood surface water management program, 1998-2008.

Type of Project	Project Name	Accomplishments
Drainage	North Scriber Creek Detention Facility	Reduces flooding problems along the Scriber Creek corridor.
Drainage	Meadowdale Glen Flood Protection Project	Reduces flooding problems.
Drainage	Numerous culverts and other drainage improvements along the urban stream network	Reduces flooding problems throughout the City.
Water Quality	Adopted Animal Control Ordinance (LMC 6.02.160)	Requires citizens to pick up their pets' waste.
Water Quality	Stormwater Monitoring Plan for the Wastewater Treatment Plant[a]	Stormwater Monitoring Plan was developed for the Wastewater Treatment Plant
Water Quality	Pet waste management stations.	Two pet waste management stations were installed in Meadowdale Playfield and Lynndale Park.
Water Quality	Swamp Creek Total Maximum Daily Load (TMDL) monitoring	Wrote an Ecology-approved Quality Assurance Project Plan (QAPP) and began monitoring 4 locations in the Swamp Creek watershed in spring 2008.
Public Education	Education grant program	Administered 10 classroom education grants totaling $3164 to encourage education in the classroom.
Public Education	Educational booth	Developed a portable educational materials booth for providing stormwater education at public events.
Public Education	Educational publications	Educational articles have been published in Inside Lynnwood, a quarterly newsletter.
Public Education	Public awareness signage	Awareness signage has been posted at creek crossings and storm drain signage material has been made available for citizens for posting at neighborhood storm drains. Signs have been installed at Scriber Lake Park, Scriber Creek Park, and Mini-Park in the Scriber Creek/Swamp Creek watershed to restrict feeding of waterfowl.
Development and Redevelopment Projects	Adopted Drainage Control Code (LMC Chapter 13.40)	Regulates development and redevelopment to ensure that flow control and water quality treatment best management practices (BMPs) are implemented to reduce downstream flooding.
Development and Redevelopment Projects	Operations and maintenance covenant	Operations and maintenance covenants are attached to all plat documents to ensure that stormwater facilities are adequately inspected and maintained.
Development and Redevelopment Projects	Adopted new Tree Ordinance (LMC 17.15)	Preserves and protects existing trees and encourages the planting of new ones for both aesthetic and environmental benefit.

Table 2-1 (continued). Summary of accomplishments of the City of Lynnwood stormwater management program, 1998-2008.

Type of Project	Project Name	Accomplishments
Development and Redevelopment Projects	Adopted Environmentally Critical Areas Ordinance (LMC 17.10)	Protects critical areas using best available science and Ecology methodologies.
Pollution Prevention and Municipal Operations and Maintenance	Vehicle washing	All City vehicles are washed at designated vehicle wash racks or commercial car washes, preventing contamination of stormwater runoff to area receiving waters.
Pollution Prevention and Municipal Operations and Maintenance	Street sweeping	A street sweeping program has been established that sweeps residential streets once per month and arterials twice per month.
Pollution Prevention and Municipal Operations and Maintenance	Stormwater pollution prevention plan (SWPPP)	SWPPP developed for the Wastewater Treatment Plant and the Utility Maintenance Center.
Pollution Prevention and Municipal Operations and Maintenance	Stormwater Monitoring Plan for the Wastewater Treatment Plant[a]	Stormwater Monitoring Plan was developed for the Wastewater Treatment Plan.
Pollution Prevention and Municipal Operations and Maintenance	System mapping and tracking	The City has inventoried and mapped most of the public storm drainage system.

Notes:

[a] This plan was developed as an Appendix to the municipal stormwater pollution prevention plan (Lynnwood 2009) that covers the City's Wastewater Treatment Plant and the Utility Maintenance Center.

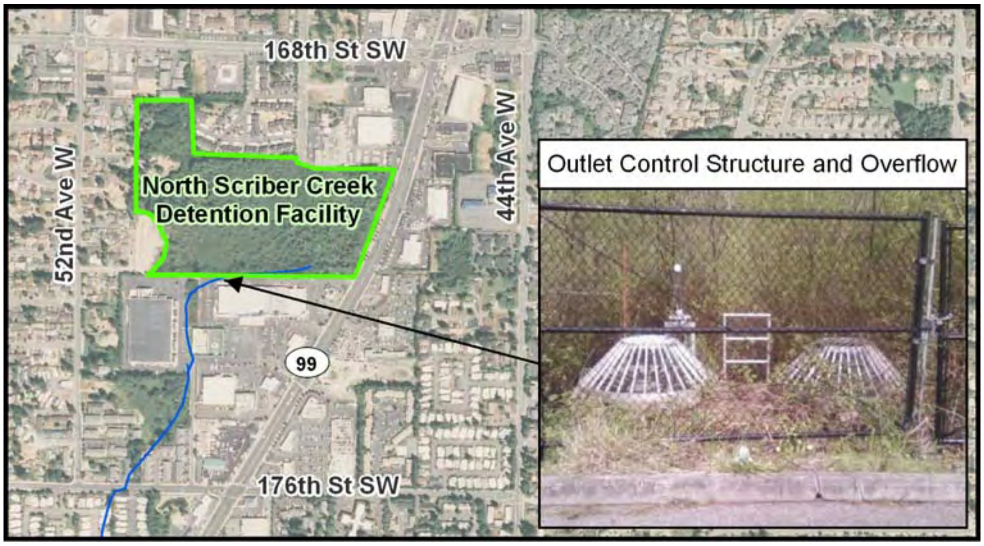


Figure 2-1. North Scriber Creek detention facility.

Figure 2-2. Pet waste management station.

Figure 2-3. Portable stormwater education booth.

Commission, and the City Council. The City Council held a public hearing on the plan, closed the public comment period, and adopted the plan on July 27, 2009. The public comment and testimony were reviewed and considered by both staff and the City Council. Internal City review and State Environmental Policy Act (SEPA) review were conducted during the public review period and final revisions to the plan were made in August and September 2009 to address comments from City staff and the City Council.

2.7 Document Organization

This remainder of this document is broken up into four sections:

- **3. Background** characterizes the study area and includes a map of drainage basins within the City. Applicable policies, regulations, and regional drainage issues are also summarized in the background section.

- **4. Problem Identification and Solution Development** describes the City's stormwater problems related to drainage and water quality. This includes an analysis of citywide problems and site specific problems.

- **5. Stormwater Program Evaluation** compares the existing stormwater program to regulatory drivers. Stormwater program needs that were identified during this project are also described in this section.

- **6. Recommended Stormwater Management Program and Implementation** provides recommendation and guidance for stormwater problems and meeting stormwater program requirements.

In many instances during the development of this document, detailed analysis was conducted to support conclusions and recommendations. This analysis included interviews with City staff, field reconnaissance, hydrologic modeling, hydraulic modeling, geomorphic analysis, field reconnaissance, research and evaluation of LID and water quality treatment techniques, review of water quality monitoring data, and alternatives analysis for potential CIP projects. The text of this document briefly summarizes the methods and results of these analyses. More detailed information related to methods and results of technical analyses is provided in appendices at the end of this document.

3.0 Background

3.1 Characteristics of the Study Area

The City of Lynnwood, located in southwest Snohomish County, covers approximately 7.8 square miles and has a population of 36,400. Since its founding in 1959, the City has transformed from a quiet rural community to a Regional Growth Center (Puget Sound Regional Council 2008) composed of dense residential, commercial, and light industrial land uses. Topography in the City mainly consists of gently rolling slopes, ranging from approximately 620 feet elevation above mean sea level in the northwest to 200 feet at the confluence of Scriber Creek and Swamp Creek, just south of the City limits (Snohomish County 2002a). The southern portion of the City drains to Scriber Creek, Hall Creek, and Hall Lake, the western portion drains into Edmonds, and the northeast corner drains to Tunnel Creek and Swamp Creek. A small portion of City drainage also flows to a local depression of outwash soils near Meadowdale Pond in the northwest corner of the City.

The main drainage basins in the City include: Meadowdale Pond, Scriber Creek, Hall Creek, Tunnel Creek, and Golde Creek. A map of the 10 drainage basins in the City is provided in Figure 3-1. Additional descriptions of each of these drainage basins are in Appendix A. Regional drainage and water quality issues associated with downstream drainage basins are addressed later in this section. Drainage and water quality problems within the City are discussed in Section 4: Problem Identification and Solution Development.

Two regional stormwater management facilities have been constructed since the 1998 Comprehensive Flood and Drainage Management Plan (R.W. Beck 1998). One of these is the North Scriber Creek Detention Facility, located west of State Route 99 (SR 99) at 172nd Street SW. This facility covers 18 acres and serves as a regional stormwater detention facility for the Scriber Creek basin. The second regional stormwater management facility is Meadowdale Glen, located southeast of Meadowdale Drive near 172nd Street SW, which was expanded from the existing Meadowdale Pond (350,000 cubic foot capacity) to provide an additional 260,000 cubic feet of flood storage.

After a series of public meetings in October and November 2008, the City proposed annexation of its Municipal Urban Growth Area (MUGA). The master Interlocal Agreement with Snohomish County has been negotiated, and residents within the annexation area are scheduled to vote on those annexations in April 2010. If approved by the voters, annexations would become effective later in 2010, with the City most likely taking over operations and maintenance (O&M) of stormwater facilities in annexed areas on January 1, 2011. City of Lynnwood and Snohomish County staff are currently discussing the use of county services (i.e. interim transitional services) for at least one year after the City assumes responsibility for the stormwater facilities.

Figure 3-1. Drainage basins within the City of Lynnwood and Phase 1 and 2 annexation areas.

8 ½ x 11 color

The northern boundary of the MUGA is 148th Street SW and Norma Beach Road and the southern boundary is Larch Way. Phase 1 of the proposed annexation includes three parts: the East annexation area (east of SR 525 and I-5), the North annexation area (between 52nd Avenue W and SR 525), and the Maple Precinct annexation area (near Meadowdale High School and another section bordering Edmonds). Phase 2 includes the remaining MUGA: a section to the northwest of the existing City limits between Puget Sound and 52nd Avenue W and a section to the east extending from I-5 to Larch Way and Larch Way to North Road. These annexation areas are shown in Figure 3-2.

Appendix B of this plan discusses staffing needs related to annexation. However, this plan does not address flooding, erosion, and water quality problems in the MUGA. Some of these problems were evaluated in the Drainage Needs Assessment reports prepared by Snohomish County (Snohomish County 2002a, 2002b, and 2007).

3.2 Support for High Density Urban Development

At the time this plan was written, the City is nearly fully developed, with most parcels already occupied by existing development. However, the City is expected to experience significant growth through redevelopment and intensification of development density. This growth is consistent with the State Growth Management Act (GMA). One of the goals of the GMA is to promote intensification of development inside the municipal Urban Growth Boundary to eliminate costly and environmentally damaging urban sprawl. It is clear that the type of urban development supported by the GMA is also essential for creating high quality, sustainable urban areas that allow for a reduction in greenhouse gas (GHG) emissions. GHG emission reductions are required under state and federal laws. Planned annexations would add a substantial number of undeveloped sites to the City, thereby altering the City's fully developed status and making planned urban development even more important.

Lynnwood has taken several actions to encourage appropriate urban development while protecting single family neighborhoods:

- In 2005 the City adopted the City Center Plan to accommodate up to 9 million square feet of development. This area, which is currently dominated by single story suburban development, will transition over time to include high-rise buildings with structured parking. This area and Alderwood Mall and environs have been designated a Regional Urban Center by the Puget Sound Regional Council. The City also worked hard in a successful effort to have the planned light rail line extended into City Center.

- In 2006 the City adopted an Economic Redevelopment Plan for the Highway 99 Corridor and is currently in the process of developing a detailed land use plan for the corridor. One of the key features is the

Figure 3-2. City of Lynnwood proposed annexation areas.

8 ½ x 11 color

creation of high intensity, mixed use centers at major nodes along Highway 99.

- The City's MUGA contains two "Urban Centers" that have been designated by Snohomish County. The concept for these centers is similar to the type of intensified development envisioned for the Highway 99 corridor.

All of these areas will experience high density urban development, often with multi-story buildings and structured parking. Traditional approaches to stormwater control such as underground vaults and large ponds are generally not consistent with this type of construction. The land values are quite high, building footings are often far below grade, and there are fewer surface parking lots. Alternative approaches, such as LID stormwater management (e.g., bioretention swales, green roofs, pervious pavements) and off-site regional facilities will be required in order to achieve water quality and flow control targets and enable this development to occur as planned.

3.3 Applicable Policies and Regulations

The City of Lynnwood's surface water management program supports efforts to comply with several local, state, and federal regulatory requirements. These include:

- The Washington State Department of Ecology's (Ecology's) National Pollutant Discharge Elimination System (NPDES) Phase II Municipal Stormwater Permit (Ecology 2009), which was originally issued in February 2007 and subsequently modified on June 17, 2009. The NPDES Phase II Municipal Stormwater Permit requires cities that manage small municipal separate storm sewer systems to develop a stormwater management program focused on reducing discharge of pollutants to the maximum extent practicable and protecting water quality. The NPDES Phase II permit modifications in June 2009 include the extension of some permit compliance deadlines and requirements for the City to identify barriers to LID and develop a plan for implementing LID more broadly in the future.

- The Washington State Growth Management Act requirements for inventory and protection of environmentally critical areas (such as steep slopes, wetlands, and streams) (Chapter 36.70A of the Revised Code of Washington). The Growth Management Act also requires Cities to develop comprehensive plans in order to ensure environmentally responsible and economically sustainable development, including planning for stormwater related capital facilities.

- Ecology's Total Maximum Daily Load (TMDL) implementation plan for fecal coliform bacteria reduction in Swamp Creek (Ecology 2006), TMDL actions for phosphorus reduction in Lake Ballinger (Ecology 1993), and a potentially pending TMDL for phosphorus in Scriber Lake (Ecology 2004), all of which stem from Section 303(d) of the federal Clean Water Act. The TMDL Plan for Swamp Creek includes specific required and recommended actions for the City of Lynnwood to reduce fecal coliform bacteria loading to Swamp Creek.

- The federal Endangered Species Act, specifically in relation to listings of Puget Sound Chinook salmon (70FR37160), Coastal-Puget Sound bull trout (64FR58910), and Puget Sound steelhead (72FR26722) as threatened species and the Southern Resident killer whale as endangered species (70FR69903) in (the immediate vicinity of Lynnwood). The Endangered Species Act prohibits the *take* of all listed species, including a take that could result from the City's stormwater facility operations or private development stormwater management activities that are permitted by the City.

- The City's 2020 Comprehensive Plan (Lynnwood 2008a) lists goals and objectives that the surface water management program should seek to achieve within the current City limits and areas that are annexed in the future.

- The Puget Sound Partnership (Partnership), formerly the Puget Sound Action Team, is the regional organization that the governor has charged with restoring the health of the Puget Sound by 2020 (Puget Sound Partnership 2008). The City's surface water management program will need to focus on the major stormwater related issues that the Partnership highlights for action to assist in this critically important regional effort.

Several sections of the Lynnwood Municipal Code govern aspects of stormwater management on new development and redevelopment project sites (see Introduction section). Appendix C provides more detailed information on stormwater-related regulations and municipal code requirements.

3.4 Regional Drainage and Water Quality Issues

In addition to the legal requirements described above, the City's stormwater management program should address regional drainage concerns that are affected by stormwater runoff generated within city limits. Lynnwood's land area occupies portions of several drainage basins that extend outside of the city limits, including Perrinville Creek, Poplar Creek, Hall Creek (tributary to McAleer Creek via Lake Ballinger), and Swamp Creek.

Flooding and erosion are the primary concerns in Perrinville Creek within the Edmonds city limits (Figure 3-1). Approximately 48 percent of the Perrinville Creek drainage basin area is within Lynnwood. The City of Lynnwood plans to construct an infiltration basin in the northwest corner of Lynndale Park to provide additional flow control in the Perrinville Creek basin. This large infiltration basin would be constructed as part of the Olympic View Drive improvements project and would collect runoff from approximately 5 acres of impervious roadway surface and provide water quality treatment and flow control. The City of Edmonds is planning a capital improvement project to divert high flows from the creek in a new pipeline directly to Puget Sound in order to reduce the impacts of channel erosion in the basin. Funding for that improvement is uncertain at the time this document was produced.

A water quality improvement report and implementation plan (Ecology 2006) has been developed for Swamp Creek to address elevated concentrations of fecal coliform bacteria. This TMDL involves cooperation from several other jurisdictions including Snohomish County, Mountlake Terrace, Everett, Kenmore, Bothell, and Brier. The TMDL requirements for the City of Lynnwood are discussed in the Stormwater Program Evaluation section of this plan.

Increasing attention is also being given to water quality and flooding problems upstream and downstream of Lake Ballinger. In 2008, the jurisdictions around Lake Ballinger formed The Hall Lake, Hall Creek, Chase Lake, Echo Lake, Lake Ballinger, and McAleer Creek Watershed Forum (the Forum). The Forum includes representatives from the City of Edmonds, City of Lake Forest Park, City of Lynnwood, City of Mountlake Terrace, City of Shoreline, and Snohomish County. Using grant money from the State Legislature, the Forum hired a team of consultants to develop a strategic action plan for the watershed, which includes specific actions and projects to address specified water resource issues.

Several drainage and water quality issues located in the MUGA were identified in the 1998 Comprehensive Flood and Drainage Management Plan (R.W. Beck 1998) and later in the Swamp Creek Drainage Needs Report (Snohomish County 2002a). Since 2002, work has been performed to address flooding in the Golde Creek basin at 28th Avenue W near the entrance of Alderwood Middle School, at 201st Street SW, and several private culvert crossings.

4.0 Problem Identification and Solution Development

Drainage and water quality problems have been identified in the City of Lynnwood on both a citywide and site-specific scale. This plan builds upon the problem lists that were developed in previous comprehensive plans based upon interviews with City staff, field reconnaissance, and computer modeling. The following sections summarize existing citywide and site specific problems and potential solutions to these problems. Appendix D provides detailed information on problems and solutions as well as the process used to evaluate problems and develop solutions. Capital improvement project solutions to site-specific problems are provided in Appendix E.

4.1 Citywide Problems and Solutions

Citywide problems are those that occur on a citywide scale and result from local or regional trends in development and behavior. For example, conversion of forest land to residential development is a regional development trend that has caused increases in stormwater quantity, flooding of the public right-of-way and private property, and stream erosion and sedimentation problems. This list of citywide problems was developed by reviewing previous surface water plans, conducting interviews with City staff, and reviewing the references discussed in Section 2 of this plan report. Solutions were developed based on field reconnaissance, the Stormwater Management Manual for Western Washington (Ecology 2005), and assessment of realistic funding resources.

The primary citywide drainage problems are flooding and stream channel erosion. The primary citywide water quality problems are non-point source pollution, and potentially pollution sources associated with illicit discharges and illicit connections to the storm drainage system. The nature of these drainage and water quality problems is described below and the causes and solutions are summarized in Table 4-1. More detailed explanation of these solutions is provided in Appendix D.

4.1.1 Citywide Drainage Problems

Increased impervious surfaces are the product of urbanization (i.e. residential and commercial development) that has occurred in the City over the past century. Conventional development disrupts the natural hydrology of the landscape by converting natural surfaces (e.g. forests) into impermeable surfaces (e.g., streets and roofs). Impervious surfaces can deliver precipitation directly to the stormwater system and the stream channel rather than allowing precipitation to be collected by vegetation and infiltrate into the soil. Therefore, increased impervious surfaces cause higher peak flow rates in the stormwater system and the stream channels to which the stormwater system discharges resulting in flooding, erosion, and sedimentation downstream.

Table 4-1. Causes of citywide drainage and water quality problems, and possible solutions.

Problem	Cause(s)	Solution(s)
Flooding and stream channel erosion	Increased impervious surfaces	Develop and implement more stringent stormwater flow control requirements for new development and redevelopment projects on private property and for the City's own projects.
Flooding and stream channel erosion	Increased impervious surfaces	Retrofit or expand existing stormwater flow control facilities.
Flooding and stream channel erosion	Increased impervious surfaces	Implement a low impact development program to encourage the use of natural drainage systems to slow the delivery of stormwater to the municipal system.
Flooding	Undersized private stormwater pipes between sections of the municipal stormwater system	Evaluate the potential for pipe replacement or partnering with private pipe owners.
Flooding	Undersized municipal stormwater pipes and culverts	Conduct additional system evaluation to identify undersized pipes. Replace pipes as part of ongoing system maintenance or as Capital Improvement Program (CIP) projects.
Flooding	Improperly maintained private stormwater facilities	Adopt and enforce the operations and maintenance standards of the Stormwater Management Manual for Western Washington, or an approved equivalent manual.
Flooding	Improperly maintained private stormwater facilities	Develop an outreach and inspection program to evaluate and enforce the maintenance of private stormwater facilities.
Non-point source pollution	Improper pesticide and fertilizer use	Provide citywide public education on pesticide and fertilizer use. Restrict use of phosphorus-containing fertilizers in the Scriber Lake and Hall Lake drainage basins.
Non-point source pollution	Runoff from industrial/ commercial areas and roadways	Encouraging the use of low impact development (LID) and other stormwater treatment BMPs. Consider writing an ordinance to promote LID in new construction and retrofit situations. Continue catch basin cleaning program. Routine maintenance of the public and private stormwater ponds located throughout the City.
Non-point source pollution	Stream bank erosion	Vegetate buffers along stream edges, stream restoration projects, and habitat enhancement projects on both public and private property.
Non-point source pollution	Sediment transport from construction sites	Adopt Volume II of the Stormwater Management Manual for Western Washington (Ecology 2005), or an approved equivalent manual.
Non-point source pollution	Pet waste and faulty septic systems	See fecal coliform bacteria solutions below.
Illicit discharges and illicit connections	Illegal dumping, leaks and spills, unregulated discharges, and disposal of pollutants directly into storm drains.	Perform business inspections and educate business owners and operators on proper source control BMPs. Develop and adopt ordinances to implement a business inspection program and address certain illicit discharges. Adopt Volume IV of the Stormwater Management Manual for Western Washington (Ecology 2005), or an approved equivalent manual.
Illicit discharges and illicit connections	Sanitary sewer connections incorrectly plumbed to the separate storm drainage system.	Develop an Illicit Discharge Detection and Elimination (IDDE) program to locate and fix illicit connections.
Fecal coliform bacteria pollution	Pet waste	Public education and additional pet waste stations in the City would help to promote proper disposal of pet waste.
Fecal coliform bacteria pollution	Illicit connections	Develop IDDE program to locate and fix illicit connections.
Fecal coliform bacteria pollution	Faulty septic systems	Provide public education regarding proper septic system maintenance.

Residential development in the Puget Lowland has been shown to increase peak flow rates by as much as 10 times from pervious developed surfaces when compared to forested conditions (Burges et. al. 1998) and peaks can be expected to increase even more for commercial or industrial development areas where a greater proportion of the landscape is converted to impervious surfaces or compacted.

The science of stormwater management has evolved significantly in the Puget Sound region. Local designs frequently employ computer modeling software to simulate existing and proposed site conditions, and stormwater management solutions are commonly integrated into the development site planning process. Effective stormwater management can control the runoff of precipitation to make a developed landscape behave more like a forest by retaining runoff with flow control facilities (e.g., LID natural drainage systems, storage pipes, detention vaults, detention ponds, and infiltration facilities). Unfortunately, concentrated urban development occurred in much of the City before strict stormwater management standards were put in place, so a large percentage of the City landscape sheds rainfall runoff quickly to pipes, ditches, and streams. Urbanization was identified as one of the primary causes of flooding along Scriber Creek nearly two decades ago (Lynnwood, Snohomish County, and Brier 1989).

The effects of urbanization patterns on the physical processes of Puget Sound lowland creeks have been well documented (Booth and Henshaw 2001, Castro 2002, Konrad 2000, Moscrip and Montgomery 1997) and the physical character of Lynnwood's urban creek network that is present today is largely the result of such development-induced impacts to the drainage network and land cover. However, studies have also shown that urban creek channels can restabilize (i.e., cease eroding at accelerated rates above what would occur naturally) after extensive development has occurred (Booth and Henshaw 2000, Finkenbine et al., 2000), though native aquatic biota are not likely to adapt to these new flow conditions (Hartley et al., 2001). The City may consider performing further drainage basin level analysis of land use development and geomorphic processes to evaluate creek restabilization. The Department of Ecology's current regulations allow less stringent flow control targets for creeks that have restabilized to their present-day hydrologic regime. Further discussion on this topic is provided in Section 5 of this report.

City maintenance staff have observed several improperly maintained private stormwater facilities that do not adequately control stormwater flows, indicating that lack of private facility maintenance is exacerbating the effects of urbanization (i.e. flooding due to increased runoff). There are over 400 private stormwater facilities in the City, including pipes and flow control facilities. In some places the municipal stormwater system flows into privately owned stormwater pipes that are unable to convey the flows. These pipes may have been appropriately sized when they were designed and installed, but now they are inadequate to convey the flows they receive. A large percentage of the drainage systems on private land in the City also include flow control facilities. The Lynnwood Municipal Code requires facility owners to operate and maintain each facility in a manner that is subject to the approval of the public works department and may include retaining the original conveyance capacity and, if applicable, flow control performance. Historically, the City established stormwater facility maintenance requirements for new developments as part of the platting process, but did not include performance standards for maintenance in the plat document. As part of the current platting process, the City establishes maintenance covenants with all new stormwater facility owners. These covenants include the stormwater facility maintenance standards from the Stormwater Management Manual for Western Washington (Ecology 2005).

Despite the current code requirements and the maintenance covenant, City staff have observed that the lack of maintenance is causing poor facility performance and increased flows in the municipal stormwater system. The City should consider performing a study to evaluate potential approaches for ensuring private stormwater facility owners perform appropriate maintenance. The study should also evaluate regional approaches for private facility inspection and maintenance enforcement, identify necessary code revisions and staffing, and develop documentation to support City council decision making. Further discussion of the need for this study is provided in Appendix D and a project description is provided in section 5.

4.1.2 Citywide Water Quality Problems

Non-point source pollution is a common water quality issue in developed, urban settings and one of the main water quality issues in the State and the country (Ecology 2008, EPA 2008). Some of the non-point sources of pollution in the City include pesticides and fertilizers from residential and commercial property landscaping; oil, grease, metals, and toxic organic pollutants from industrial/commercial areas and roadways; sediment transport from eroding stream banks; sediment transport from construction sites; and bacteria from pet waste and faulty septic systems.

Illicit discharges and illicit connections to the stormwater system have been identified as a primary concern in the NPDES Phase II permit. It is uncertain how many such connections may exist. Within the City, some examples of illicit discharges could include illegal dumping, leaks and spills at wrecking yards and other commercial storage and maintenance facilities, unregulated discharges of carpet cleaning washwater, and disposal of coffee grounds into storm drains. Illicit connections include internal building drains, sump overflows, process wastewater discharges, or sanitary sewer pipes (i.e., toilets, sinks, appliances, showers, bathtubs) that are incorrectly plumbed to the separate storm drainage system.

Swamp Creek is on Ecology's 303(d) list for water quality impairments due to fecal coliform bacteria. A TMDL implementation plan has been developed for the entire Swamp Creek basin which includes Scriber Creek, Golde Creek, and Tunnel Creek (Ecology 2006). Sources of fecal coliform bacteria in the basin include pet waste that is not properly disposed of, illicit connections, and faulty septic systems.

4.2 Site-Specific Problems and Solutions

Several site-specific problems were evaluated in order to develop planning level solutions and cost estimates. The solutions were prioritized and ranked based on several criteria (see Appendix E). The site-specific problems were identified by conducting interviews with City staff, performing field reconnaissance, and reviewing the references discussed in Section 2 of this plan. Solutions to the drainage problems were developed based on field reconnaissance, hydrologic modeling, hydraulic modeling, geomorphic analysis, and evaluation of several alternative solutions. Solutions to the water quality problems were developed based on field reconnaissance, discussion with City staff, and research on potential LID and water quality treatment alternatives. Solutions to drainage and water quality problems are summarized in Tables 4-2 and 4-3 respectively. Some drainage problems occurring on private property are not the City's responsibility. However, the City should consider these problems when prioritizing CIP projects and may seek to partner with private property owners to implement mutually beneficial solutions. Solutions to flooding and erosion problems that would require a CIP project on private property are presented in Table 4-4. Appendix D provides detailed descriptions of all the problems and solutions. CIP project summary sheets and itemized planning level cost estimates for the proposed solutions are provided in Appendix E, along with a prioritized list of projects that was developed through cost-benefit analysis. Appendix F presents the methods and results of hydrologic and hydraulic modeling of the reach of Scriber Creek between 188th Street SW and 44th Avenue W in which extensive flooding occurs, to support development of conceptual solutions for several flood control CIP projects in that area. A map of the problem and solution locations is provided in Figure 4-1.

4.3 Low Impact Development Solutions

Low impact development (LID) encompasses a broad range of land use planning, site design, and policy tools collectively aimed at reducing or eliminating the adverse effects of development and related land use conversion on the environment. Stormwater management is one of the key components of LID. Stormwater management in the context of LID seeks to mimic natural hydrologic processes to negate increases in runoff volumes and peak flow rates, reduce pollutant loadings in runoff to surface waters, and recharge groundwater. To meet the City's obligations under the NPDES Phase II permit and to promote cost-effective and attractive land use practices in Lynnwood, LID stormwater solutions should be incorporated into new development and redevelopment projects wherever practical. This may be accomplished through the creation of LID stormwater incentives or guidelines for City Center and the Highway 99 corridor revitalization, as well as for other sites throughout the city. In addition, an LID stormwater pilot project in a highly visible location could be an effective way to demonstrate the feasibility and attractiveness of LID stormwater facilities while also increasing local knowledge of factors that affect BMP feasibility and helping to remove barriers to LID implementation. For example, project WQ-4 listed above and described in detail in Appendix E could constitute an LID pilot project. Developing LID examples and guidelines as a component of the surface water management program will provide the City with an additional set of tools to address citywide drainage and water quality problems that are difficult to solve with conventional stormwater management solutions.

In the Puget Sound area, evolving research and guidance for LID stormwater solutions often uses the term "natural drainage practices" to describe best management practices (BMPs) that focus on the processes of evaporation, transpiration, and infiltration as a means of treating stormwater onsite through native soils, vegetation, and bioengineering to mimic the pre-developed site condition (PSAT 2005). Examples of these natural drainage BMPs include permeable pavements, green roofs, bioretention areas (also referred to as rain gardens), compost or topsoil amendment in lawn areas, and cisterns for water reuse. Different LID stormwater BMPs can be selected for flow control and/or water quality treatment depending on site-specific conditions. These types of natural drainage BMPs can often be designed and constructed alongside roadways

Table 4-2. Identified site-specific drainage (i.e., flooding and erosion) problems and solutions Lynnwood.

Solution Identification Number [a]	Location	Problem	Primary Causes	Conceptual Solution	Estimated Cost for Design, Permitting and Construction
FL-1	Scriber Creek at 188th Street SW	Flooding	Undersized culvert	Culvert replacement	$630,000
FL-2	Scriber Creek at 189th Street SW	Flooding	Undersized culvert	Culvert replacement	$410,000
FL-3	Scriber Creek at 190th Street SW	Flooding	Undersized culvert	Culvert replacement	$520,000
FL-4	Scriber Creek at 191st Street SW	Flooding	Undersized culvert	Culvert replacement	$450,000
FL-5	Scriber Creek at 44th Avenue W	Flooding	Roadway settlement and creek sedimentation[b]	Raise existing roadway[b]	$4,500,000[b]
FL-6	Maple Road and Ash Way Intersection	Flooding	Roadway settlement, insufficient conveyance, sediment accumulation in drainage system	Detailed study	$150,000
ER-1	Scriber Creek channel stabilization downstream of 191st Street SW	Erosion	Flow too great for non-“hardened” channel	Stream channel stabilization	$290,000

Notes.
[a] Flooding problems designated as “FL”. Erosion problems designated as “ER”.
[b.] Problem and solution were not evaluated during development of this plan. Causes, solution, and cost presented here are based on the City’s 2008-2013 Capital Facilities Plan (Lynnwood, 2007b).

Table 4-3. Identified site-specific water quality problems and solutions in Lynnwood.

Problem Identification Number	Location	Water Quality Problem	Associated Known or Potential Source(s)	Conceptual Solution(s)	Estimated Cost for Design, Permitting and Construction
WQ-1	Scriber Lake	Eutrophication, high phosphorus concentrations [303(d) list], and low dissolved oxygen concentrations	Stormwater runoff from developed watershed , internal phosphorus loading	(1A) Aeration system retrofit for Scriber Lake or (1B) Floating island treatment system for Scriber Lake	(1A) $90,000 (1B) $140,000
WQ-2	Hall Lake	Silt, nutrients, and metals loading to the lake, and Hall Creek downstream	Stormwater runoff from developed watershed	Street edge runoff treatment retrofits in the Hall Lake Basin	$2,130,000
WQ-3	Golde Creek	Sediment, potential source of fecal coliform	Stormwater runoff from developed watershed	(3A) Drainage ditch retrofit to bioretention swale and/or (3B) Street edge or parking lot runoff treatment retrofits	(3A) $120,000 (3B) $90,000
WQ-4	Open roadside ditch systems throughout the City	Sediment and metals loading	Stormwater runoff from developed watershed	Drainage ditch retrofit to bioretention swale.	$120,000

Table 4-4. Identified site-specific problems and solutions on private property in Lynnwood.

Solution Identification Number [a]	Location	Problem	Primary Causes	Conceptual Solution	Estimated Cost for Design, Permitting and Construction
FL-7	Scriber Creek at Driveway off 194th Street SW (Casa Del Rey condominiums)	Flooding	Undersized and problematic culvert that has a 90 degree bend in the pipe. Sediment accumulation in the channel.	Culvert replacement. Construct embankment on the northwest corner of the east building.	$570,000
FL-8	Apartments and businesses 260 feet upstream of 200th Street SW and 50th Avenue W intersection	Flooding	Lack of slope, inadequate conveyance under 200th Street and 50th Avenue Intersection, backwater effects from undersized I-5 culvert and beaver related conveyance problems downstream	Install backflow preventers on stormwater outfalls from low lying areas Construct embankments between buildings and the creek	$410,000
ER-2	Scriber Creek between State Route 99 and 176th Street SW	Erosion	High flow velocities causing bank erosion	Streambank stabilization	$1,250,000

Notes.
[a] Flooding problems designated as “FL”. Erosion problems designated as “ER”. Water quality problems designated as “WQ”.

Figure 4-1. Capital Improvement Program Project Locations.

8.5 x 11

and in residential settings in the public right-of-way. Because natural drainage BMPs blend well with native plant landscaping, they can also be used amidst landscaped areas for a wide range of land uses. Although the stormwater components of LID projects can sometimes have higher capital costs, the operation and maintenance can be much easier and more cost effective over the long term than the maintenance of conventional stormwater management facilities such as ponds and vaults. Incorporation of LID into residential areas can also increase property values and add amenity value that traditional stormwater management cannot achieve (LMI 2005). Examples of LID BMPs in roadway settings are presented below in Figures 4-2 and 4-3.

Figure 4-2. Permeable pavement for infiltration of street runoff in a residential neighborhood.

Figure 4-3. Biorention swales used for flow control and water quality treatment of roadway runoff.

5.0 Stormwater Management Program Evaluation

The City's stormwater management within the overall surface water management program is responsible for meeting federal, state, and local regulations through development, implementation, and refinement of several program elements. The stormwater management program will need to expand to achieve compliance with two recent regulations: (1) the Washington State Department of Ecology NPDES Phase II Permit and (2) TMDL requirements that apply to Swamp Creek and that may apply to Scriber Lake in the future. A gap analysis was conducted to identify stormwater management program needs and to determine how to achieve compliance with these requirements over the next five years. See Appendix G for the gap analysis report. The following section summarizes the program developments that will be required to meet the NPDES Phase II Permit and TMDL requirements, as well as a suggested plan for water quality monitoring.

5.1 NPDES Compliance Strategies and Recommendations

The City's stormwater management program must change and grow to meet the requirements of the NPDES Phase II Permit. The NPDES Phase II Permit includes requirements related to five major stormwater program components:

- Public education and outreach
- Public involvement and participation
- Illicit discharge detection and elimination (IDDE)
- Controlling runoff from new development, redevelopment, and construction sites
- Pollution prevention and operation and maintenance for municipal operations

Key stormwater program needs are summarized below for each of these five components. The gap analysis report in Appendix G lists specific program needs and implementation considerations for each component.

5.1.1 Public Education and Outreach

The City has a good foundation upon which to implement public education and outreach in compliance with NPDES Phase II permit requirements. The City currently performs several public education and outreach activities, such as distributing educational material to school classrooms, providing stormwater-related public information through news articles in *Inside*

Lynnwood (a quarterly news and information publication of the City of Lynnwood), administering a grant program for stormwater education in the classroom, and providing storm drain signage materials for citizens to affix. The Public Works Department has developed a portable public education booth to provide stormwater education at community events. This booth was successfully used at community events during 2008 and 2009 to promote proper pet waste management, to distribute general information about stormwater issues in the Lynnwood community, and to give take-home educational materials to people interested in spreading awareness. Education on pet waste management is also consistent with the goals of the Swamp Creek TMDL, discussed in the next section.

Beyond the work that the City has already done to support stormwater education for school children and the general public, the City should tailor education and outreach approaches to specific audiences, such as mobile businesses that generate wastes, landscapers, property managers, developers, and contractors. This will require communication with these audiences using materials created specifically about issues relevant to each audience. For example, to effectively and consistently prevent mobile carpet cleaning businesses from dumping polluted water into storm drains, the City will need to work with representatives of these particular businesses to be sure they understand the practices they must implement to comply with the City’s regulations. The quarterly Lynnwood Business Advisory Group meetings should be considered as a forum for promoting stormwater-related public education materials to area businesses. The business license application and renewal process also presents an excellent opportunity to promote stormwater educational material to the business community.

5.1.2 Public Involvement and Participation

As discussed in the Introduction section of this plan, the development of this plan created an excellent opportunity for public involvement in stormwater management. A draft of this plan was made available for review by stakeholder groups and the general public. Meetings were conducted with stakeholder groups and the general public in June and July 2009 to discuss the City’s stormwater management program, the actions described in this plan, and to gather feedback on how to best implement the program in ways that do not cause an unbalanced compliance burden on the regulated community.

5.1.3 Illicit Discharge Detection and Elimination

The City’s stormwater management program currently includes reactionary detection of illicit discharges to the storm drain system. When City staff are alerted to a suspected pollution problem at a specific location, attempts are made to diagnose the source and control it. However, the NPDES Phase II permit requires a proactive approach to finding and fixing these kinds of significant sources of surface water pollution. Detecting and eliminating illicit discharges is important because most of the municipal stormwater system in Lynnwood drains to local lakes and streams. Illicit discharges can adversely affect the health of these streams and lakes, as well as Lake Washington and the Puget Sound further downstream. Over the next few years, the IDDE component of the City’s stormwater program will need to be expanded so City staff can effectively and efficiently detect and eliminate illicit discharges in compliance with the NPDES Phase II permit.

In accordance with timelines specified in the NPDES Phase II permit, in 2009 the City will need to adopt an IDDE ordinance, list and publicize an IDDE reporting hotline, and train City staff in detection and elimination of illicit discharges. The City will also need to begin refining the existing stormwater system map so it can be used to prioritize IDDE tracking efforts. By 2011 the City needs to have completed its stormwater drainage system mapping and established procedures for IDDE tracking and enforcement (i.e., a fully functioning IDDE plan). According to NPDES Phase II permit requirements, the City will have to identify and evaluate illicit discharges to three high priority water bodies by August 2011 and one water body will have to be evaluated each year thereafter. These evaluations will include visual field assessment to identify priority outfalls and search for previously unidentified outfalls. These visual evaluations will involve extensive field time following the course of priority creeks. After visual evaluation is complete, high priority outfalls for illicit discharges will need to be screened using analytical methods prescribed by Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments (Center for Watershed Protection 2004), or another methodology of comparable effectiveness.

As an additional measure to prevent pollutants from entering the municipal stormwater system, the City may consider adopting Volume IV of the Stormwater Management Manual for Western Washington (Ecology 2005), or an equivalent manual basis, for all activities within the community. Volume IV of the Ecology manual contains BMPs related to controlling potential sources of stormwater pollutants, such as structural and procedural controls for vehicle fueling, composting, painting, erosion control, and material storage. However, adoption of Volume IV or an equivalent basis is not a legal requirement at this time.

Among the various items that the City needs to strengthen in its stormwater management program, IDDE represents one of the biggest areas of concern, both in terms of the necessary priority and also in regards to allocating funding for it. Further discussion on the funding needs for IDDE implementation is contained in Section 6 of this report.

5.1.4 Controlling Runoff from New Development, Redevelopment, and Construction Sites

The City currently has a well developed permitting process that requires plan review and site inspections for development and redevelopment projects. However, the stormwater management requirements identified in the LMC are outdated, providing less effective flow control and treatment than the Department of Ecology now requires. The development permit review process relies, in part, on SEPA review (or other state or federal triggers) to enable imposition of more stringent requirements for larger projects. To meet the requirements of Section S5.C.4 of the NPDES Phase II Permit, the City will need to adopt a new or revised drainage code. Section S5.C.4 of the permit outlines several specific requirements that will need to be included in the new code and the major items are discussed briefly below. The City will need to review Section

S5.C.4 in detail to ensure that each specific permit item is adequately addressed in the new/revised code.

Of particular note from this permit section is the requirement pertaining to minimum stormwater technical requirements. Specifically, Section S5.C.4.a.i of the permit states that the City's ordinance shall include "the Minimum Requirements, technical thresholds, and definitions in Appendix 1 or an equivalent approved by Ecology under the NPDES Phase I Municipal Stormwater Permit, for new development, redevelopment, and construction sites. More stringent requirements may be used, and/or certain requirements may be tailored to local circumstances through the use of basin plans or other similar water quality and quantity planning efforts." Similarly, Section S5.C.4.a also states that "existing local requirements to apply stormwater controls at smaller sites, or at lower thresholds than required pursuant to S5.C.4. shall be retained."

These two permit elements essentially require the City to adopt requirements equivalent to Appendix 1 of the permit for sites disturbing greater than 1 acre, AND to retain the level of protection of the existing LMC requirements for sites below this 1-acre threshold. Based on consideration of several options for meeting these two permit requirements, the City plans to develop new drainage code language to formally adopt the Stormwater Management Manual for Western Washington, or an approved equivalent manual, as enforceable requirements for controlling runoff from new development, redevelopment, and construction.

The Stormwater Management Manual for Western Washington is a complex and technically stringent document with many additional elements not reflected in the current LMC. These additional elements will impact developers and City plan reviewers and need to be considered before adopting the entire Stormwater Management Manual for Western Washington, or an approved equivalent manual. The City will need to prepare for many changes in processes related to development and redevelopment projects and project reviews. These changes will likely affect developers, and to a lesser extent City plan review staff since the staff are already familiar with the Stormwater Management Manual for Western Washington

The City is also considering developing a City-specific addendum to the Stormwater Management Manual for Western Washington, or an addendum to an approved equivalent manual, that includes specifications on how to apply the manual in Lynnwood and requirements that are tailored to stormwater management needs that are unique to Lynnwood and not adequately addressed by the Stormwater Management Manual for Western Washington and other approved equivalent manuals in the region. The addendum could also encourage the use of LID stormwater management techniques in ways that are appropriate in Lynnwood, considering the diverse areas of the city, including the City Center, Highway 99 corridor, and the Sub-Regional Center. The following issues will be considered as the City revises its code to adopt the Stormwater Management Manual for Western Washington, or an approved equivalent manual, and during development of an addendum to the manual:

- The Stormwater Management Manual for Western Washington, as written, is not suitable as a complete set of regulatory requirements. It is written as a set of guidelines, so the City will need to clarify how to use the manual with definitive requirements.

- The Stormwater Management Manual for Western Washington is not entirely consistent with Appendix 1 of the City's NPDES permit. Clarifications will be needed to reflect the specific requirements of the permit.

- By adopting the Stormwater Management Manual for Western Washington, or an approved equivalent manual, which are generally tailored to larger developments, the City may miss potential opportunities to mitigate the stormwater impacts of new development and redevelopment on smaller sites (e.g., less than 10,000 square feet of new or replaced impervious area) in the city. Smaller site developments are common in the city and may account for a significant amount of new and replaced impervious surface, and associated stormwater impacts.

- In association with the above item, amendments to the Stormwater Management Manual for Western Washington, or an approved equivalent manual, may be warranted to address small sites or drainage basin specific requirements. For example, amendments could include modified thresholds of applicability for the minimum requirements to target smaller sites, or modified performance requirements (e.g., "pasture" or "existing" predeveloped target conditions for flow control facility sizing, rather than Ecology's "forested" target).

- Based on the PCHB rulings noted in Appendix C, the City will need to take additional steps to identify barriers to implementation of LID stormwater management techniques and should take actions to remove those barriers.

Through careful consideration of the issues noted above, the City can ensure that the stormwater management program has an effective and efficient set of requirements and tools for controlling runoff from all new development, redevelopment, and construction sites. The process for adopting the Stormwater Management Manual for Western Washington, or an approved equivalent manual, and developing the City specific addendum for new development, redevelopment, and construction sites, needs to happen among stormwater managers, City designers, plan reviewers, ,and the public, taking into consideration the specific permit requirements (and implications) as well as the specific needs of the City.

As the City develops the addendum to the Stormwater Management Manual for Western Washington, or an approved equivalent manual, there are several related analyses that would be beneficial. Specifically, the City should evaluate: 1) anticipated future development trends, 2) the needs for specialized tools to design or evaluate stormwater facilities (e.g., tools focused on smaller sites), 3) the need for basin specific stormwater management requirements, and 4) the need to evaluate creek stability. Each of these recommendations is outlined in more detail below.

Trends in future development – As noted previously, the Stormwater Management Manual for Western Washington is generally tailored to larger developments creating greater than 10,000 square feet of impervious area, or greater than 5,000 square feet of pollution-generating impervious area. Given the smaller development projects typical in the City of Lynnwood, the City should analyze projected future site development patterns and associated parcel sizes to determine whether the addendum needs to include requirements targeting smaller sites. If substantial development below 1-acre of disturbed area and below the impervious area thresholds noted above is likely to occur in Lynnwood, and if the City would like to address citywide drainage and water quality problems through regulation of development and redevelopment projects (rather than through utility ratepayer-funded capital improvement projects), stormwater management requirements targeting small sites would be beneficial. Effort will be required to ensure that the requirements of the addendum are not inconsistent with the Stormwater Management Manual for Western Washington at the 1-acre size threshold, nor less stringent than the City's current requirements (per the permit requirements). The City could achieve the benefit of consistency with requirements above and below the 1-acre threshold by keeping Ecology's thresholds (i.e., ignoring the 1 acre threshold in Figure 3-1 of Appendix 1 of the permit) but specifying additional performance requirements for smaller sites in the addendum. If the City uses separate requirements for smaller sites, the Stormwater Management Manual for Western Washington, or an approved equivalent manual, could still be referenced for some or all stormwater facility design guidelines. This would provide consistency in the facility designs from site to site, regardless of the thresholds and performance requirements.

Specialized tools for stormwater design – The City should decide what type of modeling to require for stormwater designs on small sites, i.e., event-based or continuous hydrologic modeling (per Ecology's requirements for larger sites). This decision will affect the simplicity of stormwater design and associated design submittals, as well as the consistency of design submittals. In addition to the decision on the modeling method, a simplified method for hydrologic analysis and facility sizing should be considered for small sites. A simplified method for small sites would make stormwater design more efficient for developers while also making plan review more efficient for City staff. The simplified method could be based in either event-based or continuous modeling, but would produce simplified sizing tables that do not require complex modeling or engineering review. Several jurisdictions in the region, including the City of Seattle, Kitsap County, and the City of Edmonds, are providing simplified stormwater BMP sizing tools (e.g., sizing equations and calculators) for use by developers of small sites and by City staff engaged in review of those development projects.. These sizing tools provide simple and clear guidelines for small projects, reducing the need for complex modeling and facility design (as well as complex design review). The tools were developed specifically for jurisdictions with substantial small project development patterns, and can be tailored to meet any set of design and performance requirements.

Basin specific stormwater management requirements – The City can develop basin-specific requirements for stormwater management. That is, the thresholds and performance requirements for flow control, water quality, and other stormwater elements can be tailored to basin-specific needs. This allows the priority issues to be addressed in each basin, rather than relying on a consistent set of requirements city-wide. The following list identifies potential basins and associated stormwater issues that could be partially mitigated through basin-specific stormwater requirements:

- **Scriber Creek basin** (particularly upstream of 196th Street SW): There are significant flooding problems downstream of 188th Street SW. The stream corridor is constricted between 188th Street SW and Scriber Lake and space is not available to improve flood conveyance capacity via expanding the creek's narrow floodplain. Unless private properties are purchased to enable floodplain expansion, the City's options appear to be limited to upsizing roadway culvert pipes along this reach. This would only partially alleviate flooding problems. The Scriber Creek drainage basin is mostly developed, but some additional development and redevelopment will occur in the future, offering opportunity to provide increased stormwater flow control relative to existing conditions. Most of the basin is currently zoned as low density residential land use, with the remainder zoned as commercial and high density residential land uses. To optimize stormwater flow control given these land uses, the City should consider basin-specific triggers based on additional study of this basin. For development and redevelopment projects located upstream of Scriber Lake that exceed the established triggers for applicability of stormwater treatment requirements, the City could also require use of phosphorus control BMPs per the Stormwater Management Manual for Western Washington's "phosphorus treatment menu" for reduction of phosphorus loading to Scriber Lake. This policy would support an Ecology planned (though not currently scheduled) phosphorus TMDL for Scriber Lake.

- **Swamp Creek basin (including Scriber Creek basin):** The fecal coliform bacteria TMDL for Swamp Creek affects a large portion of Lynnwood. According to the Swamp Creek Water Quality Improvement Report (Ecology 2006), the wet season loading from Lynnwood was estimated to be 3.2×10^6 billion colonies and runoff from Lynnwood is estimated to contribute 17 to 18.55 percent of the fecal coliform loading to the Swamp Creek Basin. Common sources of fecal coliform bacteria in runoff to streams and lakes include pet waste, wildlife waste, illicit connections of wastewater to the storm drainage system, and faulty septic systems. Although many conventional stormwater BMPs do not substantially reduce fecal coliform bacteria loading in stormwater runoff, the City's design standards for stormwater treatment facilities should prioritize use of BMPs that are better able to remove fecal coliform bacteria. These BMPs include wet ponds, wetlands, infiltration, bioretention, and filtration systems.

- **Northeast portion of the city including the Tunnel Creek basin (peat dewatering):** This portion of the city is underlain by a peat bog or other geologic formation that is vulnerable to settling under the weight of developed land. An example of this is the settling of the intersection of Ash Way and Maple Road described as the "Maple and Ash" problem area in Appendix D. Pending the outcome of the study described for this site in Appendix D, the City may invoke a stormwater flow control standard that supports prevention of further ground settling, such as onsite infiltration targets. Until that study is conducted, definitive requirements tailored to this drainage area are not warranted.

- **Lund's Gulch basin:** Approximately 90 percent of the Lund's Gulch basin is within the City of Lynnwood and areas proposed for annexation into the city. The headwater area of Lund's Gulch basin is heavily developed, resulting in increased flows that contribute to higher erosion rates in this already landslide-prone basin. The City, in participation with other jurisdictions, should evaluate this basin and consider stormwater management requirements that would limit erosion and degradation of the downstream reaches of Lund's Gulch Creek.

- **Perrinville Creek basin:** Approximately 50 percent of the Perrinville Creek basin is in the City of Lynnwood and areas proposed for annexation into the city. There are several erosion, sedimentation, and flooding problems in Perrinville Creek that are partially the result of development that has occurred in the basin. The City, in participation with other jurisdictions, should evaluate this basin and consider stormwater management requirements that could minimize erosion, sedimentation, and flooding problems in Perrinville Creek.

Creek Stability – The City may also consider performing further drainage basin level analysis of land use development and geomorphic processes to evaluate creek stability and its relation to flow control requirements for development. As noted in section 4, studies have shown that urban creek channels can restabilize (i.e., cease eroding at accelerated rates above what would occur naturally) after extensive development within the drainage basin. The Department of Ecology's current stormwater regulations allow less stringent flow control targets for certain creeks that have restabilized to their present-day hydrologic regime. Ecology has already analyzed change in land cover, impervious surface, and forest canopy throughout Western Washington in order to identify basins that may qualify for these less stringent requirements. To qualify, drainage basin land cover must have been at or above 40 percent total impervious area prior to 1985. The analysis performed by Ecology did not identify any basins in the City of Lynnwood. However, the City may still pursue modified flow control requirements for certain basins by performing independent analysis of change in land cover to document that the basin was 40 percent total impervious area prior to 1985. This analysis may also need to include a geomorphic study to verify that the creek channel has restabilized to the current altered hydrologic conditions. Alternatively, the City can perform basin-specific studies (as discussed above) to identify a target flow regime intended to achieve acceptable natural resource objectives. For example, a geomorphic assessment coupled with basin modeling could be used to identify specific flow control needs and opportunities in a given basin. If approved by Ecology, the City could use the basin plan to identify basin-specific flow control targets, specifically tailored to the geomorphic conditions and anticipated development patterns in the basin. This could result in a better balance between stormwater regulations, creek protection needs, and future development expectations.

5.1.5 Pollution Prevention and Operation and Maintenance for Municipal Operations

The City has developed a municipal stormwater pollution prevention plan (SWPPP) that meets the requirements of the NPDES Phase II permit for municipal heavy equipment maintenance and storage yards and material storage facilities. The SWPPP also satisfies the requirements of the NPDES Industrial Stormwater General Permit for the City's wastewater treatment plant. The SWPPP covers operations at the Utilities Maintenance Center and the Lynnwood Wastewater Treatment Plant. This SWPPP needs to be expanded to include the Parks Shop Facility at 20522 60th Avenue W, or else a separate SWPPP must be prepared for that facility to comply with this aspect of the NPDES Phase II permit.

The City operates and maintains an extensive system of storm drainage infrastructure that includes catch basins, man holes, storm drain pipes, regional stormwater ponds, small stormwater ponds, ditches and other infrastructure. Table 5-1 presents estimated quantities of specific types of stormwater facilities within the city limits as of December 2008. In addition to the SWPPP(s) noted above, the City needs to develop an operations and maintenance plan for all stormwater facilities. Maintenance frequencies for many types of stormwater facilities will need to increase in order to meet the level of service objectives in the 2020 Comprehensive Plan and to ensure regulatory compliance meet the requirements of the NPDES Phase II Permit. Table 5-2 lists the current stormwater facility inspection and maintenance frequencies and suggested frequencies that will be required to meet the requirements of the NPDES Phase II permit and to provide an adequate level of service. City staff have also identified several aspects of the maintenance program that will require additional resources in order to ensure understanding of and proper functioning of all of the City's stormwater facilities. Table 5-2 reflects these needs. City staff will need to start formally inspecting each City-owned stormwater facility as part of the routine O&M. Inspections and maintenance will need to be documented per NPDES Phase II permit requirements; therefore, the stormwater program will need to develop a tracking system using the information in the existing Cartêgraph database.

In order to reliably meet the NPDES Phase II Permit requirements for stormwater system operations and maintenance, the Surface Water Utility should develop a Stormwater Facilities Operations and Maintenance Plan that defines four important components of stormwater operations and maintenance: (1) inspection and maintenance frequencies, (2) maintenance standards, (3) procedures for inspection, maintenance, and tracking and (4) training requirements. Suggested inspection and maintenance frequencies for each type of stormwater facility are provided in Table 5-2 below and additional details on suggested maintenance can be found in the Operations and Maintenance Staffing and Equipment Memorandum (Herrera 2008) that was prepared during the course of the work on this document. Maintenance standards should be developed based upon Volume V, Section 4.6 of the Stormwater Management Manual for Western Washington (Ecology 2005), or an approved equivalent manual, with updates as appropriate as the manual evolves. The City may also consider the O&M inspection standards that are currently attached to plat documents as described in Appendix G. These standards should be updated as new performance data become available from the City's own inspection records and other regional sources.

Table 5-1. City owned stormwater facilities as of December 2008.

Item	Quantity [a]	Units
Catch Basins, Manholes, and Inlets	4,700	each
Ditches	42,200	LF
Meadowdale Facility	1	each
North Scriber Creek Detention Facility	1	each
Regional Detention Ponds	5	each
Small Detention Ponds	30	each
Underground Detention Tanks	5	each
Underground Detention Pipes	80	each
Streams	6,530	LF
Oil Water Separators	2	each
Scriber Lake Inflow/Outflow	1	each
Pipes (City)	484,800	LF
Stormwater Decant Facility	1	each
Streets (Routes [b])	8	each

Notes:

[a] Source: City of Lynnwood staff and Cartêgraph database.

[b] City streets are divided up into 8 units called routes. Sweeping proceeds on a route-by-route basis.

The Stormwater Facilities Operations and Maintenance Plan should also include maps of the City's entire storm drainage system, including significant stormwater management facilities such as detention ponds, and maintenance "hot spots" (i.e. formalize the current maintenance hot spots map using GIS or other spatial mapping tools). The Cartêgraph database, currently in use by the Public Works Department, already contains most of the needed mapping data and recent versions of this software support NPDES Phase II Permit related inspection and maintenance tracking. Institutional knowledge on facility performance and problem sites should be incorporated into this formal mapping system. Appendix G includes a suggested approach for implementation of the Stormwater Facilities Operations and Maintenance Plan, including staff training and development of a system to track all stormwater operations and maintenance activities.

As is the case for municipalities throughout the region, Lynnwood staff from several departments frequently perform maintenance activities that are in need of procedures to minimize pollutant discharge to the municipal storm drainage system (such as fertilizer application, vehicle washing, and herbicide applications). These activities occur in many locations across the City. Appendix G

Table 5-2. Current and suggested inspection and maintenance frequencies for stormwater facilities.

Activity	Current Inspection and Maintenance			Suggested Inspection and Maintenance		
	Frequency		Source	Frequency		Basis for New Frequency
Catch Basins, Manholes, and Inlets - Inspect[a]	0	times/year	City Staff	0.2	times/year	1/permit cycle (NPDES permit)
Catch Basins, Manholes, and Inlets - Clean	0.25	times/year	City Staff	0.33	times/year	anticipated maintenance needs (City)[b]
Roadside Ditches - Inspect [a]	0	times/year	City Staff	1	times/year	sufficient to determine conveyance capacity, and 1/year required for water quality (NPDES permit)
Roadside Ditches - Mow	3	times/year	City Staff	3	times/year	current maintenance practices
Roadside Ditches - Clean (Remove Sediment)	0.07	times/year	City Staff	0.10	times/year	anticipated maintenance needs (City)[b]
Meadowdale Facility - Inspect	1	times/year	City Staff	1	times/year	1/year for flow control (NPDES permit)
Meadowdale Facility - Clean	1	times/year	City Staff	1	times/year	current maintenance practices
North Scriber Creek Detention Facility - Inspect[a]	0	times/year		1	times/year	1/year for flow control (NPDES permit)
North Scriber Creek Detention Facility - Clean Sed. Trap and Adjust Weir	2	times/year	City Staff	2	times/year	current maintenance practices
Regional Detention Ponds - Inspect[a]	0	times/year	City Staff	1	times/year	1/year for flow control (NPDES permit)
Regional Detention Ponds - Clean / Mow / Veg. Control	3	times/year	City Staff	3	times/year	current maintenance practices
Small Detention Ponds - Inspect[a]	0	times/year	City Staff	1	times/year	1/year for flow control (NPDES permit)
Small Detention Ponds - Clean and Mow	3	times/year	City Staff	4	times/year	anticipated maintenance needs (City)[b]
Small Detention Ponds - Reestablish Design Depth	0	times/year	City Staff	0.15	times/year	City staff
Underground Detention Tanks - Inspect[a]	0	times/year	City Staff	1	times/year	1/year for flow control (NPDES permit)
Underground Detention Tanks - Clean	1.2	times/year	City Staff	1.2	times/year	current maintenance practices
Underground Detention Pipes - Inspect	0	times/year	City Staff	1	times/year	1/year for flow control (NPDES permit)
Underground Detention Pipes - Clean	0	times/year	City Staff	0.1	times/year	anticipated maintenance needs (City)[b]
Streams - Inspect, Remove Trash, and Maint. (HPA)	1	times/year	City Staff	2	times/year	anticipated maintenance needs (City)[b]
Scriber Lake Inflow/Outflow - Inspect	1	times/year	City Staff	1	times/year	1/year for flow control (NPDES permit)

Table 5-2 (continued). Current and suggested inspection and maintenance frequencies for stormwater facilities.

Activity	Current Inspection and Maintenance			Suggested Inspection and Maintenance		
	Frequency		Source	Frequency		Basis for New Frequency
Scriber Lake Inflow/Outflow - Clean	1	times/year	City Staff	1	times/year	current maintenance practices
Oil/Water Separators - Inspect[a]	0	times/year	City Staff	8	times/year	Stormwater Management Manual for Western Washington[c]
Oil/Water Separators - Clean	1	times/year	City Staff	2	times/year	Stormwater Management Manual for Western Washington[c]
Hot Spot Inspection and Maintenance Before, During, After, and Between Storms	1	times/year	City Staff	1	times/year	current maintenance practices
Repair/Replace Catch Basins, Manholes, and Inlets	0.006	times/year	City Staff	0.01	times/year	anticipated maintenance needs (City)[b]
Repair/Replace Underground Detention Pipes	0	times/year	City Staff	0.1	times/year	anticipated maintenance needs (City)[b]
Repair/Replace Pipes	0.004	times/year	City Staff	0.004	times/year	current maintenance practices
Pipes - Clean	0.001	times/year	City Staff	0.001	times/year	current maintenance practices
Decant Facility - Clean	3	times/year	City Staff	3	times/year	City Staff
Drainage Complaints	1	times/year	City Staff	1	times/year	City Staff
Training (O&M Related)	3	times/year	City Staff	6	times/year	current training and pollution prevention for O&M facilities
Street Sweeper	20	times/year	City Staff	20		current maintenance practices
NPDES Recordkeeping	0	times/year		221	times/year	daily

Notes:

[a] City staff currently perform informal visual inspections of these facilities during routine maintenance. Formal documented inspections will be required starting in February 15, 2010.

[b] According to City staff, these facilities are in need of more intensive maintenance than can be provided with current staffing. It is anticipated that formal inspections will identify a need for more frequent maintenance to meet levels of service that are commensurate with the requirements of the NPDES Phase II permit and the goals of the City's 2020 Comprehensive Plan.

[c] Ecology. 2005. Stormwater Management Manual for Western Washington, Publication Number 05 01-029 through 05-10-033. Washington State Department of Ecology, Olympia, Washington.

lists the activities that could affect stormwater quality and the responsible City department. A common citywide approach should be developed to foster consistent pollution prevention for these operations. It is recommended that the City adopt the Source Control BMPs from Volume IV of the Stormwater Management Manual for Western Washington (Ecology 2005), or an equivalent manual, for all City processes and facilities to ensure that City staff use appropriate BMPs to prevent pollution of stormwater. Recommendations for training of City staff are summarized later in this section. BMPs will also need to be developed for activities that are not included in Volume IV of Ecology's manual.

5.1.6 Recommended Studies

As discussed above, the City should consider studying several drainage basins in order to support development of basin-specific requirements for flow control and water quality treatment. The City should also consider further evaluation of private facility inspection, maintenance, and enforcement. In order to remove barriers to LID, the City should also consider projects that would improve local knowledge and awareness of LID stormwater management techniques. Suggested studies, projects, and conceptual cost estimates are listed in Table 5-3.

5.2 TMDL Compliance Strategies and Recommendations

This section discusses the various components of the Swamp Creek TMDL as outlined in Appendix 2 of the NPDES Phase II Permit. These sections include:

- Pollution source control activities
- Public involvement
- TMDL activity documentation and tracking
- Public outreach and education
- Water quality monitoring
- Illicit discharge detection and elimination (IDDE).

5.2.1 Pollution Source Control Activities

The NPDES Phase II permit specifies that the City's IDDE program shall address commercial animal handling areas and commercial composting areas. These types of facilities do not exist within the City limits, thus this requirement will not be addressed.

5.2.2 Public Involvement

To comply with the Swamp Creek TMDL cleanup plan (Ecology 2006), the City is required to prepare a Bacterial Pollution Control Plan (BPCP) to facilitate public involvement in activities relating to the TMDL. The BPCP should address the following:

Table 5-3. Suggested studies and projects to support development of the City's stormwater management program and stormwater management requirements.

Study	Description	Estimated Cost[a]
Scriber Creek drainage basin stormwater management standards and strategies	Perform additional study of Scriber Creek drainage basin to identify appropriate basin specific requirements for addressing existing flooding, erosion, and water quality problems in support of revising City code, developing an addendum to the Stormwater Management Manual for Western Washington, or an approved equivalent manual, and identifying potential CIP projects.	$30,000
Lund's Gulch drainage basin stormwater management standards and strategies [b]	Perform additional study of Lund's Gulch Creek drainage basin to identify appropriate basin specific requirements for addressing existing flooding, erosion, and water quality problems in support of revising City code, developing an addendum to the Stormwater Management Manual for Western Washington, or an approved equivalent manual, and identifying potential CIP projects.	$30,000
Perrinville Creek drainage basin stormwater management standards and strategies [b]	Perform additional study of Perrinville Creek drainage basin to identify appropriate basin specific requirements for addressing existing flooding, erosion, and water quality problems in support of revising City code, developing an addendum to the Stormwater Management Manual for Western Washington, or an approved equivalent manual, and identifying potential CIP projects.	$30,00
Private stormwater facility O&M study	Evaluate potential approaches for private facility inspection and enforcement of maintenance standards, including a review of approaches that are in use around the region. Develop documentation that identifies necessary code revisions and staffing requirements to support City Council decision making.	$25,000
Develop LID pilot program	Develop LID pilot program guidelines that establish goals and objectives to identify and prioritize potential LID demonstration projects. Evaluate feasibility at multiple sites and develop a prioritized site list. Develop conceptual designs and cost estimates for up to three sites to support planning level decision making.	$50,000
Develop citywide surface water management design guidelines and recommendations	Develop citywide surface water management design guidelines and recommendations. These guidelines should account for the diverse areas in the City and redevelopment projects, including Highway 99 and City Center areas.	$75,000
Develop City Center LID guidelines	Revise or augment existing City Center design guidelines to encourage use of LID stormwater management techniques.	$10,000
Small sites stormwater facility sizing tools[c]	Develop tools for sizing stormwater facilities on small sites. Tools would aid City plan reviewers and designers.	$25,000

Notes:

[a] Conceptual planning level cost. Cost will depend on actual scope of work.

[b] Study should be performed in coordination with neighboring jurisdictions.

[c] Should include tools for sizing LID BMPs.

- Ordinances (e.g., pet waste and critical areas protection)
- Inspection and enforcement resources and strategies
- IDDE program elements
- K-12 educational program
- Water quality monitoring
- Stormwater treatment, LID retrofits, and LID for new development

The City has already addressed several of these components, including:

- Establishing an ordinance requiring citizens to clean up after their pets (LMC 6.02.160)

- Establishing an Environmentally Sensitive Areas Ordinance (LMC 17.10).

- Implementing a fecal coliform bacteria monitoring program in areas that drain to Swamp Creek

- Evaluating redevelopment projects for the potential installation of improved stormwater treatment

Future actions that the City is required to implement associated with this section of the NPDES Phase II Permit include:

- Evaluating current water pollution ordinance enforcement capabilities

- Prioritizing identification of illicit discharges to the separate storm drainage system and surface water in the Scriber Creek/Swamp Creek watershed. Conducting streamwalks with City staff or a contracted third party (Ecology 2006).

- Evaluating and documenting the applicability of a K-12 educational program focused on increasing awareness of bacterial pollution problems

- Focusing on implementation of LID retrofits for water quality treatment in key areas in the Scriber Creek/Swamp Creek drainage basin

- Promoting use of LID techniques for new development and redevelopment projects

5.2.3 TMDL Activity Documentation and Tracking

The City shall discuss program changes and BPCP activities in their annual stormwater management program status report to Ecology, and allow for feedback and evaluation of TMDL-related permit requirements by Ecology and the public.

5.2.4 Public Outreach and Education

Refer to the NPDES Compliance Strategies and Recommendations section for information regarding public outreach and education.

5.2.5 Water Quality Monitoring

A Quality Assurance Project Plan was developed for fecal coliform bacteria monitoring and approved by Ecology (Lynnwood 2008b). Monitoring implementation began on May 29, 2008 and will continue on a monthly basis for 5 years. The monitoring locations include two stations on Scriber Creek (stations SC-1 and SC-2), one location on Tunnel Creek (TC-1), and one location on Golde Creek (GC-1). The City is also required to prepare for future long-term monitoring.

5.2.6 Illicit Discharge Detection and Elimination

Refer to the NPDES Compliance Strategies and Recommendations section for information regarding IDDE. As mentioned previously, the City is required to prioritize identification of illicit discharges to the separate storm drainage system and surface water in the Scriber Creek/Swamp Creek watershed.

5.3 Stormwater Monitoring Strategy and Recommendations

In addition to the TMDL monitoring described in the previous section, it is expected that the City will also be required to implement two different types of long-term monitoring (i.e., stormwater monitoring and stormwater management program effectiveness monitoring) during the next NPDES Phase II permit cycle, which is scheduled to commence in February 2012. Details regarding these two monitoring requirements and recommendations on implementation of the monitoring are discussed in separate subsections below.

5.3.1 Stormwater Monitoring

For cities with populations between 10,000 and 75,000, the current NPDES Phase II permit requires that two outfalls or conveyances be identified for long-term stormwater monitoring no later than December 31, 2010. One of the outfalls or conveyances shall represent commercial land use and the second outfall or conveyance shall represent high-density residential land use. Other considerations for stormwater monitoring discussed in Section S8.C.1.a of the NPDES Phase II permit include:

- Suitability of the site for permanent installation and operation of flow-weighted composite sampling equipment
- Justification of basin size based on comparison of times of runoff concentration with rainfall durations for typical seasonal storms

- No less than 80 percent of the area served by the outfall or conveyance needs to be classified as having the desired land use (i.e., commercial or high-density residential); however, the monitoring site cannot represent a single commercial complex.

Two of the four monitoring locations selected for Swamp Creek fecal coliform bacteria TMDL monitoring (Figure 5-1) have potential for long-term monitoring sites pending access requirements and land use analysis of the contributing basin. The TMDL monitoring location established in the Golde Creek basin (GC-1) on Alderwood Mall Parkway is located in a portion of the City that is zoned for commercial land use and that is highly developed. The drainage area tributary to one of the TMDL monitoring locations established on Scriber Creek (SC-2) contains high-density residential land use in a portion of the basin. Basin delineation would be required to determine if 80 percent of the contributing area upstream of monitoring station SC-2 can be classified as high-density residential land use or if the monitoring location would need to be shifted further upstream for NPDES permit stormwater monitoring purposes.

A range of monitoring parameters could be evaluated to characterize the runoff in the targeted basin areas; however, a parameter list has not yet been established by Ecology for Phase II permittees. The monitoring requirements in the NPDES Phase I permit include the following parameters:

- Precipitation event data (antecedent dry period, rainfall distribution, flow and hydrograph data including sampled and total runoff time periods and volumes)
- Conventional parameters (total suspended solids, turbidity, conductivity, chloride, biochemical oxygen demand, hardness, methylene blue activating substances)
- Bacteria (fecal coliform)
- Nutrients (total phosphorus, orthophosphate, total kjeldahl nitrogen, nitrate-nitrite)
- Metals (total and dissolved copper, zinc, cadmium, and lead; mercury in commercial land use areas)
- Organics (polycyclic aromatic hydrocarbons, phthalates)
- Pesticides (2,4-Dichlorophenoxyacetic acid [2,4-D, Meta-chlorophenylpiperazine [MCPP], Triclopyr, Diazinon, Malathion, Chloropyrifos, Dichlobenil, Prometon, Pentachlorophenol)
- These Phase I permit monitoring parameters may be indicative of Ecology's expectations for future Phase II permit monitoring.

Figure 5-1. Current Water Quality Monitoring Locations in the City of Lynnwood.

5.3.2 Stormwater Management Program Effectiveness Monitoring

- Stormwater management program effectiveness monitoring is the second monitoring component discussed in the NPDES Phase II permit (Section S8.C.1.b). The City is required to develop at least two suitable questions to address the effectiveness of its stormwater management program in controlling stormwater-related problems no later than December 31, 2010. The NPDES Phase II permit provided examples of two suitable questions:

- How effective is a targeted action or narrow suite of actions?

- Is the stormwater management program achieving a targeted environmental outcome?

- A monitoring plan for City's stormwater management program effectiveness monitoring must be developed to address each question the City chooses to answer (as acceptable under the Phase II permit), and must include the following elements:

- A statement of the question

- An explanation of how and why the issue is significant

- A discussion of whether and how the results of the monitoring may be significant to other MS4s

- A specific hypothesis about the issue or management actions that will be tested

- A description of the sites where monitoring will be conducted

- A description of the specific parameters (i.e., physical, chemical, and/or biological characteristics) or attributes to be measured

- A description of the data collection and analysis methods

- Expected modifications to management actions based on the results

- TMDL monitoring for fecal coliform bacteria is currently being conducted on tributaries to Swamp Creek and Scriber Creek (Figure 5-1), thus this monitoring could ideally be tied into the City's stormwater program effectiveness monitoring requirement. The City could evaluate the reduction in fecal coliform bacteria loading resulting from the installation of pet waste management stations and increased public education regarding the proper disposal of pet waste. Two suggested questions to address fecal coliform bacteria reductions include:

- ◻ How effective are the pet waste management stations and public education efforts regarding pet waste?

- ◻ Has there been a reduction in fecal coliform bacteria concentrations in the tributaries to Swamp Creek since the pet waste management stations were installed and public education efforts regarding pet waste were expanded?

- The fecal coliform bacteria issue is significant due to the TMDL for Swamp Creek and regional efforts that are underway to reduce fecal coliform bacteria concentrations in the basin.

- The City should also consider other questions to form the basis for future stormwater monitoring. Other issues of concern that could be the subject of monitoring include reduction of receiving water pollutants as a result of IDDE program implementation, reduction of phosphorus loading to Scriber Lake resulting from public education efforts, and reduction of storm flows and pollutants in a specific stream channel resulting from implementation of “pilot” LID stormwater projects on public or private property.

6.0 Recommended Stormwater Management Program and Implementation

6.1 Stormwater Management Program Coverage and Focus Areas

As described earlier in this plan, the City needs to expand its stormwater management program to comply with the requirements of its NPDES Phase II municipal stormwater permit. Specific recommendations are presented above in Section 5. In summary, the following are areas of emphasis for the City's stormwater management program in the next 3 years under the current NPDES Phase II permit, which is set to expire in February 2012.

- Public education and outreach:
    - Increase use of educational materials in more venues to reach more of the City's businesses and residents, and establish consistent means for measuring the effectiveness of stormwater education and outreach efforts
    - Modify education and outreach approaches that are found to be less effective, and continue and expand those approaches that are found to be successful
- Public involvement and participation:
    - Proactively engage the general public and business community in the City's stormwater management efforts through web site and in person contact
    - Increase the type and amount of stormwater information posted on the City's web site. At minimum, post this report, the annual reports submitted to Ecology on stormwater management program status, and educational materials.
    - Gather public input during development of each annual report to Ecology
    - Create a mechanism for regular and meaningful public feedback on the City's stormwater management program. This could take the form of a stormwater advisory group, comprised of a small number of influential people, open meetings that are announced in advance to a cross-section of stakeholders, or one-on-one meetings led by the City's stormwater program manager. These meetings would be

for learning about the public's perceptions of the pros and cons of the City's approach to different stormwater management issues.

- Illicit discharge detection and elimination (IDDE):
  - Develop and adopt an IDDE ordinance in the fall of 2009
  - Develop a written IDDE plan in 2009, and fully implement that plan by August 2011 in accordance with NPDES permit specific requirements, which include:
    - Complete mapping of storm drainage infrastructure throughout the city by February 2011
    - Create (or share with another jurisdiction) and publicize an IDDE hotline telephone number for the public to report spills of toxic materials and observations of suspected illicit discharges by February 2009
    - Train applicable City staff in IDDE awareness, field inspection procedures, and documentation in the fall of 2009, have an ongoing IDDE training program established by February 2010, and document all trainings
    - Prioritize water bodies / areas of the city for IDDE field work
    - Procedures to evaluate and assess IDDE program effectiveness and findings, including documentation of spills that occur and illicit connections that are found and the resultant actions taken, as well as public feedback on education related to IDDE issues
- Controlling runoff from new development, redevelopment, and construction sites:
  - By February 2010, or as soon thereafter as possible, adopt and codify use of the Department of Ecology's Stormwater Management Manual for Western Washington, or an approved equivalent manual, as the basis for development and redevelopment project stormwater management requirements.
  - Incorporate innovative infrastructure options, sustainable design, green technologies, and systems alternatives in the City Center, the Sub-Regional Center, and Highway 99 revitalization by developing specific guidelines or requirements.

- ☐ Develop specific provisions to encourage use of LID techniques for managing stormwater in new development, redevelopment, and retrofit projects. Consider developing an LID pilot program to demonstrate the use of LID.

- ☐ Develop an addendum to the Stormwater Management Manual for Western Washington, or an approved equivalent manual, that tailors requirements to Lynnwood as described in Section 5 of this report.

- ☐ Revise the City's development permit review procedures and processes to correspond with the Stormwater Management Manual for Western Washington, or an approved equivalent manual, and supplemental LID policy/guidance.

- ☐ Train all City staff responsible for implementing the updated code requirements to control stormwater runoff from new development, redevelopment, and construction sites, including permitting, plan review, construction site inspections, and enforcement, by February 2010, or as soon thereafter as reasonable based on the schedule for adoption of the new stormwater code.

- ☐ Develop an approach and plan for inspection and maintenance enforcement at private stormwater facilities based on further research of used around the region. Begin performing and recording inspections.

- ☐ Based on further research, develop an approach and appropriate revisions to City code in order to enforce stormwater maintenance requirements on private facilities, including appropriate policies and procedures for dealing with defunct homeowners associations.

- ▪ Pollution prevention and operations and maintenance for municipal operations:

  - ☐ Update the City's draft Municipal SWPPP to include parks facilities

  - ☐ Adopt pollution source control procedures for municipal operations

  - ☐ Update the stormwater facility data in the Cartêgraph database and update the software as needed to track NPDES related inspection and maintenance activities

- ◻ Develop an Operations and Maintenance Plan for stormwater facilities throughout the city that covers, at minimum, the following:
  - Training of City staff on pollution prevention procedures
  - Maintenance frequencies and procedures for all stormwater facilities to satisfy the NPDES Phase II permit
  - Training of City staff on the contents of the Operations and Maintenance Plan
  - A procedure for implementing the Cartêgraph database to track inspections and maintenance
  - A system to track stormwater-related training

In addition to the stormwater management program elements listed above, the City should also continue to design and construct capital improvement projects for drainage and water quality problems that have been identified. Appendix D provides details of specific capital improvement projects and the recommended priorities for implementation based on several prioritization criteria.

6.2 Stormwater Management Program Funding

Implementation of the stormwater management activities outlined above requires appropriate levels of funding. The City draws all of its funding for stormwater management program work from the Surface Water Utility Fund 411. The City also issues revenue bonds, which are paid by the Surface Water Utility, to implement storm and surface water capital improvement projects. The City conducted a utility rate study, published in 2007 (FCS GROUP 2007), covering the Surface Water Utility's funding and projected future needs. The rate study assumed that one full time equivalent (FTE) staff person would be added to the Public Works Department to support compliance with various NPDES Phase II permit needs, and that other operating expenses would increase. The rate study also factored in several capital improvement projects for storm and surface water management that the City planned to construct between 2007 and 2012 (FCS GROUP 2007). In February 2007, the City adopted a new stormwater rate schedule that increased stormwater utility rates approximately 70 percent in 2007 and approximately 15 percent each year through 2012.

This plan recommends new capital improvement projects and additional stormwater program activities that were not accounted for in the 2007 rate study. Another rate study is scheduled to be completed in 2009, and should account for new capital improvement project costs that are described in Appendix E of this plan and the additional staffing needs that are described in detail at the end of this section.

Depending on when the City decides to implement the capital improvement projects presented in Appendix E, the Surface Water Utility rates for residential, commercial, and industrial customers may need to be raised beyond the rate schedule that was adopted in February 2007. The February 2007 rates will certainly fund implementation of most NPDES Phase II permit compliance activities summarized above, but doing so may force slowing the rate at which the City can design and construct capital improvement projects.

Table 6-1 presents an estimate of the additional FTE staff needed for compliance with stormwater management program activities between 2009 and 2012. These projected long term needs of an additional 1.4 FTE stormwater management program staff are based on the assumption that the existing 1.625 FTEs dedicated to the stormwater management program (1 FTE administration and management, 0.5 FTE O&M management, and 0.125 utility management) continue to perform their current duties, and also take on the NPDES permit compliance activities summarized above. This forecast assumes that the City would perform the programmatic work necessary to comply with NPDES Phase II requirements (e.g., staff training, code revisions, document development, establishing an IDDE program, private stormwater facility inspections) internally, without hiring consultants to perform that work. If the City chooses to maintain existing staffing levels and use consultants to complete some of the stormwater program expansion work, the net cost to the Surface Water Utility would be similar. This forecast does not account for additional stormwater program staff needs that would result from annexation of portions of the municipal urban growth area.

Table 6-1. Summary of additional staffing needs for full implementation of stormwater management program to comply with NPDES Phase II permit requirements.

Year	Quarter	Stormwater Management Program Staff Hours [a,b]	Operations and Maintenance Staff Hours [a,c]
2009	2nd	1.6	0.6
2009	3rd	2.0	1.2
2009	4th	2.0	1.5
2010	1st	2.0	2.2
2010	2nd	1.4	2.1
2010	3rd	1.6	2.1
2010	4th	1.2	2.0
2011	1st	1.3	2.0
2011	2nd	1.2	2.1
2011	3rd	1.4	2.0
2011	4th	1.4	2.0

Assumptions:

[a] Activities will be performed at a rate that meets the requirements of the NPDES Phase II Permit.

[b] Cumulative additional program oversight level of effort relative to January 2009 staffing levels.

[c] Cumulative additional O&M level of effort relative to January 2009 staffing levels.

In addition to stormwater management program staffing needs, the City will need approximately 2 additional FTE staff members on the storm drainage utility maintenance crew to meet the requirements of the NPDES Phase II Permit for the current City stormwater facilities. This will satisfy unmet stormwater system maintenance needs identified by City staff and inspection and maintenance requirements of the NPDES Phase II permit (1.8 FTE based on Herrera 2008). This level of staffing will also provide additional staff to assist with meeting additional programmatic requirements of the NPDES Phase II Permit, including development of an O&M plan. Based on a detailed evaluation of the crew's existing workload in 2008, stormwater operations and maintenance staff spend approximately 30 percent of their time mowing ditches and ponds, and approximately 20 percent of their time cleaning catch basins. The remaining 50 percent of crew time is spent operating and maintaining other stormwater facilities. The City may consider obtaining additional (summer) staff or contract support to perform mowing and catch basin cleaning. This would make approximately 2 FTEs available to perform the additional inspection, cleaning, maintenance, and repair needed to meet the requirements of the NPDES Phase II permit. In addition, future inspection and maintenance activities will need to be tracked using a formal recordkeeping system. The City may also consider employing administrative staff to record inspection results and to track system maintenance as it is performed.

Appendix H provides detailed estimate of stormwater management program and operations and maintenance staffing needs in the years 2009 through 2012.

6.3 Implementation Steps

Implementation of recommended stormwater management program components will require a concerted effort amongst several City departments, led by the Public Works Department. The first steps, to be completed by late summer 2009, include the following:

- Communicate with all affected City staff about how the stormwater management program is changing
- Train City staff in updated stormwater management design standards, operations and maintenance requirements, pollution prevention, and the IDDE program
- Develop stormwater education materials for targeted businesses
- Refine public outreach efforts to increase education to the public and to initiate education for targeted businesses
- Revise the Lynnwood Municipal Code with respect to IDDE
- Adopt the Stormwater Management Manual for Western Washington, or an approved equivalent manual, through revisions to the Lynnwood

Municipal Code and consider special provisions for the City Center, Sub-Regional Center, and Highway 99 revitalization

- Develop and adopt a City-specific addendum to the Stormwater Management Manual for Western Washington, or an approved equivalent manual, including provisions for using LID stormwater management techniques throughout the City. Give special consideration to the City Center, Sub-Regional Center, and Highway 99 revitalization.

- Prepare a thorough, written IDDE plan that is coordinated amongst the staff who will be responsible for its implementation

- Expand the SWPPP for municipal operations that may pollute stormwater, beyond those occurring at the wastewater treatment plant and the Utilities Maintenance Center currently addressed in the SWPPP plan

After completing these steps, the City should focus on the following:

- Continuing communication between City departments

- Gaining feedback from the public on the effectiveness of education and outreach efforts

- Developing recordkeeping procedures that streamline the City's ability to solicit and record feedback on the effectiveness of its stormwater management program, and to compile information that Ecology requires in annual stormwater management program status reports

This plan represents a comprehensive approach to managing stormwater runoff and preventing pollution of that runoff for all areas of the city. This plan should be revisited on an annual basis to evaluate stormwater management program priorities and to determine if adequate funding is in place to achieve regulatory compliance, and address stormwater-related problems of concern to the community.

7.0 References

Booth, D.B. and P. Henshaw. 2000. Natural Restabilization of Stream Channels in Urban Watersheds. Journal of the American Water Resources Association, Vol. 36, No. 6.

Booth, D.B. and P. Henshaw. 2001. Rates of Channel Erosion in Small Urban Streams. Land Use and Watersheds: Human Influence on Hydrology and Geomorphology in Urban and Forest Areas. Mark Wigmosta and Stephen Burges, (eds.). American Geophysical Union, Washington, D.C. pp. 17-38.

Burges, S.J., Wigmosta, M.S., and Meena, J.M. 1998. "Hydrologic Effects of Land-Use Change in a Zero-Order Catchment". Journal of Hydrologic Engineering, Vol. 3, No. 2, 86-97, April 1998.

Castro, J.M. and P.L. Jackson. 2002. Bankfull Discharge Recurrence Intervals and Hydraulic Geometry Relationships: Patterns in the Pacific Northwest, USA. Journal of the American Water Resources Association 37(5):1249-1262.

CWP. 2000. Pollution Prevention Fact Sheet: Septic System Controls. Obtained from the Stormwater Manager's Resource Center (SMRC) Website: <www.stormwatercenter.net>. Prepared by the Center for Watershed Protection, Ellicott City, MD.

CWP. 2004. Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments. Center for Watershed Protection and Robert Pitt, October, 2004. Accessed via agency website on December 18, 2008. http://www.cwp.org/Resource_Library/Controlling_Runoff_and_Discharges/idde.htm

CWP. 2007. Urban Subwatershed Restoration Manual No. 3 – Urban Stormwater Retrofit Practices. Version 1.0. Prepared for the U.S. Environmental Protection Agency Office of Wastewater Management by the Center for Watershed Protection, Ellicott City, MD.

Davis, A.P., M. Shokouhian, H. Sharma, and C. Minami. 2001. Laboratory study of biological retention for urban stormwater management. Water Environment Research 73: 5-14.

Ecology. 2005. Stormwater Management Manual for Western Washington. Washington State Department of Ecology, Water Quality Program, Lacey, Washington.

Ecology. 2006. Swamp Creek Fecal Coliform Bacteria Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Publication Number 06-10-021. Prepared by the Washington State Department of Ecology. June 2006.

Ecology. 2009. Western Washington Phase II Municipal Stormwater Permit. Prepared by the Washington State Department of Ecology. Modified June 17, 2009.

Elkin, D. 2008. Portland's Green Streets. Lessons Learned Retrofitting our Urban Watersheds. Low Impact Development Conference Proceedings. Portland BES Sustainable Stormwater Program, Landscape Architect. November 2008.

FCS GROUP. 2007. City of Lynnwood Utility Rate Study. Prepared for the City of Lynnwood by FCS Group, Inc., Redmond, WA. May 2007.

Finkenbine, J.K., J.W. Atwater, and D.S. Mavinic. 2000. Stream Health After Urbanization. Journal of the American Water Resources Association. Vol. 36, No. 5.

Gray and Osborne. 2002a. Lower Scriber Creek Study. Prepared for the City of Lynnwood, Washington by Gray and Osborne, Inc., Seattle, Washington. March 2002.

Gray and Osborne. 2002b. Scriber Lake Study. Prepared for the City of Lynnwood, Washington by Gray and Osborne, Inc., Seattle, Washington. March 2002.

Gray and Osborne. 2002c. Hall Lake Water Quality and Quantity Evaluation. Prepared for the City of Lynnwood, Washington by Gray and Osborne, Inc., Seattle, Washington. March 2002.

Hartley, D.M., C.R. Jackson, and G. Lucchetti. 2001. Discussion of "Stream Health After Urbanization." Journal of the American Water Resources Association. Vol. 37, No. 3.

Herrera. 2008. Draft Technical Memorandum: Operations and Maintenance Staffing and Equipment. Prepared for the City of Lynnwood Public Works Department by Herrera Environmental Consultants, Inc., Seattle, WA. July 15, 2008.

Horner, R., H. Lim, and S.J. Burgess. 2002. Hydrologic Monitoring of the Seattle Ultra-Urban Stormwater Management Projects. Water Resources Series Technical Report No. 170. University of Washington, Seattle, Washington. November 2002. Accessed via agency website on April 5, 2009. http://www.ce.washington.edu/pub/WRS/wrs-rpts.index.html

Jones and Stokes. 2000. Stream Habitat Analysis. Report 2 – Salmonid Habitat Assessment. Prepared for the City of Lynnwood, Washington by Jones and Stokes, Bellevue, Washington. October 2000.

Konrad, C.P. 2000. The Frequency and Extent of Hydrologic Disturbances in Streams in the Puget Lowland, Washington. Water Resources Series Technical Report No. 164. University of Washington, Seattle, Washington. December 2000. Accessed via agency website on April 5, 2009. http://www.ce.washington.edu/pub/WRS/wrs-rpts.index.html

LMI. 2005. Low-Impact Development Strategies and Tools for Local Governments. Building a Business Case. Prepared by LMI Government Consulting. September 2005.

Lynnwood, City of. 2000. Stormdrain Facilities Database (private stormwater facilities). Excel data were provided by the City of Lynnwood in January 2008.

Lynnwood, City of. 2007a. City Center Sub-Area Plan. September 2007. Accessed via agency website on October 20, 2008. http://www.ci.lynnwood.wa.us/Docs/CCP-SubAreaPlanSeptember2007.pdf

Lynnwood, City of. 2007b. 2008-2013 Capital Facilities Plan. As adopted by City Council on November 13, 2007. Accessed via agency website on October 20, 2008. http://www.ci.lynnwood.wa.us/Content/CityHall.aspx?id=770

Lynnwood, City of. 2008a. 2020 Comprehensive Plan. Updated September 24, 2007. Accessed via agency website on November 24, 2008. http://www.ci.lynnwood.wa.us/Content/HomePage.aspx?id=88

Lynnwood, City of. 2008b. Swamp Creek Fecal Coliform Bacteria Total Maximum Daily Loads Water Quality Study Design (Quality Assurance Project Plan) for the City of Lynnwood. March 10, 2008.

Lynnwood, City of. 2008c. Drainage infrastructure and zoning GIS data. GIS files were provided by the City of Lynnwood in January 2008.

Lynnwood, City of. 2009. Draft Municipal Stormwater Pollution Prevention Plan. (In preparation).

Moscrip, A.L. and D.R. Montgomery. 1997. Urbanization, Flood Frequency, and Salmon Abundance in Puget Lowland Streams. Journal of the American Water Resources Association 33(6):1289-1297.

MRLC (Multi-resolution Land Characteristics Consortium). 2001. National Land Cover Database Impervious raster layer. Data compiled in 2001. Accessed via agency website on January, 2009. <http://www.mrlc.gov/nlcd_multizone_map.php>.

PSAT. 2005. Low Impact Development Technical Guidance Manual for Puget Sound. Puget Sound Action Team and the Washington State University Pierce County Extension. Olympia, Washington. May, 2005.

Puget Sound Partnership. 2008. Puget Sound Action Agenda: Protecting and Restoring the Puget Sound Ecosystem by 2020. Olympia, Washington. December, 2008.

Puget Sound Regional Council. 2008. Vision 2040: People – Prosperity – Planet. February, 2008. Accessed via agency website on March 23, 2009. http://psrc.org/projects/vision/pubs/vision2040/index.htm

R.W. Beck. 1998. City of Lynnwood Comprehensive Flood and Drainage Management Plan. Prepared for the City of Lynnwood Public Works Department by R.W. Beck, Inc., Seattle, WA.

Snohomish County. 2002a. Swamp Creek Drainage Needs Report, DNR No. 2. Snohomish County Department of Public Works Surface Water Management Division, December 2002. Accessed via agency website on December 18, 2008. http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/SWM/Library/Publications/Urban_Drainage/DNR/Swamp_DNR.htm

Snohomish County. 2002b. Puget Sound Tributaries Drainage Needs Report, DNR No. 11. Snohomish County Department of Public Works Surface Water Management Division, December 2002. Accessed via agency website on December 18, 2008. http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/SWM/Library/Publications/Urban_Drainage/DNR/Puget_Sound_DNR.htm

Snohomish County. 2003. Water Bodies vector shapefile. Data compiled in 2002. Obtained May, 2003 from Snohomish County.

Snohomish County. 2007. Implementation of DNR/MDP Flooding Projects Status Report. Snohomish County Department of Public Works Surface Water Management Division. May 2007. Accessed via agency website on December 18, 2008. http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/SWM/Work_Areas/Urban_Drainage/2005StatusReportforDNRMDPFloodingprojects.htm

Swamp Creek Watershed Management Committee and Snohomish County. 1994. Swamp Creek Watershed Management Plan. Swamp Creek Watershed Management Committee and Snohomish County Public Works, Surface Water Management Division.

URS. 1992. Scriber Lake Restoration Project. Prepared for the City of Lynnwood, Washington by URS Consultants, Seattle, Washington. March 1992.

APPENDIX A

City of Lynnwood Drainage System Summary

City of Lynnwood Drainage System Summary

Several drainage basins are located within the City of Lynnwood and its proposed Phase 1 and Phase 2 annexation areas, or Municipal Urban Growth Areas (MUGAs). Each basin is described below, including basin size, urban development, and receiving water body. Drainage basin sizes and areas located within the City of Lynnwood and MUGAs were determined using geographic information system (GIS) data.

A general description of the City's soils and geology, groundwater, topography and slope, and climate is also provided. A map of the drainage basins in the City and Phase 1 and 2 annexation areas is presented in Figure A-1 and a soils map in Figure A-2.

Drainage Basin Descriptions

Scriber Creek

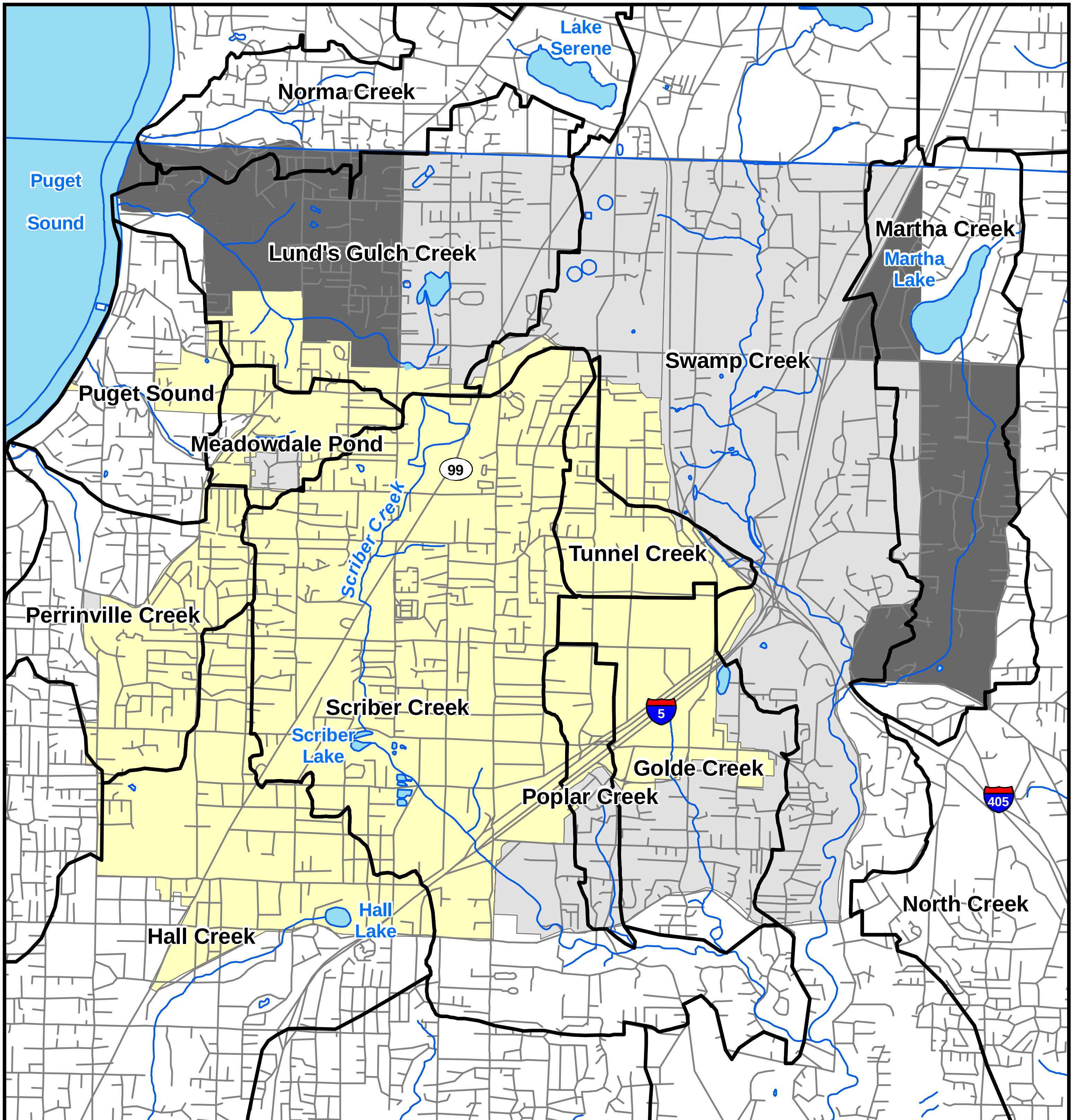
The Scriber Creek basin is a subbasin of the Swamp Creek drainage basin and the largest drainage basin in the City, comprising an area of approximately 3,000 acres. Approximately 74 percent of the Scriber Creek basin is within the City limits, and 4 percent of the basin is located within the proposed Phase 1 annexation area.

The Scriber Creek basin is the most highly developed of the Swamp Creek subbasins, with an approximately 39 percent effective impervious area (EIA) (Snohomish County 2002a). Commercial and transportation land uses account for approximately 40 percent of the Scriber Creek basin area (Snohomish County 2002a). The upper reaches of Scriber Creek are located near 164th Street SW in the northern portion of the City. The stream in this headwater area has a low gradient. In the upper basin areas, large sections of the stream are piped, and open channel reaches are lined with riprap for bank armoring where the creek parallels State Route (SR) 99, passing through a variety of low-, medium-, and high-density residential areas and numerous commercial areas.

Scriber Creek then crosses SR 99 near 186th Place SW before flowing through residential developments between 188th Street SW and 196th Street SW. After passing under 196th Street SW, the creek flows into Scriber Lake. It then flows southeast from Scriber Lake through a box culvert under the intersection of 200th Street SW and 50th Ave SW and crosses Interstate 5 (I-5) near 204th Street SW in a long culvert. In the lower reaches of the Scriber Creek basin downstream of I-5, land use is dominated by low-density residential areas. Scriber Creek then combines with Poplar and Golde Creeks before eventually discharging to Swamp Creek near the intersection of Cypress Way and Locust Way.

Swamp Creek

The Swamp Creek basin is located in the Lake Washington watershed. The total basin size is approximately 25 square miles (Snohomish County 2002a). Two major tributaries, Martha Creek and Scriber Creek, drain the eastern and western portions of the watershed, respectively.



Legend

- Creek
- Road
- Basin Boundary
- Water body
- City of Lynnwood
- Annexation Phase 1
- Annexation Phase 2

Figure A-1. Drainage Basins within the City of Lynnwood and Proposed Phase 1 and 2 Annexation Areas.

N

0 1,500 3,000 6,000 Feet

HERRERA ENVIRONMENTAL CONSULTANTS

K:\Projects\07-03686-000\Project\annexation.mxd

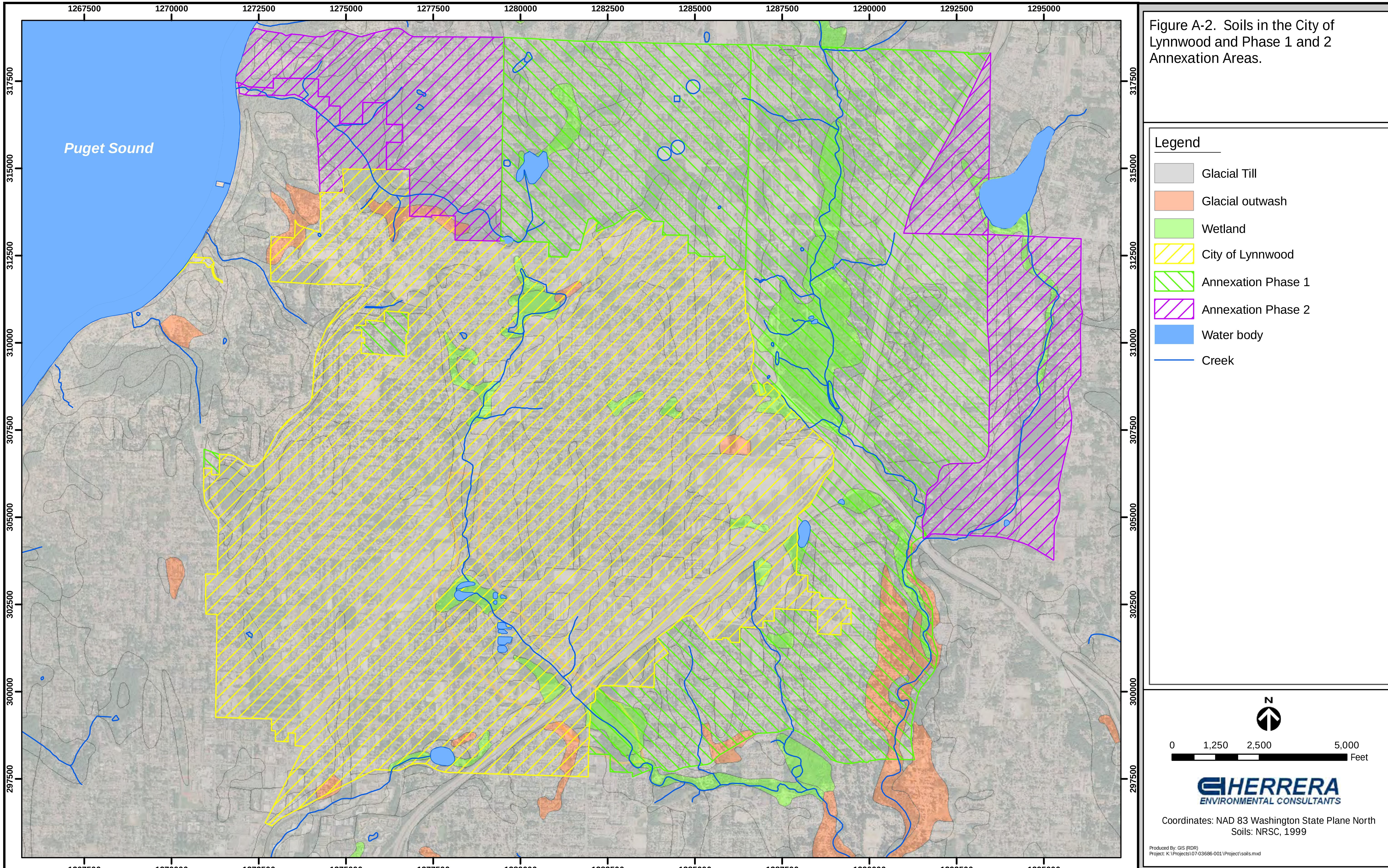


Figure A-2. Soils in the City of Lynnwood and Phase 1 and 2 Annexation Areas.

Approximately 190 acres of the Swamp Creek basin are located within City limits. Approximately 2,400 acres of the basin are within the proposed Phase 1 and Phase 2 annexation areas.

The upper reaches of the Swamp Creek basin are located north of the City limits. As the creek flows south, it enters the proposed northern annexation areas of the City in the Middle Swamp Creek subbasin (Snohomish County 2002a). Land use in the proposed annexation areas of the Middle Swamp Creek subbasin is chiefly wetlands, industrial, and residential areas. The Swamp Creek Regional Detention Basin is also located in the Middle Swamp Creek subbasin between 164th Street SW and the I-5/I-405 interchange. This regional detention basin is approximately 105 acres in size and is owned by Snohomish County (Snohomish County 2002a). The Middle Swamp Creek subbasin also includes the Tunnel Creek drainage basin (see description below).

After passing through the Swamp Creek Regional Detention Basin, Swamp Creek flows to the southeast, passing under I-5, before heading south and passing under I-405. Swamp Creek enters the South Swamp Creek Subbasin as the crossing of Filbert Road (Snohomish County 2002a). Swamp Creek then combines with Martha Creek and flows south through a series of low-density residential developments before combining with Scriber Creek approximately 0.5 miles south of one of the proposed Phase 1 annexation areas. In the South Swamp Creek Subbasin, Swamp Creek flows through a steep sided valley flanked by upland plateaus that include primarily residential development. South Swamp Creek Subbasin includes small portions of the City of Brier, Bothell, and Kenmore. Swamp Creek ultimately discharges to the Sammamish River, approximately 0.5 miles east of Lake Washington.

Perrinville Creek

The Perrinville Creek drainage basin is approximately 920 acres in size and is located in northern Edmonds and the southwestern portion of Lynnwood. Approximately 48 percent (438 acres) of the basin area is within the City limits. Approximately 6 acres of the basin is located in a proposed Phase 1 annexation area.

The upper reaches of Perrinville Creek are located near the intersection of Olympic View Drive and 76th Avenue W. Several small tributary drainages are located in the upper reaches of the basin, where the creek flows northwest through a series of low and medium-density residential areas. The gradient of Perrinville Creek steepens approximately 1 mile from the Puget Sound, where the creek drops 400 feet in elevation. The lower reaches of the creek are dominated by the heavily forested Snohomish County Park, with minor amounts of low-density residential developments surrounding the park. The creek then crosses under Talbot Road and the Burlington Northern Santa Fe Railway tracks before discharging to the Puget Sound at Browns Bay.

Hall Creek

The Hall Creek drainage basin comprises approximately 2,263 acres. This basin is bordered by the Scriber Creek basin to the northeast, and the Perrinville Creek basin to the northwest. The southwest portion of the City contains the headwaters of this basin. Approximately 16 percent of the basin is located within the City limits. Most of the Hall Creek basin is located south of the City limits.

In its upper reaches, the Hall Creek channel has a low gradient. Development in the upper portion of the Hall Creek basin is characterized by low and medium-density residential areas with several light industrial areas. The western portion of the basin includes the Edmonds Community College campus and the Lynnwood Municipal Golf Course. The central portion of the basin is dominated by commercial development associated with the SR 99 corridor. Hall Lake, located in the northeastern portion of the Hall Creek basin just inside Lynnwood city limits, collects drainage from 135 acres within the City limits. Hall Creek flows west out of Hall Lake before heading south, ultimately discharging to Lake Ballinger.

Golde Creek

The Golde Creek drainage basin comprises approximately 875 acres and is located in the eastern portion of the City. Approximately 45 percent of the basin is located within the City limits and 46 percent is located in the proposed Phase 1 annexation areas. The Golde Creek basin is bordered by the Poplar Creek basin to the west, the Tunnel Creek basin to the north, and the Swamp Creek basin to the east.

Golde Creek flows from north to south. Development in the headwater areas of the basin is dominated by the Alderwood Mall. The existing drainage system in this area is a network of pipes that direct flow to the south under I-5. Golde Creek continues south through a series of commercial developments south of I-5. Development in the lower reaches of the basin is primarily low to medium-density residential areas. Golde Creek ultimately flows into Scriber Creek in Brierwood Park.

Poplar Creek

The Poplar Creek basin is 230 acres in size and is located in the eastern portion of the City. Approximately 54 percent of the basin is located within the City limits and 43 percent is located in the proposed Phase 1 annexation areas. The Poplar Creek basin is surrounded by the Scriber Creek basin to the west and the Golde Creek basin to the east.

Poplar Creek flows from north to south. The development in the northern portion of the basin is characterized by medium-density residential. As the creek flows south, it passes through a series of commercial areas before flowing under I-5. After passing under I-5, Poplar Creek continues flowing south, where the development is characterized primarily by low-density residential. Poplar Creek ultimately discharges to Scriber Creek south of the intersection of Larch Way and Poplar Way.

Tunnel Creek

The Tunnel Creek drainage basin is approximately 300 acres in size and is part of the Middle Swamp Creek subbasin. 94 percent of the basin area lies within the northeastern portion of the City limits. The remaining 6 percent (18 acres) of the basin area lies within the proposed Phase 1 annexation area.

Development in the Tunnel Creek basin is primarily single-family residential, but also includes Lynnwood High School and portions of SR 525. The basin has a high gradient near the headwaters, and the stream channel has a low gradient near SR 525 and the confluence with Swamp Creek. Tunnel Creek flows through a culvert under SR 525, then under Maple Road, and ultimately discharges downstream of the control structure of the Swamp Creek Regional Detention Basin, located in Swamp Creek approximately 100 feet upstream of the Swamp Creek crossing of Maple Road.

Lund’s Gulch Creek

The Lund’s Gulch Creek drainage basin is approximately 1,440 acres in size and is located in the MUGA north of the City. A small portion of the basin (13 percent) is located within the City limits. Approximately 37 and 40 percent of the basin are located in the proposed Phase 1 and Phase 2 annexation areas, respectively. The Lund’s Gulch Creek basin is heavily developed, with approximately 25.3 percent, or 364 acres, of EIA (Snohomish County 2002b). The density of development and associated impervious surfaces is projected to increase in the future (Snohomish County 2002b).

Development in the headwater areas of the Lund’s Gulch Creek basin consists of commercial land use along the SR 99 corridor and suburban residential neighborhoods. The existing drainage system in the upper watershed is a network of pipes and ditches that collect and convey stormwater runoff from paved and other hardened surfaces directly to stream channels (Snohomish County 2002b). In the lower basin, the creek flows through a steep, heavily forested ravine in Meadowdale County Park that is almost entirely undeveloped. Lund’s Gulch Creek ultimately discharges to the Puget Sound via a culvert/bridge under the Burlington Northern Santa Fe Railway tracks.

Norma Creek

The Norma Creek drainage basin is approximately 939 acres in size and is located in the MUGA north of the City. The basin includes approximately 88 acres of the proposed Phase 1 and Phase 2 annexation. The basin is also heavily developed, with approximately 22.7 percent, or 213 acres, of effective impervious area (Snohomish County 2002b).

The headwater areas of Norma Creek, which include Lake Serene, are dominated by suburban low-density residential developments and minor amounts of commercial development. The creek flows in a westerly direction through a series of residential developments at a low to moderate grade. The channel gradient steepens considerably as the creek approaches the Puget

Sound, where the land use is dominated by forestland and a small amount of low-density residential developments.

Martha Creek

The Martha Creek drainage basin is approximately 1,275 acres in size and is located in the MUGA east of the City. Approximately 60 percent of the Martha Creek basin is located within the proposed Phase 1 and 2 annexation areas.

The headwater areas in the north end of the Martha Creek basin includes a section of I-5, low- to medium-density residential developments, and Martha Lake. Martha Creek flows south out of Martha Lake through low- to medium-density residential developments, passes under I-405, and ultimately discharges into Swamp Creek near the intersection of SR 524 and Locust Way.

Meadowdale Glen Infiltration Ponds

The Meadowdale Glen Infiltration Ponds drainage basin (Meadowdale basin) is approximately 270 acres in size. Approximately 80 percent of the Meadowdale Pond basin is located within the northwestern portion of the City limits. Approximately 12 percent of the basin area is within the proposed Phase 1 annexation area.

Development in the Meadowdale basin is characterized by the Meadowdale Playfield area, several low to medium-density residential areas, and several small areas of forested land. The Meadowdale basin is a terminal basin and doesn't contribute surface runoff to any other basins. All the drainage from this area passes into large infiltration ponds (Meadowdale Glen Infiltration Ponds) maintained by the City of Lynnwood.

Puget Sound Basins

Approximately 600 acres in the western portion of the City drain to the Puget Sound through unnamed tributaries. The development in these basins is dominated by low and medium-density residential areas. In general, the unnamed tributaries flow from east to west.

Soils and Geology

Glacial till soils cover the majority of the City and the proposed Phase 1 and Phase 2 annexation areas (NRCS 2008). Till soils are moderately well-drained with low infiltration capacity, and overlie a relatively impermeable hardpan layer. Infiltration through the hardpan typically ranges between 6 and 18 inches per year (Snohomish County 2002a). Till soils are highly consolidated and not particularly erosive. Small areas of wetland soils are present in the City and proposed annexation areas, including along the Scriber Creek corridor between its confluence with Swamp Creek and Scriber Lake, and in the Swamp Creek Regional Detention Basin area. Wetland soils are typically very dense, due to high concentrations of organic matter, and typically have low infiltration rates. Small areas of glacial outwash soils are also present in the City and surrounding areas proposed for annexation. Outwash soils are highly permeable and generate low runoff rates.

Groundwater

Groundwater storage in the Puget Sound lowlands typically occurs in outwash deposits confined by layers of till. The primary aquifer in the south Snohomish County area is a Vashon advance outwash deposit underlying the Intercity plateau (Snohomish County 2002a). For the drainage basins that discharge runoff to the Puget Sound, including Norma Creek, Lund's Gulch Creek, the Puget Sound basins, and Perrinville Creek, groundwater discharges commonly occur from the aquifer along the boundary between the Esperance Sand and Whidbey Formation units (Snohomish County 2002b). The groundwater discharges are expressed as seeps and springs on cliff faces, ravine slopes, and in drainage channels.

Topography and Slope

A large portion of the City and the proposed Phase 1 and 2 annexation areas lies on the Intercity plateau, an upland glacial plateau between the Puget Sound and the Snohomish River. Ground slopes in this area are low to moderate, trending from north to south. Elevation ranges from 400 to 600 feet above sea level on much of the Intercity plateau. Steeper slopes are encountered in the basins described above that discharge to the Puget Sound, where perennial channels and most of their tributary channels are situated in narrow, deeply incised V-shaped ravines (Snohomish County 2002b).

Climate

The climate in the City of Lynnwood is typical of the Puget Sound lowlands, located west of the Cascade Mountains, and is strongly influenced by the Pacific Ocean. Winters are rainy and mild, with average temperatures between 30 and 50 degrees Fahrenheit (°F). Summers are generally dry and moderately warm due to warm Pacific high pressure that typically dominates the region, with higher temperatures approaching 80°F. The mean annual precipitation is about 37 inches in Lynnwood (see Table A-1). Approximately 78 percent of this precipitation (29 inches) falls between October 1 and April 30 in a typical year, (Snohomish County 2008) although large storms may occur throughout the year.

Table A-1. Average monthly and annual precipitation at the Alderwood Water District Office weather station. (Snohomish County 2008).

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sept.	Oct.	Nov.	Dec.	Total
Average Annual Precipitation (inches) [a]	4.85	3.18	3.68	2.91	2.48	1.96	1.04	1.22	1.4	3.52	5.24	5.58	37.06

[a] Precipitation averages based on data collected by Snohomish County Department of Public Works Surface Water Management Department from water years 1988 through 2009 (Snohomish County 2008).

References

NRCS. 2008. Snohomish County Web Soil Survey. United States Department of Agriculture. Obtained December 10, 2008 from the National Resources Conservation Service website: <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>.

Snohomish County. 2002a. Swamp Creek Urban Growth Area Drainage Needs Report. Snohomish County Public Works, Surface Water Management. Snohomish County, Washington. December 2002.

Snohomish County. 2002b. Puget Sound Tributaries Drainage Needs Report. Snohomish County Public Works, Surface Water Management. Snohomish County, Washington. December 2002.

Snohomish County. 2008. Alderwood Water District Office @ 35th Rain Gauge. 15204 35th Ave. West, Lynnwood, Washington. Accessed via agency website on December 21, 2008: <http://198.238.192.103/spw_swhydro/hydrology-find-site.asp>.

APPENDIX B

Annexation

Annexation

Introduction

The City of Lynnwood (City) is interested in annexing large areas of the municipal urban growth area (MUGA) in unincorporated Snohomish County. Annexation would greatly increase the size of the City's storm drainage system, increasing the workload for an already overextended stormwater maintenance crew. There are also several drainage problems in the annexation areas that would become the City's responsibility. The City recently completed a Fiscal Annexation Analysis (Berk & Associates 2009) to examine the fiscal, governance, and strategic implications of large scale annexation. Though the Fiscal Annexation Analysis considered public works staffing and drainage problems in the annexation area, this appendix presents a supplemental estimate of stormwater facility increases that would occur due to annexation, the staffing and equipment increases that will be required to operate and maintain the expanded system under City ownership, and the number of drainage problems that will need to be incorporated into the City's comprehensive plan and capital facilities plan as determined during the Fiscal Annexation Analysis.

Storm Drainage System in the Annexation Area

The City's storm drainage system would increase by between 68 and 1,859 percent after annexation, depending on the type of drainage facility (Table B-1). The number of facilities would more than double for ditches, ponds, tanks and pipes, streams, and inlets, outlets, and weirs.

Drainage complaints and hot spot (chronic problem site) inspection and maintenance were not considered in the calculations for this appendix. However, annexation of the municipal urban growth area would increase the number of drainage complaints the City receives and would also increase the need for hot spot inspection and maintenance before, during, and after storms. The staff and equipment estimates presented in the following sections may need to be adjusted to account for increased drainage complaints and hot spot inspection and maintenance, once more is known about the specific stormwater needs of the facilities in the annexation area.

Stormwater Staff and Equipment Increases

City staff and equipment needs for operation and maintenance of the annexation area stormwater facilities were calculated using the methods presented in the Draft Operations and Maintenance Staffing and Equipment Memorandum prepared for the City on July 15, 2008 (Herrera 2008). The memorandum describes calculations that were used to quantify staff and equipment increases that would be needed to meet the requirements of the NPDES Western Washington Phase II Municipal Stormwater Permit (NPDES Phase II Permit) for stormwater facilities within the existing City limits. For this appendix, the same methods were used to quantify staff and equipment that would be needed to meet the requirements of the NPDES Phase II Permit for stormwater facilities within the existing City limits and the Phase 1 and 2 Annexation Areas. Based on these calculations, the City stormwater operations and maintenance staff would need to increase by approximately 12.7 full time equivalent (FTE) staff to maintain the annexation area stormwater facilities with a level of service that meets the requirements of the NPDES Phase II Permit (Table B-2). In addition, the City would need to purchase or rent additional heavy equipment (Table B-3). The City may also choose to contract out some of this maintenance to reduce requirements for full time staff and equipment.

Table B-1. Stormwater facility increases resulting from annexation.

Item	Facilities in City Limits [a]	Facilities in Annexation Areas [b]	Potential Percent Increase with Annexation	Unit
Catch Basins, Manholes, and Inlets	4,700	3,745	80%	each
Ditches	42,240	154,470	366%	linear feet
Meadowdale Facility	1	0	0%	each
North Scriber Creek Facility	1	0	0%	each
Regional Detention Ponds	5	0	0%	each
Small Detention Ponds	30	84	280%	each
Underground Detention Tanks and Pipes	85	121	142%	each
Streams	6,534	121,499	1,859%	linear feet
Oil Water Separators	2	0 [d]	0%	each
Hot spot inspection and maintenance	75	0 [d]	0%	each
Lake Inlets, Outlets, and Weirs	1	11	1,100%	each
Drain Pipes	484,817	330,829	68%	linear feet
Decant Facility	1	0	0%	each
Drainage Complaints	50	0 [d]	0%	each
Streets (Routes [c])	8	0 [d]	0%	each

Notes:
[a] Source: City of Lynnwood staff and Cartegraph database.
[b] Source: City of Lynnwood staff.
[c] City streets are divided up into 8 units called routes. Sweeping proceeds on a route-by-route basis.
[d] Not evaluated in the annexation area.

Drainage Problems and Capital Improvement Projects in the Annexation Area

During the Fiscal Annexation Analysis the City conducts a review of drainage problems and capital improvement projects within the proposed annexation areas. These projects were identified by Snohomish County during the Snohomish County Drainage Needs Reports that were initially completed in 2002 and subsequently updated in 2007. The Fiscal Annexation Analysis lists all stormwater problems and identified capital improvement projects that would need to be considered in the City’s comprehensive planning process and capital facilities program budget, including 24 capital projects in the Phase I Annexation Area with a total projected cost of over $10.2 million and only approximately $1.0 million in known funding. After annexation the City would need to reevaluate this list to remove completed projects and identify new problems.

Table B-2. Staffing needs for stormwater program management and operation and maintenance of stormwater facilities to meet NPDES permit requirements for existing city size and with proposed annexation areas.

Scenario (City size and level of service)	Full Time Equivalent Staff Needed [a]	Potential Staff Increase [a]
Stormwater program management for current city limits and current level of service	1.6	
Stormwater program management for current city limits and at a level of service that will meet the NPDES Phase II Permit requirements [b]	3.0	1.4
Stormwater program management after annexation and at a level of service that will meet the NPDES Phase II Permit requirements [c]	4.0	1.0
Operations and maintenance for current city limits and current level of service	5.1	NA
Operations and maintenance current city limits and at a level of service that will meet the NPDES Phase II Permit requirements [d]	7.1	2.0
Operations and maintenance after annexation and at a level of service that will meet the NPDES Phase II Permit requirements [d]	17.9	12.8

Notes.

[a] Rounded to the nearest tenth of an FTE.

[b] See Appendix H.

[c] Assumes annexation will increase the City area by 5.7 square miles (73 percent) and City population by 27,764 (78 percent) resulting in a 33 percent increased demand for stormwater management program staffing.

[d] Based on the Draft Operations and Maintenance Staffing and Equipment Memorandum (Herrera 2008) and including additional hours to assist with other NPDES permit related activities identified in Appendix H.

Table B-3. Equipment needs for operation and maintenance of stormwater facilities. [a]

Equipment	Current Equipment Quantity [b]	After Annexation [c]	Potential Equipment Increase [d]
Pickup Truck	1.0	0.8	0
Vactor	1.0	1.0	0
Mower	1.0	1.8	1
Dumptruck	1.0	1.0	0
Small Dumptruck	1.0	1.1	0
Backhoe/Trailer	1.0	1.0	0
Storm Service Truck	1.0	1.8	1

Notes.

[a] Assumes 250 service days per year per piece of equipment.

[b] Represents actual quantity of equipment currently owned by the City

[c] Based on the Draft Operations and Maintenance Staffing and Equipment Memorandum (Herrera 2008).

[d] Equipment needs are rounded up to whole numbers.

References

Herrera. 2008. Draft Technical Memorandum: Operations and Maintenance Staffing and Equipment. Prepared for the City of Lynnwood Public Works Department by Herrera Environmental Consultants, Inc., Seattle, Washington. July 15, 2008.

Berk & Associates. 2009. Fiscal Annexation Analysis, Final Report. Prepared for the City of Lynnwood by Berk & Associates, Seattle, Washington. January 14, 2009.

APPENDIX C

Applicable Regulations

Applicable Regulations

Introduction

This appendix summarizes regulations related to surface water management, water quality, flood protection, and habitat protection that affect the City's surface water management program. Future surface water management requirements and regulations are also briefly discussed.

Federal and state regulations drive many aspects of the City of Lynnwood's stormwater management program. Recent significant regulatory changes, initiated by the Federal Water Pollution Control Act of 1972 (the Clean Water Act), include:

- Revised state water quality standards

- National Pollutant Discharge Elimination System (NPDES) municipal stormwater permit requirements

- Total maximum daily load (TMDL) cleanup action requirements for water bodies, on the Washington State Department of Ecology's Clean Water Act Section 303(d) list due to significant water quality degradation

Additional federal regulations that apply to the City of Lynnwood's surface water management program include the National Flood Insurance Program (NFIP), administered by the Federal Emergency Management Act (FEMA) and the following listings related to the federal Endangered Species Act (ESA):

- Listings of Puget Sound Chinook salmon as threatened
- Listing of the Coastal-Puget Sound bull trout as threatened
- Listing of the Puget Sound steelhead as threatened
- Listing of the Southern Resident killer whale as endangered

Current Regulations and Regulatory Policies

Stormwater Management Program

Section 402 of the Clean Water Act requires some municipalities to obtain an NPDES permit for municipal stormwater discharges to receiving waters. In Washington State, the Department of Ecology (Ecology) is responsible for issuing and renewing these permits.

Discharges from municipal separate storm sewer systems ("MS4s") are regulated by Ecology under the NPDES program. An MS4 is a system designed to collect and convey stormwater runoff (such as from road drainage, constructed channels, and neighborhood storm drains). The municipal NPDES permit program seeks to control or reduce pollutant discharge to the maximum extent practicable, through primarily programmatic efforts.

The City of Lynnwood is listed as a *small* MS4 in the Western Washington Phase II (NPDES) Municipal Stormwater Permit, and is regulated by Ecology as a permittee. The NPDES Phase II Permit became effective for Lynnwood and numerous other jurisdictions in western Washington on February 16, 2007. This permit represents the most significant new surface water regulation since the Comprehensive Flood and Management Plan was prepared in 1998.

The NPDES Phase II Permit has nine special conditions (S1 through S9) and 21 general conditions (G1 through G21). Special requirements for the City's stormwater management program are presented under special condition 5 (S5) of the permit. Special condition 7 (S7) lists stormwater management program requirements related to TMDL implementation plans. Lynnwood is currently subject to a TMDL for fecal coliform bacteria in Swamp Creek. S5 and S7 requirements are summarized below. Additional requirements related to TMDL implementation plans are discussed later in this appendix. The permit was modified on June 17, 2009. Modifications include the extension of permit deadlines and requirements for the City to identify barriers to LID and develop a plan for implementing LID more broadly in the future.

S5. Stormwater Management Program for Cities, Towns, and Counties

- Develop and implement a stormwater management program that meets NPDES permit requirements by August 19, 2011
- Prepare and maintain written documentation of the stormwater management program
- Gather, track, and maintain information to evaluate stormwater management program implementation
- Incorporate mechanisms for interjurisdictional and interdepartmental coordination
- Design the stormwater management program to reduce discharge of pollutants to the maximum extent practicable; meet all known, available, and reasonable methods of prevention, control and treatment (AKART) requirements; and protect water quality
- Address the following components in the stormwater management program:
    - Public education and outreach
    - Public involvement and participation
    - Illicit discharge detection and elimination

- ☐ Controlling runoff from new development, redevelopment, and construction sites
- ☐ Pollution prevention and operation and maintenance for municipal operations

S7. Compliance with Total Maximum Daily Load Requirements (TMDL)

- Comply with the special requirements identified in Appendix 2 of the NPDES Phase II Permit. Currently, a TMDL and TMDL implementation plan has been developed for fecal coliform bacteria loading to Swamp Creek, under which the City of Lynnwood has obligations to control sources of bacteria. Therefore, Appendix 2 only includes requirements related to Swamp Creek.
  - ☐ Address commercial animal handling and commercial composting facilities in the illicit discharge detection and elimination (IDDE) program
  - ☐ Prepare a Bacterial Pollution Control Plan
  - ☐ Track TMDL related activities (e.g., public education, stormwater monitoring)
  - ☐ Incorporate bacterial pollution awareness into the public education program
  - ☐ Monitor water quality

Applicability

The NPDES Phase II permit became effective for the City of Lynnwood on February 15, 2007. Lynnwood must comply with all permit requirements by February 16, 2012. The Swamp Creek TMDL directly applies to the City, and the City's obligations in the associated action plan are clear as noted above.

Puget Sound Water Quality Management Plan and Action Agenda

The Puget Sound Partnership was established by Washington state statute in 1983 as the Puget Sound Water Quality Authority, later becoming the Puget Sound Action Team and eventually the Puget Sound Partnership in 2007. The Puget Sound Water Quality Authority was directed to identify pollution-related threats to Puget Sound's resources, conduct risk assessments, and coordinate and report on information relating to water quality in Puget Sound. The Puget Sound Water Quality Management Plan, first drafted in 1987, was last updated in 2001 for the period from 2001 through 2003 (PSAT 2000). The management plan was used to direct the work activities of the Action Team and to budget for addressing priority measures to restore and protect the health and diversity of the Sound.

In December 2008, the Puget Sound Partnership published an Action Agenda for restoration and protection of Puget Sound. This sweeping document supersedes the previous water quality management plan, encompassing a wider range of ecological (including water quality), social, and economic issues. The Action Agenda calls on all governments and citizens in the Puget Sound basin to support its priorities and initiatives.

Applicability

A key theme of the Action Agenda is stormwater pollution. The Action Agenda and other work of the Puget Sound Partnership is not legally binding on the City. However, because Lynnwood is located within the Puget Sound drainage, many of the provisions of the Partnership's plan will affect the decisions of regulatory authorities in the region, indirectly affecting the City's stormwater management program.

Water Quality

Various federal and state laws related to water and sediment quality significantly affect stormwater management in Lynnwood. The primary regulatory influences are the federal Clean Water Act and several state-administered water quality programs, including Ecology's surface water quality standards set forth in Washington Administrative Code (WAC) section 173-201A and TMDL program addressing basin-scale water quality management for surface water bodies, listed on the State's Clean Water Act Section 303(d) list.

State Surface Water Quality Standards

Surface water quality standards describe the quality of water expected to support beneficial surface water uses. Section 303(c) of the Clean Water Act states that water quality standards are the responsibility of states and qualified tribes. Ecology administers water quality standards in Washington state to be "consistent with public health and public enjoyment of the waters and the propagation and protection of fish, shellfish, and wildlife" (WAC 173-201A).

Effective July 2003, Ecology restructured its surface water quality standards to more explicitly define water quality requirements for aquatic life, recreation, and water supply uses, among others. For example, designated uses for aquatic life include: *char, salmon and trout spawning, core rearing, non-core rearing* and *migration, redband trout* and *warm water species.* There are now 18 designated uses in WAC 173-201A, and Ecology has established water quality criteria (such as maximum temperature and bacteria levels) for each of them.

Applicability

The City of Lynnwood is responsible for regulating surface water discharges to receiving waters in its jurisdiction to meet Ecology's surface water quality standards. None of the water bodies in Lynnwood, nor Lake Ballinger or Swamp Creek downstream of the City, are explicitly addressed in Ecology's water quality standards. However, in accordance with the NPDES Phase II Permit, the City needs to manage stormwater discharges from its municipal drainage systems in a manner that supports achieving the water quality standards for all surface waters to the best of its ability.

TMDLs for Degraded Water Bodies

Ecology is required to establish a TMDL for each pollutant identified in each impaired water body on the Section 303(d) list. TMDL's represent the daily limit on pollutants the water body can contain while still complying with water quality standards. A TMDL is established with the use of data and modeling. The TMDL is then divided among all point source polluters and nonpoint sources of the pollutant in the tributary drainage area. The TMDL typically includes a margin of safety and accounts for future growth.

Ecology can limit pollutant discharge by prioritizing a TMDL allocation for the listed surface water or by using mechanisms such as the municipal NPDES permit program to establish water quality control requirements for individual drainage basins. This could lead to mandatory limits on human activities in that basin.

Scriber Lake and Swamp Creek are on Ecology's Section 303(d) list of impaired waters. Table C-1 shows the pollutants listed for these water bodies.

Table C-1. Section 303(d) list of threatened and impaired surface water bodies and associated pollutants relevant to Lynnwood's jurisdiction.

Water Body	Associated Pollutants	TMDL Plan
Scriber Lake	Total phosphorous	No
Swamp Creek	Fecal coliform bacteria	Yes
	Temperature	No
	Dissolved Oxygen	No

Source: Ecology 2004

A TMDL implementation plan has been developed for Swamp Creek. All water bodies on the state's Section 303(d) list are required to have TMDL's by 2013 in order to comply with a 1997 agreement between the U.S. Environmental Protection Agency and Ecology. In addition to the water bodies listed in Table C-1, the southwest corner of the City drains to Lake Ballinger, which has a TMDL implementation plan.

Swamp Creek TMDL

A TMDL implementation plan for fecal coliform bacteria was produced by Ecology in 2006. Specific provisions of this plan that apply to the City are described below.

Scriber Lake TMDL

Scriber Lake exceeds state standards for phosphorus concentrations, but a TMDL implementation plan has not been established.

Lake Ballinger TMDL

A TMDL for phosphorus and a Quality Assurance Project Plan has been established for long term monitoring of Lake Ballinger. The TMDL plan was first prepared in 1993 (Ecology 2008). Hall Creek drains from the City of Lynnwood to Lake Ballinger. The City has evaluated water quality issues associated with Hall Lake and Hall Lake tributaries.

Applicability

The Swamp Creek fecal coliform bacteria TMDL implementation plan (Ecology 2006) establishes requirements for the City of Lynnwood. In response, the City has already established an ordinance requiring citizens to clean up pet waste (LMC 6.02.160). The City will also need to establish stormwater management requirements for commercial animal handling and commercial composting facilities, including related BMPs identified in the Stormwater Management Manual for Western Washington (Ecology 2005). City storm drainage outfalls that discharge to tributaries of Swamp Creek will need to be designated as a high priority on the City's prioritized outfall list. To comply with the Swamp Creek TMDL cleanup plan imposed by Ecology, the City's stormwater management program will need to include a Bacterial Pollution Control Plan and address TMDL-related monitoring and public education and outreach. A Quality Assurance Project Plan (QAPP) has been developed by the City to outline the monitoring that it will conduct, and fecal coliform bacteria monitoring will soon be implemented at two locations on Scriber Creek, one location on Poplar Creek, and one location on Golde Creek (Lynnwood 2008a). A detailed list of TMDL requirements and needs is provided above under Special Requirement 7 (S7) of the City's NPDES Phase II Permit.

Scriber Lake is listed on the State's 303(d) list of threatened and impaired surface water bodies due to high levels of phosphorus. Though there is currently not a TMDL implementation plan in place for Scriber Lake, the City should consider activities and local requirements that could reduce phosphorus loading to the lake and position the City to take action if a TMDL is developed in the future.

In 1971 the City was a signatory party to an interlocal agreement to clean up Lake Ballinger. While the phosphorus concentration in Lake Ballinger continues to meet the TMDL set forth by Ecology in 1993, the City should still seek to reduce phosphorus loading in runoff within its jurisdiction to preserve the long-term water quality of Lake Ballinger.

Flood Protection

The U.S. Congress established the National Flood Insurance Program (NFIP) with the passage of the National Flood Insurance Act of 1968. The NFIP is a federal program enabling property owners in participating communities to purchase insurance as protection against flood losses, in exchange for floodplain management regulations that reduce future flood damages. Participation in the NFIP is based on an agreement between local communities and the federal government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk for new construction, the federal government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. The Federal Emergency Management Agency (FEMA) is currently responsible for the NFIP.

Applicability

Section 1315 of the National Flood Insurance Act prohibits FEMA from providing flood insurance unless a community adopts and enforces floodplain management regulations that meet or exceed floodplain management criteria established under Section 1361(c) of the act. These floodplain management criteria are specified in the Code of Federal Regulations (CFR), Title 44, Part 60, Criteria for Land Management and Use. The emphasis of the National Flood Insurance Program (NFIP) floodplain management requirements is focused on reducing threats to lives and the potential for damages to property in flood-prone areas.

In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the nation's floodplains. Mapping of floodplains creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs and for determining flood insurance rates for new construction.

Lynnwood complies with the NFIP with a flood control ordinance and explicit code requirements for development in flood hazard areas. Lynnwood currently manages floodplain hazards through its Flood Hazard Area Regulations (LMC 16.46), which address areas of special flood hazard as identified by the Federal Insurance Administration in "The Flood Insurance Study for Snohomish County, Washington and Incorporated Areas," dated November 9, 1999. The flood insurance study and flood insurance rate map are on file at the City of Lynnwood Public Works Department. Mapped floodplains in Lynnwood include flood hazard areas along Scriber Creek, Swamp Creek, and Hall Creek.

Habitat Protection

The Endangered Species Act

The federal Endangered Species Act of 1973 provides broad protections for listed threatened and endangered species and their designated critical habitat. In 1999, both the Puget Sound Chinook salmon (70FR37160) and the Coastal-Puget Sound bull trout (64FR58910) were listed as threatened by NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS), respectively. In 2005, NOAA Fisheries designated the Southern Resident killer whale as endangered (70FR69903). In 2007 NOAA Fisheries designated Puget Sound steelhead as threatened (72FR26722).

Critical habitat has not been designated for Puget Sound steelhead, but has been designated for Chinook salmon (70FR52630), bull trout (70FR56212) and the Southern Resident killer whale (71FR34571).

The ESA prohibits the *take* of all listed species, which is defined broadly to include harming, harassing, pursuing, hunting, shooting, wounding, killing, trapping, or collecting a listed species.

Applicability

Puget Sound Chinook salmon, Puget Sound steelhead, Coastal-Puget Sound bull trout, and Southern Resident killer whale are currently listed as threatened or endangered by NOAA Fisheries or the USFWS in the immediate vicinity of Lynnwood, though their habitat range does not extend into Lynnwood. Puget Sound coho salmon are prevalent in Lynnwood's streams and are potential prey species for listed species such as bull trout and chinook. Activities potentially affecting the water quality or habitat of Hall Creek, Scriber Creek, Swamp Creek, and tributaries of these creeks, and any activities that could potentially affect any watercourse that drains to listed fish habitat could also trigger ESA protections and consultation. If additional species are subsequently listed under the ESA, activities in areas used by these species for rearing, foraging, and migration within the City's jurisdiction could trigger ESA consultations.

The ESA prohibitions against taking of a listed species apply to any person subject to the jurisdiction of the United States and it applies to both public and private lands and activities. This includes individuals, businesses, and federal, state, and local governments. Both a person whose actions harm or harass a protected species and a governmental entity that authorizes that person's actions can violate the ESA prohibitions. Thus, the City of Lynnwood should implement plans and policies that support the ESA prohibitions. The City's 2020 Comprehensive Plan (Lynnwood 2008) establishes objectives (i.e., SWM-1.1 and SWM 1.2) for studying the legal issues and practical requirements of ESA that relate to stormwater and developing a compliance program that protects the City from liability and goes towards the goal of enhancing the habitat of ESA listed species.

The ESA applies whenever development activities directly or indirectly modify fish habitat or kill or injure listed species. Specific examples include:

- Constructing or maintaining barriers that eliminate or impede a listed species' access to habitat essential for its survival or recovery
- Removing, poisoning, or contaminating plants, fish, wildlife, or other biota required by the listed species for feeding, sheltering, or other essential functions

- Discharging pollutants (including those in stormwater runoff) into a listed species' habitat

- Removing or altering rocks, soil, gravel, vegetation, or other physical structures that are essential to the integrity and function of a listed species' habitat

- Removing water or otherwise altering streamflow when it is likely to impair spawning, migration, or other essential functions

- Releasing non-indigenous or artificially propagated individuals into a listed species' habitat

- Constructing or operating inadequate fish screens or fish passage facilities at dams or water diversion structures in a listed species' habitat

- Constructing or using inadequate bridges, roads, or trails on stream banks or unstable hill slopes adjacent or above a listed species' habitat

- Constructing or using inadequate pipes, tanks, or storage devices containing toxic substances, where the release of such a substance is likely to significantly modify or degrade listed species' habitat

- Conducting timber harvest, grazing, mining or other land use activities that increase sediment loading to streams

- Disturbing streambeds so as to trample eggs or trap adult fish preparing to spawn

- Altering lands or waters in a manner that promotes unusual concentrations of predators

- Shoreline and riparian disturbances that retard or prevent the development of habitat conditions upon which listed species depend

- Filling or isolating side channels, ponds and intermittent waters upon which listed species depend for refuge during high flows

Many of these activities are applicable to the City of Lynnwood, either because the City is engaged in them or writes permits for private developments to engage in them.

The City of Lynnwood does not have specific regulations addressing the ESA. In enforcing the State Environmental Policy Act (SEPA), the City prompts applicants to identify ESA species in their project area. This does not require analysis to determine the potential for a project to result in a *take* of listed species if they are determined to be present in the vicinity of a proposed project. Project proponents may be required to assess the project's potential impact on listed species in greater detail, and may be required to write a Biological Assessment report for the USFWS and/or NOAA Fisheries. The Lynnwood Municipal Code does contain protections for Fish and Wildlife Priority Habitats (LMC 17.10.080), but these regulations are in need of revision to be more specific to ESA listed species, adequately meet the requirements of the ESA, and meet objectives SWM-1.1 and SWM-1.2 of the 2020 Comprehensive Plan.

The Lynnwood Municipal Code (LMC 17.10.030) also defines "Essential Habitat" as habitat necessary for the survival of species listed as:

- "Threatened" or "endangered" under the federal Endangered Species Act
- "Threatened" or "endangered" by the Washington Department of Fish and Wildlife
- "Candidate" or "species of concern" by the USFWS or NOAA Fisheries
- "Sensitive" or "state candidate" by the Washington Department of Fish and Wildlife

The City may increase buffer widths and setback distances in areas adjacent to Essential Habitat.

The following are examples of actions that may trigger impacts on ESA-listed species:

- Grading of a site
- Clearing of a site
- Work below the ordinary high watermark of any wetlands or creeks that have ESA listed species present, ESA species habitat, or drain to watercourses that have habitat for ESA listed species
- Installation of additional impervious surfaces
- Discharge of stormwater to watercourses that have ESA listed species, ESA species habitat, or drain to watercourses that have habitat for ESA listed species
- Processing, handling, storage, or treatment of hazardous substances in the vicinity of ESA listed species or their habitat
- Withdrawal, interception, or injection of groundwater
- Landscaping or reoccurring activities that require the application of herbicides, pesticides, and fertilizers
- Physical alterations to a watercourse or its banks

State Salmon Recovery Planning Act

The State has responded to the Endangered Species Act listings described above by enacting legislation authorizing (but not requiring) local governments and other stakeholders to take certain actions to promote salmon recovery. The Washington state legislature established the Salmon Recovery Act (RCW 77.85) through House Bill 2496 for the improvement and recovery of salmonid fish runs throughout the state. This act established a Salmon Recovery Office within the Office of the Governor to coordinate a state strategy for salmon recovery (to healthy sustainable population levels) with the purpose of coordinating and assisting the development of salmon recovery plans.

Applicability

The Salmon Recovery Act authorizes a lead entity (a county, city, conservation district, special district, tribal government, or other entity) in a water resource inventory area (WRIA) to establish a committee to develop local watershed projects that address habitat concerns. The role of the committee is to compile a list of projects, prioritize project implementation, establish priorities for individual projects, and submit the list to the Salmon Recovery Funding Board (SRFB) for funding.

Although the City of Lynnwood is not a member of the WRIA 8 salmon recovery council, it is participating in watershed planning and restoration efforts within WRIA 8 (Lake Washington / Cedar/Sammamish River). Specific efforts are focused in the Lake Ballinger and Hall Lake watersheds in cooperation with Snohomish County and surrounding cities. The City of Lynnwood Public Works Department has also identified endangered species protection in the objectives of the 2020 Comprehensive Plan. In 2008, the City created a resolution to assist in an interjurisdictional action plan to address flooding and water quality issues in the Hall Lake / Lake Ballinger / McAleer Creek watersheds.

Growth Management Act

The Growth Management Act (GMA) was passed by the Washington state legislature in 1990. The GMA was enacted in response to rapid population growth and concerns about suburban sprawl, environmental protection, and quality of life. The GMA has been amended several times and is codified primarily in Chapter 36.70A of the Revised Code of Washington. Under the requirements of Section 4 of the GMA, the City of Lynnwood must develop and adopt comprehensive plans and development regulations that prevent the adverse effects of uncontrolled development and poor land use practices. One of the key directives of the GMA is to use “best available science” to support effective land use planning that can avert environmental degradation.

Applicability

The GMA provides a framework for regional coordination. To satisfy GMA requirements, Lynnwood’s comprehensive planning must include the following elements: land use, housing, capital facilities, utilities, and transportation. Lynnwood's planning must be consistent with Snohomish County's planning efforts and growth management policies. Lynnwood is ineligible to receive state or federal funds if it is not compliant with the GMA. The City's stormwater management program supports the City's overall Comprehensive Plan, which addresses GMA compliance issues.

Evolving Regulations and Policies

The City faces several evolving regulations relevant to stormwater management. These regulations are expected to increase the City's obligations to protect water quality and fish habitat, increase monitoring requirements, and require greater integration and coordination between programs aimed at improving environmental protection. This section summarizes regulatory policies and requirements that the City of Lynnwood will need to accommodate in its ongoing stormwater management program.

NPDES Phase II Permit Conditions

As described previously, the City of Lynnwood must comply with Ecology's NPDES Phase II Municipal Stormwater Permit. The specific permit requirements imposed on the City of Lynnwood are described in Appendix F, Gap Analysis and Needs Assessment Report (Herrera 2008). The current permit expires in February 2012, at which time a new permit will be developed and enforced by Ecology. The updated permit is likely to contain many of the same conditions as in the current permit, and is expected to include additional requirements, such as water quality monitoring requirements beyond those that the City currently faces under the Swamp Creek TMDL implementation plan. Thus, there is a distinct possibility that the City's stormwater management program will need to be ever stronger and more comprehensive in 2012 and beyond.

Low Impact Development Requirements

At the time this Surface Water Management Comprehensive Plan was written, the Washington State Department of Ecology was in the process of revising the NPDES Phase II municipal stormwater permit for Western Washington to include definitive expectations of permittees regarding implementing low impact development techniques. A Washington State Pollution Control Hearings Board ruling in February 2009 directed Ecology to "…modify the permit to require permittees to identify barriers to implementation of LID and identify actions taken to remove those barriers, to establish goals regarding the future use of LID, and to require other specific actions on reasonable and flexible time frames…" Thus, beginning some time in 2009 when the revised Phase II permit is officially issued, the City can expect to be required to push forward on several actions intended to promote use of LID on new development and redevelopment projects for a wide variety of development types. This does not represent a major change in stormwater program focus, but will require City staff to dedicate more time and energy to this issue amongst other stormwater management program activities.

Lake Ballinger Watershed Action Plan

Increasing attention is being given to water quality and flooding problems upstream, downstream, and within Lake Ballinger. In 2008, jurisdictions around Lake Ballinger formed The Hall Lake, Hall Creek, Chase Lake, Echo Lake, Lake Ballinger, McAleer Creek Watershed Forum. The Forum includes representatives from the cities of Edmonds, Lake Forest Park, Lynnwood, Mountlake Terrace, Shoreline, and Snohomish County. Using grant money from the Department of Ecology, the Forum has contracted with a consultant to develop a strategic action plan for the watershed, which will include specific actions and projects to address water resource issues. The final action plan will likely include a list of projects for implementation.

Future Listings and Critical Habitat Designations under the Endangered Species Act

NOAA Fisheries is in the process of completing the designation of critical habitat for Puget Sound steelhead in 2009 (NOAA Fisheries 2008). The Dolly Varden (*Salvelinus malma*) is identified by NOAA Fisheries as a candidate species for listing in the Puget Sound, due to its similarity of appearance to bull trout. NOAA Fisheries defines a candidate species as a species whose status is of concern, but where more information is needed before the species can be formally listed (Ryan and Schuler 1998). This listing has been documented since 2001 and is not likely to go beyond proposed status in the near future.

If a change in ESA listing occurs, and areas used as species habitat are identified in the City’s jurisdiction, it could require changes in City policies and programs, including (but not limited to) road maintenance practices, stormwater treatment, maintenance of storm drainage facilities, monitoring of water quality and flow, and watershed programs.

At this time, the City should closely monitor the status of other salmonid populations in the Puget Sound area, in addition to regulations addressing prey species for listed salmonids such as surf smelt (*Hypomesus pretiosus*), Pacific herring (*Clupea harengus pallasi*), or sand lance (*Ammodytes hexapterus*), and be prepared to modify its ESA compliance procedures accordingly if the ESA status of these marine forage fish change.

Puget Sound Partnership

The Puget Sound Partnership is a collective effort of citizens, governments, tribes, scientists, and businesses working together to restore and protect the Puget Sound. The governor and legislature requested that the PSP create a strong Action Agenda that leads to a healthy Puget Sound by 2020. As noted above, the Action Agenda produced in December 2008 prioritizes a variety of actions and policies to be coordinated amongst a broad array of federal, state, local, and tribal agencies and private entities. Decisions will be based on science, focusing on actions that have the biggest impact, and hold people and organizations accountable for results (PSP 2008).

The City should closely monitor implementation of the Action Agenda, as this may lead to opportunities for grant funding, partnering with other governments, and assistance with technical guidance that is of interest to the City. Additionally, the Action Agenda may lead to requirements for more stringent stormwater management measures in certain drainage basins in Lynnwood, as well as changing the state-level regulatory structure under which the City must operate.

References

Ecology. 2004. The 303(d) List of Impaired and Threatened Waterbodies 2004 List – by Water Resource Inventory Areas (WRIAs). Washington State Department of Ecology, Water Quality Program Home, 303(d) Home. Information obtained December 16, 2008 from agency website: <http://www.ecy.wa.gov/programs/wq/303d/>.

Ecology. 2005. Stormwater Management Manual for Western Washington. Washington State Department of Ecology, Water Quality Program, Lacey, Washington.

Ecology. 2006. Swamp Creek Fecal Coliform Bacteria Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Washington State Department of Ecology Northwest Regional Office Water Quality Program, Bellevue, Washington.

Ecology. 2008. Lake Ballinger Total Phosphorus Total Maximum Daily Load Water Quality Attainment Monitoring Report. Washington State Department of Ecology, Western Operations Section, Environmental Assessment Program, Olympia, Washington.

Herrera. 2008. Draft Gap Analysis and Needs Assessment Report. Prepared for the City of Lynnwood. Prepared by Herrera Environmental Consultants, May 14, 2008.

King County. 2005. Final Lake Washington/Cedar/Sammamish Watershed Water Resource Inventory Area 8 Chinook Salmon Conservation Plan, King County Department of Natural Resources. July 2005. Obtained December 16, 2008, from website: <http://www.govlink.org/watersheds/8/planning/chinook-plan/volumeI/01_Front_Materials.pdf>.

Lynnwood, City of. 2008a. Swamp Creek Fecal Coliform Bacteria Total Maximum Daily Loads Water Quality Study Design (Quality Assurance Project Plan) for the City of Lynnwood. March 10, 2008.

Lynnwood, City of. 2008b. 2020 Comprehensive Plan. Updated September 24, 2007. Accessed via agency website on November 24, 2008: <http://www.ci.lynnwood.wa.us/Content/HomePage.aspx?id=88>.

PSAT 2000. 2000. Puget Sound Water Quality Management Plan 2000. Puget Sound Water Quality Action Team, Olympia, Washington. Adopted December 14, 2000. Obtained August 29, 2003, from Puget Sound Action Team website: <http://www.psat.wa.gov/Publications/manplan00/mp_index.htm>.

PSAT. 2003. 2003–2005 Puget Sound Water Quality Work Plan. Puget Sound Action Team, Olympia, Washington. August 2003. Obtained August 31, 2003, from agency website: <http://www.psat.wa.gov/Publications/workplan_03/wp03_final/WORKPLAN_web.pdf>.

PSP. 2008. Action Agenda of the Puget Sound Partnership. Obtained December 11, 2008 from PSP website: <http://www.psp.wa.gov/econet.php>.

Ryan, Patrick W, and Galen Schuler. 1998. The Endangered Species Act—A Primer. Perkins Coie LLP, Seattle, Washington. Obtained August 27, 2003, from website: <http://mrsc.org/subjects/environment/esa/esaprime.aspx?r=1>.

USFWS. 2002. Information about bull trout. U.S. Fish and Wildlife Service. Obtained August 30, 2003, from agency website: <http://pacific.fws.gov/bulltrout/>.

APPENDIX D

Drainage and Water Quality Problems and Recommended Solutions

Drainage and Water Quality Problems and Recommended Solutions

Introduction

This appendix describes citywide and site-specific drainage and water quality problems identified during preparation of this update to the Stormwater Management Comprehensive Plan. Recommended solutions are identified for each problem. Citywide problems and solutions are described first, followed by descriptions of site-specific problems and solutions.

Citywide Drainage Problems and Solutions

Problems

Development of this plan update did not include a comprehensive hydraulic analysis of flooding problems that may be caused by inadequate culvert and ditch capacity or a complete geomorphic assessment to examine erosion and sedimentation. However, based on input from City staff, limited field observations, and previous studies, there are known to be significant Citywide problems that can be reduced over the long term using programmatic approaches. Two of these Citywide problems and suggested programmatic solutions are listed below:

- Flooding in locations where stormwater runoff exceeds the capacity of the drainage system or creek channel
- Erosion and sedimentation of creeks

Three primary (and related) causes were identified for these problems:

- Increased impervious surfaces
- Undersized private storm drains
- Improperly maintained private stormwater flow control facilities

Solutions

In order to solve these citywide problems, the City will need to develop and implement the following four programmatic solutions:

- Improved stormwater flow control standards for development and redevelopment
- Modifications to the existing storm drainage system

- A low impact development (LID) program
- An inspection and maintenance program for private stormwater facilities

These four solutions are discussed in more detail below.

Improved Stormwater Flow Control Standards for Development and Redevelopment

The Lynnwood Municipal Code requires stormwater flow control on development and redevelopment projects. However, the performance standards of the code do not meet the requirements of the National Pollutant Discharge Elimination System (NPDES) Phase II permit. The City typically imposes the stricter standards of the Stormwater Management Manual for Western Washington (Ecology 2005) on large development projects that are subject to State Environmental Policy Act (SEPA) review. The City intends to formally adopt the Stormwater Management Manual for Western Washington, or an approved equivalent manual for development and redevelopment. The City will also consider adopting an addendum to the manual that includes specifications on how to apply the manual in the City of Lynnwood, and includes specialized requirements that are tailored to stormwater management needs that are unique to the City of Lynnwood and not adequately addressed by the Stormwater Management Manual for Western Washington. Adoption of the Stormwater Management Manual for Western Washington, or an approved equivalent manual, and development of the addendum are discussed in Section 5 of this plan.

Modify the Existing Storm Drainage System

Modifications to the existing storm drainage system may help alleviate some flooding problems. For example, undersized storm drain pipes should be replaced and priority should be given to locations that create a public hazards. The City can gain efficiencies with these types of pipe replacement projects by integrating the projects with other street-related Capital Improvement Program (CIP) projects. The City might also consider building new stormwater flow control projects in strategic locations, such as the Scriber Creek Detention Facility upstream of 176th Street SW. However, no suitable parcels of land have been identified for another such facility. In cases where undersized private stormwater pipes impede conveyance in the public drainage system such that they cause flooding problems, the City may encourage or require pipe replacement as allowed by law.

Another option for reducing the adverse effects of impervious surface areas is to retrofit existing storm drainage infrastructure with additional flow capacity, storage, and/or infiltration facilities. Retrofit projects are typically more costly than constructing stormwater controls during new development, but major redevelopment projects, such as the City Center Project, may present a cost-effective opportunity to implement new flow control measures to reduce stormwater effects of existing impervious surfaces.

Low Impact Development (LID) Program

Development and implementation of a LID program is another way the City can reduce flooding problems associated with urbanization. LID pilot projects have been used effectively to reduce and attenuate runoff flows in nearby jurisdictions. Similar projects could be implemented in Lynnwood to address flooding and creek erosion and sedimentation problems. Pilot projects could also be designed to encourage residents and the development community to incorporate LID into stormwater management.

Because much of Lynnwood is built on glacial till soils with low infiltration rates, the pilot program should be composed of LID projects that manage stormwater effectively on till soils. Though infiltration is most effective in glacial outwash soils, infiltration has been used successfully on other LID pilot projects in locations with till soils, (e.g., City of Seattle's High Point and Street Edge Alternatives projects) and should be considered in the City's LID pilot program.

In addition, many storm drainage outfalls are present along Scriber Creek, which is indicative of residential developments discharging roof and street drainage directly into the creek. Developments that discharge directly to the creek have the most direct effect on creek flow and therefore should be given a high priority when implementing an LID pilot program.

Maintenance of Private Stormwater Facilities

The City's current drainage code (LMC Chapter 13.40) and maintenance covenants that the City imposes on private stormwater facility owners provide adequate legal grounds to inspect private stormwater flow control facilities and take enforcement actions when maintenance is neglected. The maintenance requirements set forth in the code and covenants are similar to requirements used in nearby jurisdictions. The City's private stormwater facilities maintenance covenant meets the requirements of the NPDES Phase II permit, except for the discrepancies noted in the Gap Analysis Report (Appendix G of this plan). However, maintenance covenants established with older facilities do not include specific maintenance standards. Therefore, the City will need to adopt maintenance standards equivalent to the maintenance standards found in Chapter 4 of Volume V of the Stormwater Management Manual for Western Washington (Ecology 2005), and retroactively apply these standards to existing private drainage systems through modifications to City code.

Despite the maintenance requirements already established in the City code and private site covenants, City staff believe that lack of maintenance is a problem at private stormwater facilities and a major contributor to citywide flooding problems. To address this issue, interviews were conducted with representatives from five nearby jurisdictions to identify effective methods of encouraging private stormwater facility maintenance. Interviewees were selected based on geographic proximity to Lynnwood and similar population density. Based on this research, the City should encourage private stormwater facility maintenance through an outreach and inspection program. This type of program is used by several neighboring jurisdictions, and is effective in encouraging private facility owners to conduct inspections on their own and to perform necessary maintenance. In addition, performing outreach and education as part of the inspection process can increase public participation and increase the likelihood that maintenance is conducted in the future to correct facility deficiencies. It is recommended that the City perform additional study of regional inspection programs prior to making formal policy decisions on the City's approach to inspection.

If non-conformances are identified during the inspection, a letter could be mailed to the facility owner identifying the maintenance needs and deadlines. Then, the facility owner would need to perform maintenance and provide the City with a maintenance verification report. If the facility owner fails to perform the maintenance, then escalating actions can be taken, including fines and property liens. If the facility is a major risk to public safety, City staff may perform the maintenance and bill the facility owner. A lien may be placed against the property if the City is not reimbursed for the maintenance. The current City code addresses financial responsibility for maintenance of new facilities (i.e., facilities less than 2-years old), but it should be updated to address financial responsibility for all facilities and include escalating enforcement actions such as the ones listed above. It is recommended that the City perform additional study and legal review of regional maintenance enforcement prior to making formal policy decisions on the City's approach to enforcement.

It is estimated that approximately 1.0 full time equivalent (FTE) of City staff time would be needed to develop a private facility inspection program and then conduct inspections at each private facility in the city during the first year of the inspection program (approximately 400 to 500 facilities). Inspection staff time is expected to decrease to 0.5 FTE after the first or second year as maintenance needs are addressed and less follow-up action is necessary. To have the greatest impact, this inspection and enforcement program should prioritize known problem facilities, the largest facilities, and the oldest facilities. These priority facilities can be identified by updating the City's private stormwater facility database with facilities built after 2000, developing a map of all facilities by georeferencing the facility addresses, and prioritizing the facilities based on age, physical characteristics, and input from the City's stormwater crew. Crew input could be obtained by during a focused review of the private stormwater facility map and discussion of problem sites. In cases where the private stormwater facility owner no longer exists (e.g., defunct homeowners associations), the City could accept maintenance responsibility for the maintenance of the property on a case-by-case basis, or alternatively on a citywide basis. The city should consider additional study of this issue prior to making policy decisions.

Citywide Water Quality Problems

The primary citywide water quality problem is nonpoint source pollution from a variety of sources associated with urban development and pollutant-generating activities exposed to precipitation. There may also be illicit discharges of wastewater into the City's storm drainage systems.

Nine primary causes were identified for these problems:

- Improper pesticide and fertilizer use
- Runoff from industrial and commercial areas

- Runoff from roadways and parking lots
- Stream bank erosion
- Sediment transport from construction sites
- Pet waste
- Illegal discharges to the storm drainage system
- Sanitary sewer connections to the storm drainage system
- Faulty septic systems

Citywide Water Quality Solutions

In order to solve these citywide problems, the City will need to develop and implement programmatic solutions that both reduce nonpoint source pollution and detect and eliminate illicit discharge.

These solutions are discussed in more detail below. If the City annexes additional areas of unincorporated Snohomish County as proposed, these same solutions apply, but the geographic scope and complexity of the solutions will increase.

Reducing Nonpoint Source Pollution

Pesticide and fertilizer use can be addressed through public education about application timing, availability of low-phosphorus formulations, dosage recommendations, and alternatives to pesticide and fertilizer use. This program should be focused in the Scriber Lake and Hall Lake drainage basins. Water quality sampling of Scriber Lake conducted from 1989 through 1990 indicated average summer phosphorus levels of approximately 70 μg/L (URS 1992), which is significantly higher than the action value of 20 μg/L established in Washington Administrative Code 173-201A-230. Hall Lake is a kettle lake that exhibits high depth to width ratios and distinctive ecologic and physical characteristics, including biogenic meromixis (Culver et al. 1981). In addition, Hall Lake is tributary to Lake Ballinger, which currently has a TMDL for phosphorus. Therefore, consideration should be given to a program similar to that being implemented in the Lake Whatcom watershed, where Whatcom County and the City of Bellingham have written ordinances restricting the use of fertilizers containing phosphorus in the watershed and promote the use of the "Lake Whatcom blend" non-phosphorus fertilizer that is sold in local stores.

Encouraging the use of LID and other stormwater treatment BMPs in industrial/commercial areas and alongside roadways can reduce the oil, grease, metals, nutrients, and toxic organic pollutants found in urban runoff. The City should adopt an ordinance to promote LID in new construction and retrofit situations. The City should also expand its education and outreach efforts to inform all residents and business owners regarding specific activities that pollute stormwater runoff and specific BMPs that should be implemented to reduce and eliminate runoff pollution. The catch basin cleaning program that the Public Works Department has developed should be continued. However, increased water quality benefits could also be provided through more frequent maintenance of the many public and private stormwater ponds located throughout the City. City staff currently perform maintenance of public stormwater facilities and maintenance frequencies could be increased by increasing operations and maintenance staffing. There are also several area contractors that perform stormwater facility maintenance.

In response to the Swamp Creek TMDL for fecal coliform bacteria, the City has already passed an animal control ordinance, obtained two pet waste management stations that were installed in Meadowdale Playfield and Lynndale Park, and begun a monthly sampling program at four locations in the Scriber Creek, Golde Creek, and Tunnel Creek drainage basins (see Accomplishments of the Stormwater Management Program section in the main body of this plan). Additional ways to address fecal coliform bacteria pollution include public education regarding pet waste disposal and septic system maintenance. Additional pet waste stations in popular parks or other public areas would most likely further reduce bacteria pollution from pets. Development and implementation of an illicit discharge detection and elimination program (see the following section) will also help to identify areas within the City that are “hotspots” of greater runoff pollutant loading, in which education and outreach efforts and runoff treatment retrofits should be targeted.

A business inspection program would also be beneficial to provide education on proper pollution source control BMPs listed in Volume IV of Ecology’s Stormwater Management Manual for Western Washington (Ecology 2005). An ordinance and related code modifications should be written to establish the business inspection program. Public education materials have been assembled by the City regarding antifreeze, automotive repair, solvent and cleaner disposal, vehicle recycling, carpet cleaning, oil and grease disposal, material storage, and wash water disposal. Businesses with outdoor material storage; vehicle washing, fueling, and/or maintenance; and food preparation should be targeted through a business education program. Information on developing spill plans and obtaining spill kits should also be provided to all applicable City businesses and City-owned facilities.

Eroding streambanks can be addressed by retaining vegetated buffers along stream edges and encouraging private property owners to plant native vegetation along stream edges. Stream restoration and habitat enhancement projects within the City limits would also help to reduce the detrimental effects of streambank erosion. Recommended erosion reduction projects in Scriber Creek are discussed in Appendix E.

Adoption of Volume II of Ecology’s Stormwater Management Manual for Western Washington (Ecology 2005), or the similar contents of an equivalent manual, will help to reduce sediment transport from construction sites by providing a comprehensive source of information on erosion and sediment control BMPs that can be implemented effectively. The City will need to increase its inspection and code enforcement efforts associated with construction sites to comply with its NPDES Phase II permit, and in so doing will realize a cumulative reduction in runoff sediment loading to surface waters.

Illicit Discharge Detection and Elimination

Development of an Illicit Discharge Detection and Elimination (IDDE) program is a key component of the NPDES Phase II permit. This program will help the City to identify illicit connections and illicit discharges of wastewater into the storm drainage system (40 CFR 122.26(b)(2)) and take steps to correct these problems. The IDDE program must be implemented by the City before August 19, 2011. The City may want to focus the IDDE program by targeting problem businesses along the SR 99 corridor and/or facilities that are currently covered by the NPDES Industrial Stormwater General Permit. Smoke testing and dye testing by a licensed contractor should be used to verify suspect pipe connections.

Site-Specific Problems and Solutions

Several site-specific problems were evaluated in order to develop planning level solutions and cost estimates. These problems were identified by interviewing City staff, performing field reconnaissance, and reviewing the references discussed in Section II of this plan. The site-specific drainage and water quality problems and solutions are described below.

Site-Specific Flooding Problems and Solutions

Based on direction from City staff, specific flooding problems were evaluated in two locations with the worst chronic flooding:

- Scriber Creek from 188th Street SW to 200th Street SW (herein called the Scriber Creek Problem Area)
- The intersection of Maple Road and Ash Way (herein called the Maple and Ash Problem Area)

The causes of flooding problems and recommended solutions for these two locations are described below.

Scriber Creek Problem Area

Flooding has occurred in the Scriber Creek problem area for several decades, in the form of overbank stream flooding of arterial streets, flooding of residential streets, and flooding that inundates private residences and businesses. The large storm on December 3, 2007 was estimated to have a recurrence interval of approximately 100 years (i.e., one percent chance of occurrence in any year). During this storm, Scriber Creek flooded roadways and homes between 188th Street SW and 200th Street SW (see photos of this flooding in Figures D-1 through D-6). Flooding is also still a concern at 44th Avenue W.

Figure D-1. December 3, 2007 flooding of Scriber Creek at 188th Street SW.

Figure D-2. December 3, 2007 flooding of Scriber Creek at 190th Street SW.

Figure D-3. December 3, 2007 flooding of Scriber Creek upstream of a private driveway extending east off 194th Street SW (at Casa Del Rey condominiums).

Figure D-4. December 3, 2007 flooding of Scriber Creek at "old" 196th Street SW.

Figure D-5. December 3, 2007 flooding of apartment complex by Scriber Creek upstream of the intersection of 200th Street SW and 50th Avenue W.

Figure D-6. December 3, 2007 flooding of businesses by Scriber Creek upstream of the intersection of 200th Street SW and 50th Avenue W.

Flooding in the Scriber Creek Problem Area is due to a combination of factors, including increased streamflows resulting from urbanization of the upstream drainage basin, undersized culverts, residential development encroaching on the Creek's floodplain in the problem area, sediment accumulation in low gradient reaches of the creek channel within the problem area, and ongoing sediment input from systemic channel enlargement that is occurring upstream of the problem area between SR 99 and 176th Street SW. Detailed analysis was performed to examine the extent of flooding problems, to evaluate erosion, and to evaluate potential solutions. A separate Scriber Creek Flood Study Report, contained in Appendix F of this plan, documents the detailed analysis.

Hydrologic modeling, hydraulic modeling, and geomorphic analysis were conducted to evaluate flooding and erosion problems in the Scriber Creek Problem Area. Hydrologic modeling was conducted to quantify the streamflow in the Scriber Creek Problem Area for different recurrence interval storms (2-year to 100-year recurrence intervals). Hydraulic modeling was performed to predict where flooding will occur during these storms based on the existing configuration of the creek and culverts. Field reconnaissance was conducted to evaluate the geomorphic processes in Scriber Creek around and upstream of the flooding problem area, including sediment supply, creek channel bed incision, bank erosion, sediment deposition, and channel bed aggradation. The results of the existing condition hydrologic and hydraulic model results and geomorphic analysis are summarized in Table D-1, including the recurrence interval and type of flooding at eight locations in the Scriber Creek Problem Area and erosion-related problems that are occurring in two locations in the Scriber Creek Problem Area. Flooding at 44th Avenue W was not evaluated during this analysis due to limitations discussed in Appendix F of this plan.

In order to address these problems, an ensemble of solutions was developed and evaluated using hydraulic modeling. Each component of this ensemble will help to significantly reduce the frequency and depth of flooding in the Scriber Creek Problem area. Table D-2 illustrates the frequency of flooding that can be expected with the proposed solutions in place as well as the severity of flooding that would occur during the 100-year storm. The culvert replacement solutions listed in Table D-2 were sized to meet Washington state fish passage criteria. Although salmon are currently unable to access this reach of Scriber Creek, the Washington Department of Fish and Wildlife (WDFW) would require replacement culverts to provide adequate fish passage in the expectation that manmade barriers to fish migration will eventually be rectified downstream (Holser 2008 personal communication). Additional detail on fish passage requirements for these solutions can be found in the Scriber Creek Flood Study report (Herrera 2009).

The solutions listed in Table D-2 address flooding and erosion problems in the Scriber Creek Problem Area by increasing flood flow conveyance and stabilizing eroding sections of the channel. These solutions will also meet fish and wildlife enhancement objectives (and expected permitting requirements) by using natural methods for reducing channel erosion and promoting fish passage throughout the stream corridor.

These solutions will need to be accompanied by an ongoing sediment management program in Scriber Creek. To implement the sediment management program, the City must first complete and submit a new Joint Aquatic Resources Permit Application (JARPA) for a WDFW Hydraulic Project Approval permit. As part of the permit application process, the City should reevaluate the list of locations, frequencies, and timing for sediment removal in the Scriber Creek Problem Area and in reaches upstream of the problem area.

The City will also need to continue addressing flow obstructions created by beaver activity in lower Scriber Creek. During the course of the Scriber Creek flooding analysis described above, an accumulation of woody debris was noted in the inlet to the 66-inch diameter culvert that conveys Scriber Creek under Interstate 5 (I-5). The woody debris reduces conveyance capacity and is likely beaver related. The City should coordinate with the Washington State Department of Transportation to remove the debris and place a trash rack on the inlet to the I-5 culvert to prevent beaver activity from causing a recurring flow obstruction at this location. Beaver dams are also present in the Scriber Creek Problem Area around I-5 and downstream of 44th Avenue W in the area that the City proposes to annex. Beaver activity in that area contributes to flooding of 44th Avenue W in major storms, and contributes to backwater effects that extend far upstream of I-5. Snohomish County and the City conducted limited beaver management activities prior to installation of the new culvert under 44th Avenue W. These activities included installation of beaver deceiver pipes to lower water levels on the upstream side of the dam during flood events (Mach 2009 personal communication). If the annexation occurs, the City should reevaluate beaver management in lower Scriber Creek, and consider enacting a long-term beaver monitoring and beaverdam control plan, in accordance with applicable state and federal permit requirements for improved flood flow conveyance.

Maple Road and Ash Way Problem Area

The intersection of Maple Road and Ash Way is adjacent to one of the gateway entrances to the City. The traffic volume at this intersection is heavy throughout the day and provides access to on ramps to SR 525, I-5 and I-405. This intersection is also a primary crossing of SR 525 and is located on an important emergency vehicle route.

According to City staff, the Maple and Ash intersection floods during every significant rainstorm (i.e., several times per rainy season)and results in closure of this intersection for several hours, approximately twice per year on average. Closure of this intersection results in traffic congestion along other roadway crossings of SR 525, I-5, and I-405 and also increases emergency vehicle response times by 5-10 minutes for locations northeast of the Maple and Ash intersection, according to City staff. Figure D-7 is a photo of the Maple and Ash Problem Area taken on December 3, 2007, which was an extremely large storm event. This photo shows approximately 3 to 4 feet of standing water in the Maple and Ash problem area.

In addition to anecdotal information obtained from City staff, a combination of field reconnaissance and simple hydraulic analysis were used to identify the likely causes of flooding in the Maple and Ash Problem Area. More detailed analysis will be required to identify a long-term solution to flooding of the Maple and Ash Problem Area. The scope of the study and an associated cost estimate were developed for the purposes of this plan. That study is included with the CIP project recommendations in Appendix E.

Table D-1. Flooding and Erosion Problems in the Scriber Creek Problem Area.

Location	Modeled event at which flooding first occurs (i.e., 2-, 10-, 20-, 50-, or 100-yr) [a]	Type of problem	Estimated Maximum Flooding Depth during the 100-year storm [a]	Apparent Causes [b]
176th Street SW to SR 99	NA	Erosion - Systematic channel enlargement	NA	Flow too great for existing channel
188th Street SW	10-yr	Flooding of arterial street	7 inches	Undersized culvert
189th Street SW	10-yr	Flooding of residential street	6 inches	Undersized culvert
190th Street SW	10-yr	Flooding of residential street	10 inches	Lack of slope, undersized downstream channel, undersized downstream culvert, and sediment deposition in the channel and culvert
190th Street SW	NA	Flooding of residences	NA	Lack of slope, undersized downstream channel, undersized downstream culvert, and sediment deposition in the channel and culvert
191st Street SW	20-yr	Flooding of residential street	5 inches	Undersized culvert
191st Street SW to 193rd Street SW	NA	Erosion of channel	NA	Flow too great for non-“hardened” channel
Upstream of 194th Street SW (Casa Del Rey condominiums)	NA	Sediment accumulation in channel	NA	Undersized and problematic culvert downstream, sediment accumulation in the channel
Private Driveway off 194th Street SW (Casa Del Rey condominiums)	NA	Flooding of residences	NA	Undersized and problematic culvert downstream
Private Driveway off 194th Street SW (Casa Del Rey)	100-yr	Flooding of residential street	2 inches	Undersized and problematic culvert
Private Driveway off ”old” 196th Street SW	50-yr	Flooding of residential street	11 inches	Lack of slope, inadequate conveyance
Old 196th Street SW	50-yr	Flooding of residential street	2 inches	Lack of slope, inadequate conveyance
Apartments and businesses 260 feet upstream of 200th Street SW and 50th Avenue W intersection	10-yr	Flooding of residences and commercial locations	10 inches	Lack of slope, inadequate conveyance under 200th Street and 50th Avenue Intersection, backwater effects from undersized I-5 culvert and beaver related conveyance problems downstream

Notes.
[a] Based on hydraulic modeling of existing conditions.
[b] Based on hydraulic modeling of existing conditions, field observations, and City staff.

Table D-2. CIP project solutions for Scriber Creek Flooding and Erosion Problem Area.

CIP ID	Location	Solution	Modeled event at which flooding first occurs (i.e., 2-, 10-, 20-, 50-, or 100-yr)[1]	Estimated Maximum Flooding Depth During the 100-Year Storm [a]
FL-1	188th Street SW	Replace existing culvert with 8’-2” x 5’-9” corrugated metal pipe arch	Passes all modeled flows	NA
FL-2	189th Street SW	Replace existing culvert with 12’-4”x 7’-9” corrugated metal pipe arch	Passes all modeled flows	NA
FL-3	190th Street SW	Replace existing culvert with 10’ x 5’ precast concrete box or 3-sided culvert structure	Passes all modeled flows	NA
FL-4	191st Street SW	Replace existing culvert with 8’ x 5’ precast concrete box or 3-sided culvert culvert structure	Passes all modeled flows. Also enables existing 6’ x 4’ precast concrete box culvert at 190th Street to pass 20-yr flow.	190th Street is approximately 2.0 inches under water.
FL-5 [b]	44th Avenue W at Scriber Creek crossing	Raise roadway in culvert crossing vicinity to reduce frequency of flooding of road surface that cannot be mitigated using a larger culvert	Solution not modeled	Solution not modeled
FL-6	Maple Road and Ash Way	Detailed study.	NA	NA
FL-7	Driveway off 194th Street SW (Casa Del Rey condominiums)	Replace existing culvert with 12’ x 5’ precast concrete box culvert.	Passes all modeled flows	NA
FL-8	Upstream of 200th Street SW and 50th Avenue W intersection	Backflow preventers and embankments.[c]	Solution not modeled	Solution not modeled
ER-1	Scriber Creek channel downstream of 191st Street SW	Approximately 200 linear feet of channel stabilization and restoration	NA	NA
ER-2	Scriber Creek channel between 176 Street SW and SR 99	Approximately 1000 linear feet of stream bank stabilization	NA	NA

Notes.
NA = not applicable
[a] Based on hydraulic modeling of proposed conditions, including all solutions listed in this table.
[b.] Problem and solution were not evaluated during development of this plan. Causes and solutions presented here are based on the City’s 2008-2013 Capital Facilities Plan (Lynnwood 2007).
[c] Solution presented in Scriber Creek Watershed Management Plan (Snohomish County et al. 1989). Solution should receive further evaluation prior to incorporation into the capital improvement program.

Figure D-7. December 3, 2007 flooding of the Maple Road and Ash Way intersection.

Field Reconnaissance

The following observations were made during field reconnaissance:

- Severe roadway settlement (estimated 2 to 4 feet)
- Settlement of land adjacent to the SR 525 support columns beside the roadway
- Crushed culvert inlets and outlets
- Culvert inlets and outlets filled with sediment
- Apparent adverse grade of culverts resulting from roadway settlement

Basic Hydraulic Analysis

Hydraulic analysis was conducted to determine whether high Swamp Creek water surface elevations may contribute to flooding in the Maple and Ash Problem Area. This analysis compared water surface elevations for Swamp Creek (Snohomish County 2002) with recent Light Detection and Ranging (LIDAR) elevation data for the problem area to determine the likely extents of inundation that would result from the Swamp Creek water surface elevations. Figure D-8 displays the estimated extents of inundation around the Maple and Ash Problem Area that would result from water surface elevation at the Swamp Creek flow control structure upstream of Maple Road under existing conditions. Figure D-9 shows the estimated extents of inundation around the Maple and Ash intersection that would result from the water surface elevation at the Swamp Creek flow control structure upstream of Maple Road under future land

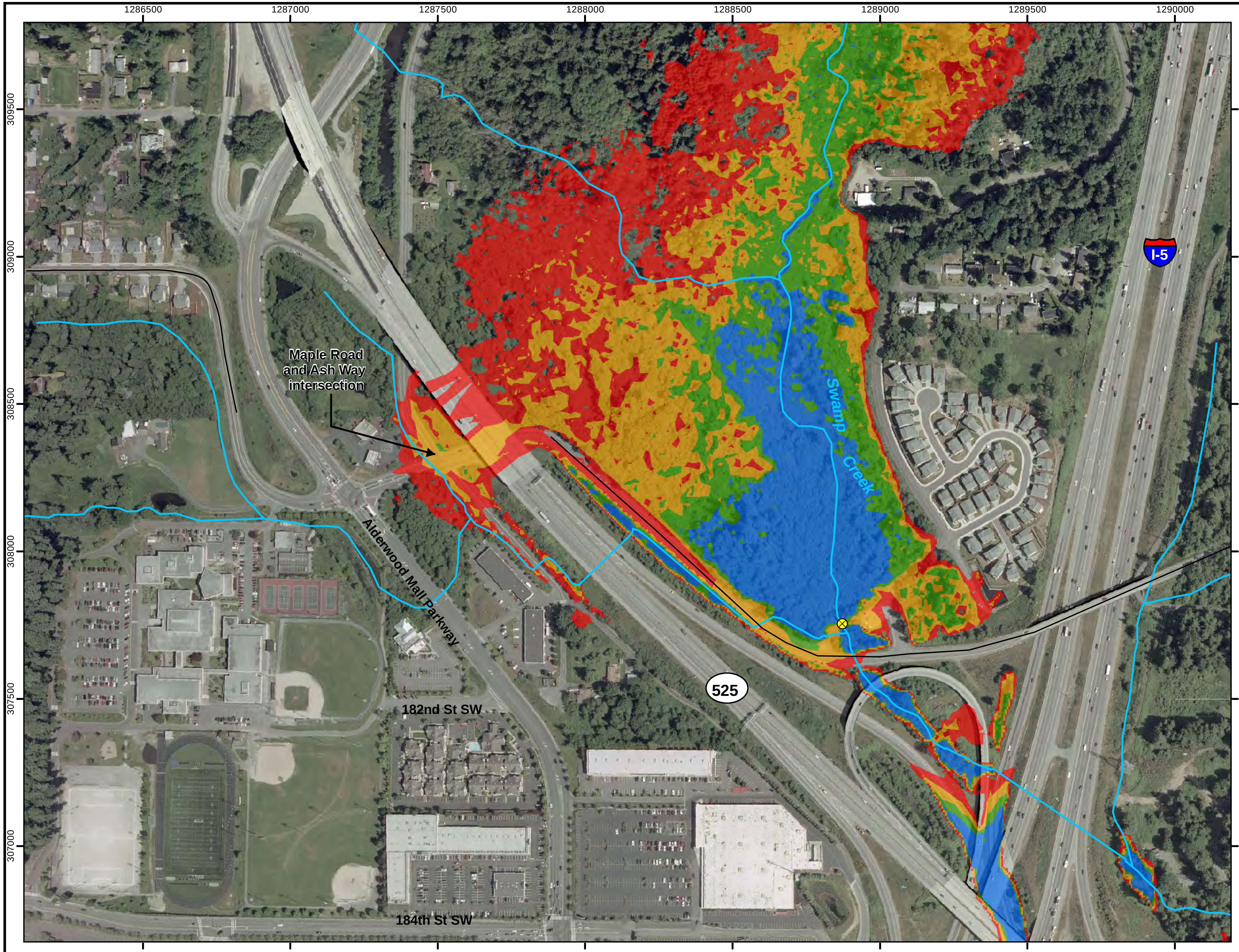


Figure D-8. Existing Land Use Conditions Flood Inundation Around the Maple Road and Ash Way Intersection Based on Existing Water Surface Elevations from the Swamp Creek Drainage Needs Report (Snohomish County 2002) at the Control Structure Upstream of Maple Road.

Legend

Control structure

Creeks

Surface inundation

< 347.50 (2-year)

348.85 (10-year)

350.6 (25-year)

352.54 (100-year)

N

0 162.5 325 650 feet

HERRERA ENVIRONMENTAL CONSULTANTS

Coordinates: Washington State Plane North
NAD 83 (feet)
Aerial: King County, 2002

Produced By: GIS (JAS)
Project:
K:/Projects/07-03686-001/Projects/Flood_inundation_swamp_control_structure.mxd (09/16/2008)

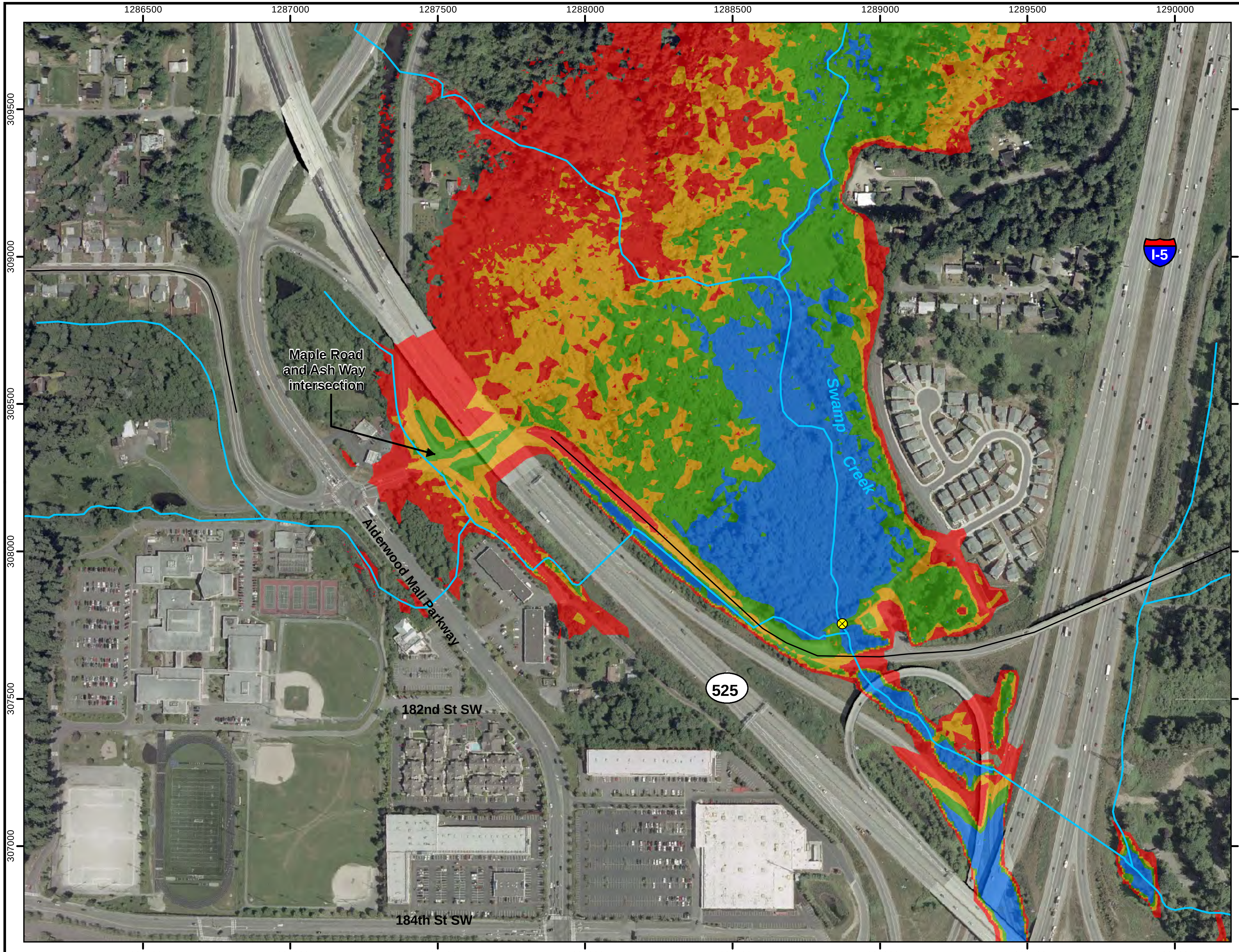


Figure D-9. Future Land Use Conditions Flood Inundation Around the Maple Road and Ash Way Intersection Based on Future Water Surface Elevations from the Swamp Creek Drainage Needs Report (Snohomish County 2002) at the Control Structure Upstream of Maple Road.

Legend

Control structure

Creeks

Surface inundation

< 347.9 (2-year)

347.9 - 349.98 (10-year)

349.98 - 351.6 (25-year)

351.6 - 355.15 (100-year)

N

0 162.5 325 650 feet

HERRERA ENVIRONMENTAL CONSULTANTS

Coordinates: Washington State Plane North
NAD 83 (feet)
Aerial: King County, 2002

Produced By: GIS (JAS)
Project:
K:/Projects/07-03686-001/Projects/Flood_inundation_swamp_control_structure.mxd (09/16/2008)

use conditions. The results indicate that the 25-year through 100-year existing water surface elevation and the 10-year through 100-year future water surface elevation for Swamp Creek at the flow control structure upstream of Maple Road would induce backwater flooding onto the roadway surface at the Maple and Ash intersection. Therefore, Swamp Creek likely plays a significant role in flooding of the Maple and Ash intersection during large storms (i.e., between 10- and 25-year recurrence interval), but is not a likely the direct cause of flooding during more frequent storms.

Discussion and Scope for Detailed Analysis

The eventual solution to flooding problems in the Maple and Ash problem area will likely involve rebuilding the roadway foundation, elevating the roadway, and replacing and/or realigning the drainage system surrounding the intersection. The solution may also include detention pond repair, basin-wide stormwater management requirements, and construction of levees.

The solution will need to address or account for the following apparent causes:

- Roadway settlement
- High flows through the intersection resulting from development in the Tunnel Creek basin
- Low gradient conveyance channels in and around the problem area
- Sediment accumulation in ditches and culverts around the Maple and Ash intersection
- Adverse slope, deterioration, and contortion of the roadway culverts resulting from roadway settlement
- High flows in the Swamp Creek basin.

In addition, there are also two suspected causes that will require further evaluation:

Malfunctioning detention ponds. City staff indicated that the detention ponds upstream of the Maple and Ash Problem Area do not fill with water during large storms. This could be an indication that these ponds are in need of maintenance or modification to restore their original function.

Dewatering of peaty soils underlying the Maple and Ash Problem Area. Severe ground settlement has occurred in the Maple and Ash Problem Area. Peat bog soil deposits are known to occur near the Maple and Ash Problem Area and nearby development has resulted in significant increases in impervious surfaces. Therefore, it is possible that reduced stormwater infiltration has caused dewatering of the peat soils, contributing to the settlement of the roadway in the Maple and Ash intersection. Additionally, pilings that support the SR 525 overpass near this intersection may have punctured an impermeable layer, allowing the peat soils to drain to deeper groundwater during the dry season.

In order to adequately evaluate the causes of flooding in the Maple and Ash Problem Area and identify the appropriate solution, detailed study of the problem will need to include the following components:

- Hydrologic modeling of Swamp Creek based on Snohomish County Drainage Needs Assessment models
- Refine delineation of Tunnel Creek basin and any other basin area that contributes flow to the Maple and Ash Problem Area

Hydrologic modeling of Tunnel Creek flow and tributary drainage area based on Snohomish County Drainage Needs Assessment models and refined basin delineation

- Drainage system and roadway reconnaissance
- Drainage system and roadway survey
- Review of available as-built roadway and drainage system plans and available topographic data
- Hydraulic modeling of runoff and stream flows through the intersection and interaction with water surface elevations in Swamp Creek. It is assumed that a two-dimensional hydraulic model would be needed to accurately assess the flooding problem.
- Geotechnical evaluation and predesign recommendations
- Study documentation
- Planning level engineering predesign and cost estimate for roadway and drainage system modifications

Appendix E presents the estimated cost for this study.

Site-Specific Water Quality Problems and Solutions

Based on identification of water quality problems in the various references listed in the Introduction section of this Surface Water Management Comprehensive Plan and feedback from City staff, five specific water quality problems were evaluated:

- Scriber Lake algal growth and nutrient enrichment
- Hall Lake pollution
- Golde Creek pollution

- Failing septic systems
- Roadway runoff pollutant loading

These five problems and recommended solutions are discussed in more detail below.

Scriber Lake

Scriber Lake was listed on Ecology's Clean Water Act Section 303(d) list for total phosphorus in 1996, 1998, and 2002/2004. The lake is also filling in at a rate of 10 feet per year from the edge (David Evans and Associates 2004). Low levels of dissolved oxygen are also a concern. A hypolimnetic aeration system was installed near the inlet of the lake and operated in 1990 and 1991 in combination with dilution of the lake with the City drinking water supply and operation of oil-water separators (URS 1992). The aeration system was intended to prevent anoxic conditions from forming in the bottom of the water column (hypolimnion), which in turn induces release of phosphorus from lake bottom sediments that contributes to algae growth. Algae decay is a contributor to low dissolved oxygen levels in the lake. Although the aeration system delayed the onset of anoxic conditions in the hypolimnion, it did not prevent it from occurring. The aeration system prevented hydrogen sulfide formation, reduced phosphorus concentrations in the hypolimnion, and decreased the biochemical oxygen demand (BOD) (URS 1992).

Proposed solutions to the water quality issues in Scriber Lake include retrofitting the hypolimnetic aeration system and/or installing a floating island treatment system. These solutions are presented as CIP projects in Appendix E. The floating island treatment system would provide biological treatment by plants and soil, and would include an aeration system separate from the hypolimnetic aeration system without significantly compromising the aesthetic appeal of the lake. Given the public usage of the adjacent park, a floating island treatment system could provide an excellent educational opportunity regarding phosphorus loading in basin runoff and ways to reduce it. The floating island treatment system could be installed adjacent to the existing floating dock in the lake or could also be a series of stand-alone floating islands.

Hall Lake

Hall Lake is an entirely private lake located in the southern portion of the City. The contributing drainage area is within the City limits and also includes some highway runoff from I-5 and runoff from Mountlake Terrace. The three primary concerns voiced by lake residents in a 2002 study (Gray and Osborne 2002) include lake hydraulics, water quality, and outlet channel maintenance. The main water quality concerns include large volumes of silt introduced to the lake during construction of I-5 and nutrient and metals loading from increased urban development in the watershed (Gray and Osborne 2002). In residential areas, metals loading in runoff is primarily due to vehicle brake emissions (i.e., copper), tire wear (i.e., zinc), building siding (i.e., multiple metals), and atmospheric deposition (i.e., cadmium, copper, and lead) (Davis et al. 2001a).

Public education regarding proper fertilizer use and a possible restriction on phosphorus-containing fertilizers in the watershed is discussed earlier in this appendix in the section on reducing nonpoint source pollution. In addition to those programmatic approaches to reducing pollutant loading to Hall Lake, retrofitting residential streets to incorporate runoff treatment using attractive bioretention swales and other LID techniques would have many direct and indirect benefits to the lake and downstream water bodies, including Lake Ballinger (PSAT 2005). Case studies of retrofits of existing City public rights-of-way in Seattle (Street Edge Alternatives ["SEA"] streets) and Portland, Oregon ("Simple Green Streets" and "Curb Extensions") indicate that these types of retrofits can provide cost-effective stormwater quality and quantity benefits, as well as creating aesthetic amenities (PSAT 2005, Elkin 2008).

These types of retrofits use compost-amended soil and small trees, shrubs, and groundcover within a swale, existing planter strip, or extruded curb planter area, to provide enhanced runoff storage, infiltration, and pollutant removal. By reducing the overall roadway width and increasing the vegetated area through which runoff flows, stormwater runoff and associated pollutant loading to downstream surface waters can be significantly minimized. As indicated by Seattle's 2nd Avenue SEA Street project, if these roadway and landscaping retrofits are well-designed, they can potentially fully infiltrate dry season runoff flows and up to 98 percent of wet season runoff (Horner et al. 2002). Mulch layers and deeper bioretention soils in the planted areas have been found to accomplish significant removal of heavy metals and phosphorus (PSAT 2005, Davis et al. 2001b). Bacteria within healthy soils can also help break down carbon-based pollutants like motor oil. Through the combined reduction of stormwater runoff volumes and the uptake of pollutants, retrofitted streets could improve the quality of runoff entering Hall Lake and may also help to reduce the volume of runoff entering Lake Ballinger during storm events. This could provide a meaningful contribution to Lake Ballinger flood control in relation to the City's partnership in the watershed forum that has been convened to address that recurrent flooding problem.

Various options for street edge retrofits are included under a general CIP project (#WQ-2) in Appendix E.

Golde Creek

Golde Creek drains an intensively developed portion of the City near Alderwood Mall. The watershed area within the existing City limits is dominated by commercial land uses. Sedimentation in the creek has been identified as a water quality concern (Jones and Stokes 2000). The creek also is a tributary to Swamp Creek, which has a TMDL for fecal coliform bacteria. Thus, drainage to Golde Creek could be a potential source of fecal coliform bacteria contamination of Swamp Creek.

The City could address these water quality issues via opportunistic retrofits of cost-effective stormwater treatment facilities. Two locations for such retrofits were identified during the course of this report update. A drainage ditch along the south side of Alderwood Mall Parkway between 28th Avenue W. and Poplar Way could be converted to a bioretention swale or bioretention area (rain garden). Another water quality improvement retrofit opportunity would be installation of a street edge or parking lot treatment system such as a Filterra® bioretention system with Bacterra™ media. Bioretention areas typically demonstrate fecal coliform bacteria removal rates of 40 to 70 percent and the new proprietary media (Bacterra™) formulated by Filterra, Inc. has been showing fecal coliform bacteria removal rates of 94 to 99 percent after a two to four storm event maturation period (CWP 2007, Ruby 2008). Two CIP projects for these types of treatment system retrofits are included in Appendix E (CIP projects #WQ-3A and WQ-3B).

Failing Septic Systems

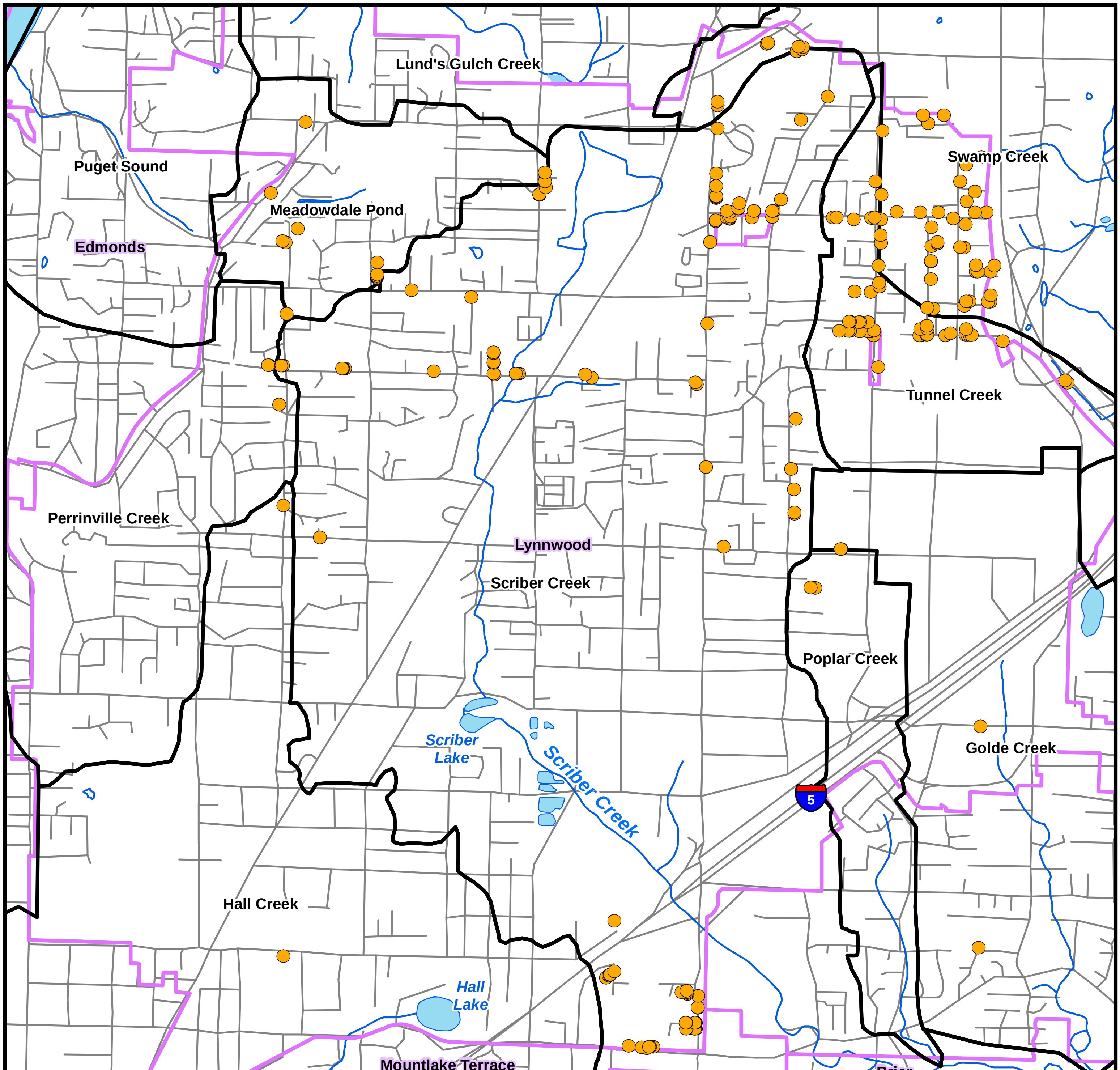
Houses in several drainage basins in the City are not connected to the sanitary sewer system and still operate on septic systems (see Figure D-10), including:

- 100 houses in the Scriber Creek basin,
- 51 houses in the Swamp Creek basin
- 47 houses in the Tunnel Creek basin
- 13 houses in the Meadowdale Pond basin
- 4 houses in the Golde Creek basin
- 4 houses in the Perrinville Creek basin
- 2 houses in the Hall Lake basin
- 2 houses in the Poplar Creek basin

Many houses operating on septic systems also lie within the MUGA proposed annexation areas and will need to be addressed once these areas have been annexed to the City. Failing septic systems are a concern primarily in the Scriber Creek/Swamp Creek watershed due to the fecal coliform bacteria TMDL for Swamp Creek. Failure of septic systems in Snohomish County is a common concern due to siting in poorly draining soils, inadequate installation, hydraulic overloading, and lapses in inspection and maintenance (Snohomish County 2002). Based on observations in nearby areas of unincorporated Snohomish County, similar impacts could also be an issue in Lynnwood, causing elevated loading of nutrients (i.e., nitrogen and phosphorus) and bacteria to enter groundwater or nearby surface waters via subsurface flow (CWP 2000). Two potential solutions to this problem were identified: (1) provide educational materials and septic system testing for homeowners and (2) connect these homes to the sanitary sewer system.

Education and septic system testing. The cost of educational programs in the City of Olympia and Thurston County, Washington have ranged from $35,000 to $40,000 to provide informational flyers or brochures, system monitoring, discount coupons for septic pumping, and training workshops (CWP 2000).

Connection to the sanitary sewer system. Currently, some of the residences using septic systems cannot be feasibly connected to the sanitary sewer system due to site constraints such as distance to the nearest sanitary sewer mainline, flow issues, or easement considerations. An average cost to remove the existing septic tank and connect a house to the City's sanitary sewer system is estimated to be approximately $25,000 per site. This estimate includes installation of onsite and offsite PVC piping, connection to the existing side sewer, septic tank decommissioning, and a 50 percent contingency. For failed septic systems within 200 feet of an



Legend

- Geocoded septic system address
- Creek
- Road
- Water body
- Basin Boundary
- City boundary

Note: The Maple precinct is reported to have 60-80 homes on septic systems; however, these addresses have not been documented and are not included in this figure.

Figure D-10. Septic System Locations in the City of Lynnwood, Washington (Source: Lynnwood, 2008).

N

0 1,100 2,200 4,400 Feet

HERRERA ENVIRONMENTAL CONSULTANTS

K:\Projects\07-03686-001\Project\geocoded_addresses.mxd existing sewer line, the Washington Administrative Code section 246-272A-0025 allows the local health officer to require connection to the public sanitary sewer system. Several local jurisdictions have initiated or are already evaluating programs to encourage or enforce homes on septic to connect to the sanitary sewer system, including the cities of Lake Forest Park, Vancouver, and Olympia in Washington State. A summary of the efforts these cities are implementing or considering is provided below:

- The City of Lake Forest Park requires homes with septic systems to secure an annual license and pay an onsite wastewater excise tax. The tax can be deferred until the property changes ownership. Homes with functioning septic systems, within 100 feet of the sanitary sewer, are not required to pay a connection fee until the property changes ownership or until their septic system fails (Lake Forest Park 2009).

- The City of Vancouver has developed a Sewer Connection Incentive Program. The City of Vancouver expands the sanitary sewer system in identified locations based primarily on prioritized sewer needs and public input collected during neighborhood meetings. The Sewer Connection Incentive Program provides residents on septic systems with low interest financing to connect to the sewer main line and perform on-site work related to side sewer construction and septic system decommissioning. As an additional incentive, the sewer main line connection fee is guaranteed for two years after the new sewer main has been constructed. Approximately one third of residents in newly sewered areas connect immediately after the sanitary sewer line is constructed, with the remaining residents typically connecting at the time of property transfer or when their septic system fails (Hale 2009 personal communication).

- The City of Olympia is currently evaluating four different incentive programs to convert homes from septic systems to sanitary sewers.

    - Allowing residents to waive or defer the general facilities charges associated with sewer connection if their home is converted within a 2-year period of sewer availability.

    - Providing discounts of up to 50 percent on sewer connection costs over a specified threshold value.

    - Providing low interest loans to residents who convert from septic systems to sanitary sewer through a Sewer Connection Assistance Loan Program funded using the Washington State Water Pollution Control Revolving Fund Loan.

    - Providing public sewer financing that would allow residents to borrow money from the City of Olympia and pay that money back to the City of Olympia using small monthly payments spread out over a long period of time. This plan could create significant risk for the City and would require the lender to pay back the loan in full at the time of property sale (Olympia 2008).

In order to protect surface water quality and reduce fecal coliform bacteria loading to Swamp Creek, the City of Lynnwood should evaluate potential options, such as those listed above, for converting homes from septic systems to public sanitary sewer systems. The City may be able to obtain a low interest loan from the Washington State Water Pollution Control Revolving Fund, which could be administered as low interest loans to citizens for conversion from septic systems to sanitary sewer connections.

Roadway Runoff Pollutant Loading

One relatively simple stormwater treatment retrofit would be to identify locations around the City that might benefit from converting an existing ditch to a bioretention swale to treat stormwater runoff. As described previously, several locations for these types of retrofits were identified in the Hall Lake watershed. The City should seek opportunities for cost-effective roadside drainage system retrofits to incorporate treatment in other drainage basins.

One potential location was identified during a limited reconnaissance of the City on June 26, 2008, along 180th Street SW west of SR 99. Currently, there is an unimproved ditch on the south side of the roadway that is approximately 12 feet in width and 150 feet in length and slopes towards Scriber Creek. This type of site is an ideal candidate for a bioretention swale or LID demonstration project. This specific treatment system retrofit is included as a recommended CIP project in Appendix E (CIP project #WQ-4). This same retrofit approach could also be applied to other similar locations in the City.

References

David A.C, R.M. Vaga, C.S. Munch, and S.M. Harris (1981) Paleocology of Hall Lake, Washington: A History of Meromixis and Disturbance. Ecology: Vol. 62, No. 3, pp. 848-863.

CWP. 2007. Urban Subwatershed Restoration Manual No. 3 – Urban Stormwater Retrofit Practices. Version 1.0. Prepared for the Office of Wastewater Management, U.S. Environmental Protection Agency, by the Center for Watershed Protection, Ellicott City, Maryland. July 2007.

CWP. 2000. Pollution Prevention Fact Sheet: Septic System Controls. Obtained from the Stormwater Manager's Resource Center (SMRC) Website: <www.stormwatercenter.net>. Prepared by the Center for Watershed Protection, Ellicott City, MD. 2000.

Davis, A.P., M. Shokouhian, and S. Ni. 2001a. Loading estimates of lead, copper, cadmium, and zinc in urban runoff from specific sources. Chemosphere 44: 997-1009.

Davis, A.P., M. Shokouhian, H. Sharma, and C. Minami. 2001b. Laboratory study of biological retention for urban stormwater management. Water Environment Research 73: 5-14.

Ecology. 2005. Stormwater Management Manual for Western Washington, Publication Numbers 05 01-029 through 05-10-033. Washington State Department of Ecology, Olympia, Washington.

Elkin, D. 2008. Portland's Green Streets. Lessons Learned Retrofitting our Urban Watersheds. Low Impact Development Conference Proceedings. Portland BES Sustainable Stormwater Program, Landscape Architect. November 2008.

Herrera. 2009. Scriber Creek Flood Study (in preparation). Prepared for the City of Lynnwood Public Works Department by Herrera Environmental Consultants, Inc., Seattle, Washington.

Holser, Ginger. 2008. Personal communication (telephone conversation with Mark Ewbank of Herrera Environmental Consultants, Inc., Seattle, Washington, regarding Washington Department of Fish and Wildlife stream simulation design criteria. Washington Department of Fish and Wildlife. December 22, 2008.

Horner, R., H. Lim, and S.J. Burges. 2002. Hydrologic Monitoring of the Seattle Ultra-Urban Stormwater Management Projects. Water Resources Series Technical Report No. 170. University of Washington, Seattle, Washington. November 2002.

Mach, David. 2009. Personal communication (telephone conversation with Matt Fontaine of Herrera Environmental Consultants, Inc., Seattle, Washington, regarding beaver management activities that were performed downstream of the City of Lynnwood). City of Lynnwood Public Works Department. April 6, 2008.

PSAT. 2005. Low Impact Development Technical Guidance Manual for Puget Sound. Puget Sound Action Team and the Washington State University Pierce County Extension, Olympia, Washington. May 2005.

Ruby, M. 2008. Bacterra by Americast Advanced Bioretention Media: Discussiong of the Benefits, Mechanisms, and Efficiencies for Bacteria Removal. Low Impact Development Conference Proceedings. Americast, Inc., Filterra Stormwater Treatment Products Division, Research and Development Manager. November 2008.

Snohomish County. 2002. Swamp Creek Drainage Needs Report, DNR No. 2. Snohomish County Department of Public Works Surface Water Management Division. Accessed via agency website on December 18, 2008. <http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/SWM/Library/Publications/Urban_Drainage/DNR/Swamp_DNR.htm>.

URS. 1992. Scriber Lake Restoration Project. Prepared for the City of Lynnwood, Washington by URS Consultants, Seattle, Washington. March 1992.

Hale, Sheryl. 2009. Personal communication (telephone conversation with Matt Fontaine of Herrera Environmental Consultants, Inc., Seattle, Washington, regarding Sewer Connection Incentive Program). City of Vancouver, WA. June 3, 2008. For general program information see <www.cityofvancouver.us/scip>.

Lake Forest Park, City of. 2009. City of Lake Forest Park Sanitary Sewer System Expansion (webpage). Accessed via agency website on June 3, 2009. <http://www.ci.lynnwood.wa.us/Content/HomePage.aspx?id=88>.

Olympia, City of. 2008. Septic to Sewer: Protecting our Natural Resources. City of Olympia Public Works Department. Accessed via agency website on June 3, 2009. <http://www.ci.lynnwood.wa.us/Content/HomePage.aspx?id=88>.

APPENDIX E

Capital Improvement Projects for Flood Control, Water Quality, and Habitat Improvement

Capital Improvement Projects for Flooding, Erosion, and Water Quality Improvement

Introduction

Appendix D presents an overview of citywide and site-specific surface water problems occurring in Lynnwood and the types of solutions that could be implemented to eliminate or reduce the severity of those problems. Because the City of Lynnwood (City) cannot afford to implement all of these projects in a short time frame, it is important to prioritize the potential capital improvement program (CIP) projects. This appendix includes discussion of a CIP project screening process to derive priorities for implementation, and provides backup detail for the preliminary cost estimates derived for each CIP project.

CIP Project Prioritization

Table E-1 provides a list of CIP projects and Table E-2 presents a scoring system used to quantify the benefits for each CIP project presented in this appendix. This scoring system reflects a variety of considerations that collectively represent the kinds of non-monetary issues the City must weigh when deciding on allocation of limited funding in the CIP program. Projects that would control a flooding problem are given an “FL” designation. Projects that would control erosion are given an “ER” designation. Projects that would improve upon existing water quality conditions are given a “WQ” designation.

Table E-1. Recommended capital improvement program projects.

Project ID	Project Title
FL-1	Scriber Creek culvert replacement at 188th Street SW
FL-2	Scriber Creek culvert replacement at 189th Street SW
FL-3	Scriber Creek culvert replacement at 190th Street SW
FL-4	Scriber Creek culvert replacement at 191st Street SW
FL-5	Raising the roadway at 44th Avenue W
FL-6	Flood study at Maple Road and Ash Way
FL-7[a]	Scriber Creek culvert replacement at Casa Del Rey condominiums driveway
FL-8[a]	Install backflow preventers and construct berms upstream of 200th Street SW and 50th Ave W
ER-1	Stabilize approximately 200 linear feet of stream channel between 191st Street SW and 193rd Place SW with grade control structures made of logs and boulders.
ER-2[a]	Stabilize approximately 1,000 linear feet of streambank using bioengineering techniques.
WQ-1A	Aeration system retrofit for Scriber Lake
WQ-1B	Floating island treatment system for Scriber Lake
WQ-2	Street edge runoff treatment retrofits in the Hall Lake basin
WQ-3A	Drainage ditch retrofit to a create a bioretention swale in the Golde Creek basin
WQ-3B	Installation of a street edge or parking lot treatment system such as a Bacterra TM bioretention system.
WQ-4	Conversion of existing unimproved ditch to a bioretention swale along 180th Avenue SW between State Route (SR) 99 and Scriber Creek

Notes:
[a] Problem and solution are on private property.

Problem and solution are on private property.A cost-benefit index for each project was derived based on the estimated implementation cost (design, permitting, and construction) divided by the benefit points. A lower cost-benefit index number correlates to higher priority, as the project would have a relatively higher overall benefit for the investment made. Tables E-3, E-4, and E-5 show the benefit points tallied for each CIP project presented in this appendix. Cost estimates for the projects are presented in the attached project summary sheets, as further described below.

Table E-5 presents the results of the project prioritization based on the cost-benefit calculations. These results should be used to generally guide the order in which the City implements the projects. For one project, retrofitting bioretention swales on residential streets in the Hall Lake drainage basin (WQ-2), there is a range of implementation scale (e.g., linear feet of street retrofitted with bioretention swales). This range of implementation scale results in a wide range of potential cost for this project, making it difficult to define a specific cost-benefit score to use in prioritization. For the purposes of initial project ranking presented in Table E-5, the midpoint of the potential quantity range was used to estimate the cost for CIP project WQ-2 project summary sheet. If the City decides to pursue a larger or smaller quantity than assumed here, the cost-benefit scoring of WQ-2, and resultant ranking for prioritized implementation, should be recalculated.

CIP Project Details

The attached project summary sheets describe the specific problems that can be addressed with a CIP project, the location of the project, the benefits that could be realized, a brief listing of key assumptions, and the estimated cost of design, permitting and construction. Each CIP project is given a unique title and identification number for reference. The locations of these projects are displayed in Figure E-1.

The cost estimates for most of the CIP projects were developed based upon information from similar projects in the region. The unit costs are appropriate for common applications. These costs are intended to provide an indication of the level of funding needed for implementation for CIP planning purposes, and should be assessed in greater detail and adjusted as necessary before launching analysis and design of any particular project.

Table E-2. Benefit points scoring system for potential flooding, erosion, and water quality improvement projects.

Flooding Reduction	
Project Benefits	Points
Roadway Flooding	
Major roadway - flooding for longer duration	15
Major roadway - flooding for a few hours	10
Minor roadway, parking lot, or building exterior area - flooding for longer duration	5
Minor roadway, parking lot, or building exterior area - flooding for a few hours	2
Roadway flooding multiplier for problem frequency (2 yr MRI = 3; 10 yr MRI = 2; 20 yr MRI = 1)	1,2,3
Property Flooding	
Property flooding - apartment complex and/or > 10 residences	20
Property flooding - 4 to 10 residences	10
Property flooding - 4 or more businesses	8
Property flooding - less than 3 residences	5
Property flooding - less than 3 businesses	4
Property flooding multiplier for problem frequency (2 yr MRI = 3; 10 yr MRI = 2; 50 yr MRI = 1)	1,2,3
Benefits of Reducing Flooding	
Flooding eliminated in 100 yr MRI event	15
Flooding recurrence reduced to 50 yr MRI or better	10
Public perception	
High public visibility / importance; or good faith opportunity to assist other jurisdictions	5
Low public visibility / importance; or no good faith opportunity to assist other jurisdictions	3
Source of Funding	
Attractive project with reasonable likelihood of grant funding or other external funding	5
Likely to receive funding only from Lynnwood Surface Water Utility	0
Property Ownership	
Public property	5
Private property	0
Erosion Control	
Project Benefits	Points
Type of Problem Addressed	
Systemic bank/channel erosion for long segments of stream channel	15
Concentrated erosion at outfall or streambank	10
Sheet erosion along roadway or streambank	3
Benefits of Addressing Erosion Problem	
Significant benefits to drainage conveyance, stream channel condition, and/or water quality	15
Moderate benefits to stream channel and/or water quality	5
Public perception	
High public visibility / importance; or good faith opportunity to assist other jurisdictions	5
Low public visibility / importance; or no good faith opportunity to assist other jurisdictions	3
Source of Funding	
Attractive project with reasonable likelihood of grant funding or other external funding	5
Likely to receive funding only from Lynnwood Surface Water Utility	0
Property Ownership	
Public property	5
Private property	0

Table E-2 (continued). Benefit points scoring system for potential flooding, erosion, and water quality improvement projects.

Water Quality Improvement	
Project Benefits	Points
Relative Size and Importance of Pollution Source	
Major pollution source to a priority water body (ESA listed species, TMDL, or on 303(d) list)	20
Moderate pollution source to a priority water body (ESA listed species, TMDL, or on 303(d) list)	10
Minor pollution source to a priority water body (ESA listed species, TMDL, or on 303(d) list)	5
Drainage Location	
Direct drainage to stream with known salmonid use	20
Drainage to lake or major wetland	10
Direct drainage to stream without known salmonid use	5
Drainage to minor wetland	2
Benefits of Solution	
Major reduction in runoff pollution to a priority water body (ESA listed species, TMDL, or on 303(d) list)	20
Major reduction in runoff pollution, or moderate reduction to a priority water body (ESA listed species, TMDL, or on 303(d) list)	15
Moderate reduction in runoff pollution, or minor reduction to a priority water body (ESA listed species, TMDL, or on 303(d) list)	10
Minor reduction in runoff pollution to non-priority water body	5
Public Education	
Opportunity for public education high	5
Opportunity for public education low	0
Public Perception	
High public visibility / importance; or good faith opportunity to assist other jurisdictions	5
Low public visibility / importance; or no good faith opportunity to assist other jurisdictions	0
Source of Funding	
Attractive project with reasonable likelihood of grant funding or other external funding	5
Likely to receive funding only from Lynnwood Surface Water Utility	0
Property Ownership	
Public property	5
Private property	0

Table E-3. Benefit scores for potential flood control CIP projects.

Flooding Reduction									
Project Benefits	Possible Points	FL-1	FL-2	FL-3	FL-4	FL-5	FL-6[a]	FL-7	FL-8[b]
Roadway Flooding									
Major roadway - flooding for longer duration	15					15	15		
Major roadway - flooding for a few hours	10	10							
Minor roadway, parking lot, or building exterior area - flooding for longer duration	5								
Minor roadway, parking lot, or building exterior area - flooding for a few hours	2		2	2	2			2	2
Roadway flooding multiplier for problem frequency (2 yr MRI = 3; 10 yr MRI = 2; 20 yr MRI = 1)	1,2,3	2	2	2	1	2	3	1	2
Property Flooding									
Property flooding - apartment complex and/or > 10 residences	20							20	20
Property flooding - 4 to 10 residences	10								
Property flooding - 4 or more businesses	8								
Property flooding - less than 3 residences	5			5	5				
Property flooding - less than 3 businesses	4						4		4
Property flooding multiplier for problem frequency (2 yr MRI = 3; 10 yr MRI = 2; 50 yr MRI = 1)	1,2,3			2	2		3	1	2
Benefits of Reducing Flooding									
Flooding eliminated in 100 yr MRI event	15	15	15	15	15			15	
Flooding recurrence reduced to 50 yr MRI or better	10					10			
Public perception									
High public visibility / importance; or good faith opportunity to assist other jurisdictions	5	5				5	5		5
Low public visibility / importance; or no good faith opportunity to assist other jurisdictions	3		3	3	3			3	
Source of Funding									
Attractive project with reasonable likelihood of grant funding or other external funding	5	5				5	5		
Likely to receive funding only from Lynnwood Surface Water Utility	0		0	0	0			0	0
Property Ownership									
Public property	5	5	5	5	5	5	5		
Private property	0							0	0
Total Benefit Points		50	27	37	35	55	72	40	57

Notes:
[a] Project is a study to define a CIP project.
[b] Solution not modeled.

jr /07-03686-000 appendix e - cip projects and prioritization.doc

Table E-4. Benefit scores for potential erosion control CIP projects.

Erosion Control			
Project Benefits	Possible Points	ER-1	ER-2
Type of Problem Addressed			
Systemic bank/channel erosion for long segments of stream channel	15		15
Concentrated erosion at outfall or streambank	10	10	
Sheet erosion along roadway or streambank	3		
Benefits of Addressing Erosion Problem			
Significant benefits to drainage conveyance, stream channel condition, and/or water quality	15		15
Moderate benefits to stream channel and/or water quality	5	5	
Public perception			
High public visibility / importance; or good faith opportunity to assist other jurisdictions	5	5	
Low public visibility / importance; or no good faith opportunity to assist other jurisdictions	3		3
Source of Funding			
Attractive project with reasonable likelihood of grant funding or other external funding	5	5	
Likely to receive funding only from Lynnwood Surface Water Utility	0		0
Property Ownership			
Public property	5	5	
Private property	0		0
Total Benefit Points		30	33

Table E-5. Benefit scores for potential water quality improvement CIP projects.

Project Benefits	Possible Points	WQ-1A	WQ-1B	WQ-2	WQ-3A	WQ-3B	WQ-4
Relative Size and Importance of Pollution Source							
Major pollution source to a priority water body (ESA listed species, TMDL, or on 303(d) list)	20	20	20				
Moderate pollution source to a priority water body (ESA listed species, TMDL, or on 303(d) list)	10			10		10	
Minor pollution source to a priority water body (ESA listed species, TMDL, or on 303(d) list)	5				5		5
Drainage Location							
Direct drainage to stream with known salmonid use	20						
Drainage to lake or major wetland	10	10	10	10			
Direct drainage to stream without known salmonid use	5				5	5	5
Drainage to minor wetland	2						
Benefits of Solution							
Major reduction in runoff pollution to a priority water body (ESA listed species, TMDL, or on 303(d) list)	20						
Major reduction in runoff pollution, or moderate reduction to a priority water body (ESA listed species, TMDL, or on 303(d) list)	15			15			
Moderate reduction in runoff pollution, or minor reduction to a priority water body (ESA listed species, TMDL, or on 303(d) list)	10	10	10		10	10	10
Minor reduction in runoff pollution to non-priority water body	5						
Public Education							
Opportunity for public education high	5		5	5	5		5
Opportunity for public education low	0	0				0	
Public Perception							
High public visibility / importance; or good faith opportunity to assist other jurisdictions	5	5	5	5	5		5
Low public visibility / importance; or no good faith opportunity to assist other jurisdictions	0					0	

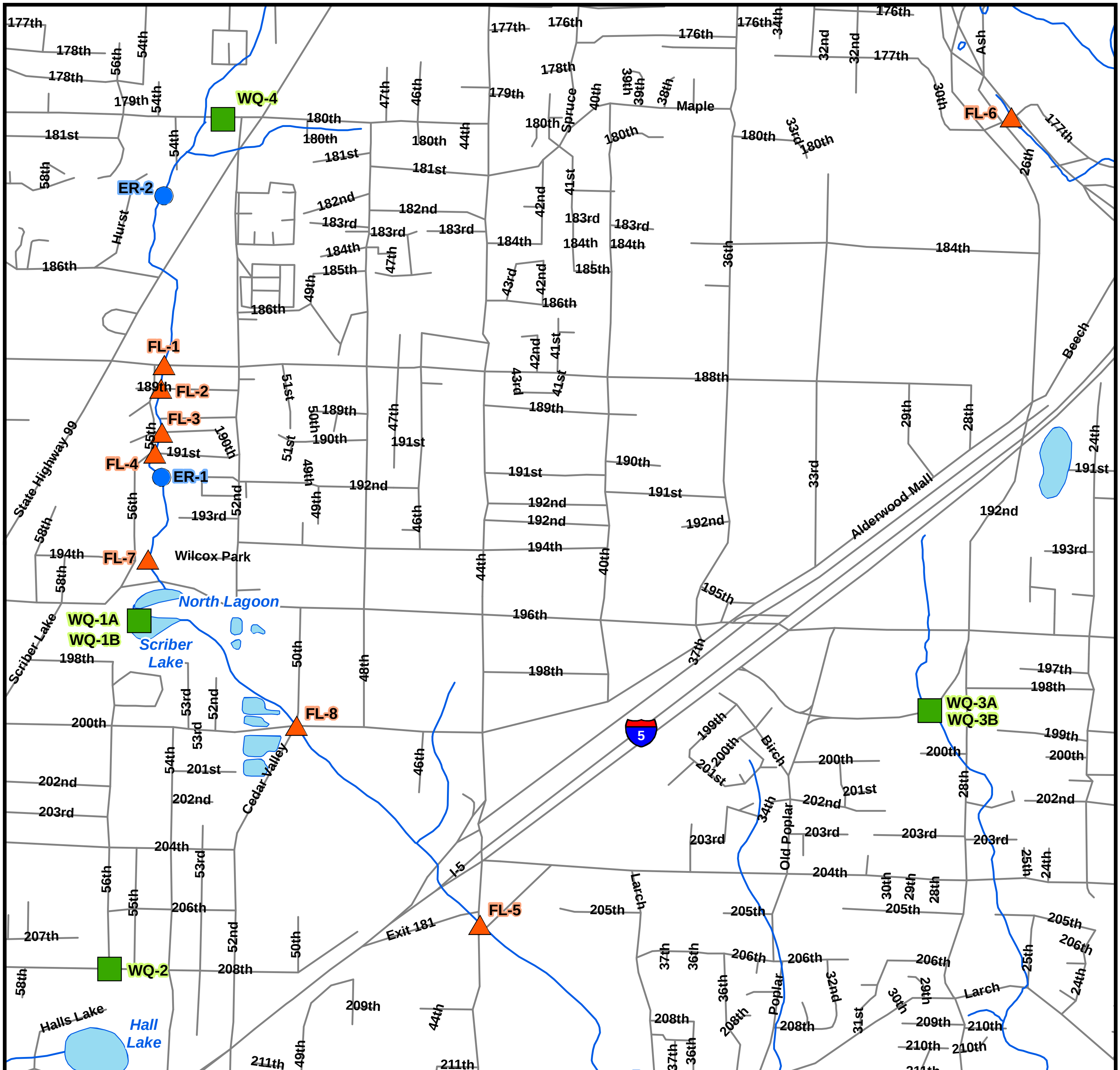
Table E-5 (continued). Benefit scores for potential water quality improvement CIP projects.

Project Benefits	Possible Points	WQ-1A	WQ-1B	WQ-2	WQ-3A	WQ-3B	WQ-4
Source of Funding							
Attractive project with reasonable likelihood of grant funding or other external funding	5			5			
Likely to receive funding only from Lynnwood Surface Water Utility	0	0	0		0	0	0
Property Ownership							
Public property	5	5	5	5	5	5	5
Private property	0						
Total Benefit Points		50	55	55	35	30	35

Table E-6. CIP project prioritization based on cost-benefit index calculations.

Rank	Cost/Benefit Score	Project ID	Project Title	Benefit Points	Estimated Cost (2009 dollars)
1	1800	WQ-1A	Aeration system retrofit for Scriber Lake	50	$ 90,000
2	2083	FL-6	Flood study at Maple Road and Ash Way	72	$ 150,000
3	2545	WQ-1B	Floating island treatment system for Scriber Lake	55	$ 140,000
4	3133	WQ-3B	Installation of a street edge or parking lot treatment system such as a Bacterra™ bioretention system	30	$ 94,000
5	3429	WQ-3A	Drainage ditch retrofit to a create a bioretention swale in the Golde Creek basin	35	$ 120,000
5	3429	WQ-4	Conversion of existing unimproved ditch to a bioretention swale along 180th St. SW between SR 99 and Scriber Creek	35	$ 120,000
7	7193	FL-8	Install backflow preventers and construct berm upstream of 200th Street SW and 50th Ave W	57	$ 410,000
8	9667	ER-1	Stabilize approximately 200 linear feet of stream channel with grade control structures made of logs and boulders	30	$ 290,000
9	12600	FL-1	Scriber Creek culvert replacement at 188th Street SW	50	$ 630,000
10	12857	FL-4	Scriber Creek culvert replacement at 191st Street SW	35	$ 450,000
11	14054	FL-3	Scriber Creek culvert replacement at 190st Street SW	37	$ 520,000
12	14250	FL-7	Scriber Creek culvert replacement at Casa Del Rey condominiums driveway and construct berm	40	$ 570,000
13	15185	FL-2	Scriber Creek culvert replacement at 189th Street SW	27	$ 410,000
14	37878	ER-2	Stabilize approximately 1,000 linear feet of streambank using bioengineering techniques	33	$1,250,000
15	38545	WQ-2	Street edge runoff treatment retrofits in the Hall Lake basin[a]	55	$2,120,000
16	81818	FL-5	44th Avenue W. roadway raising at Scriber Creek crossing	55	$4,500,000

Notes:
[a] Range of implementation scale will affect cost and benefit.



Legend

- Erosion project
- Flooding project
- Water quality project
- Lake
- Creek
- Road

Figure E-1. Capital Improvement Program Project Locations.

N

0 750 1,500 3,000 Feet

HERRERA ENVIRONMENTAL CONSULTANTS

K:\Projects\07-03686-001\Project\capital_improvement_projects.mxd

PROJECT SUMMARY SHEET

Project Title: Scriber Creek culvert replacement at 188th Street SW

Problem Description: Scriber Creek overtops 188th Street SW in a 10-yr recurrence interval flood event, disrupting traffic, endangering motorists and pedestrians, and causing flooding damage to adjacent properties.

Project Description: Replace existing 36-inch diameter culvert with a 90-foot long, 8'-2"-by-5'-9" corrugated metal pipe arch that accommodates fish passage.

Design Assumptions:

- Cut-and-cover construction.
- Temporary traffic detour during installation
- Stream dewatering via temporary sandbag dams and bypass pipe
- Bottomless concrete box structure placed on strip footing
- Geotechnical exploration needed for design
- Instream grade controls needed on upstream side to maintain wetland hydroperiod and stage-storage-discharge relationship

Project Benefits: Improved public safety, increased flow conveyance capacity, improved instream habitat, and improved fish passage.

Maintenance Requirements: Same as with all other city culverts.

Estimated Project Cost: $630,000

Notes.
1. Culvert is countersunk 2 feet below existing channel grade.

Figure 1. Proposed location for Scriber Creek culvert replacement at 188th Street SW.

Table 1. Planning level design, permitting, and construction cost estimate for Scriber Creek culvert replacement at 188th Street SW.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
REMOVE PAVEMENT	140	SY	$25	$3,500	assume 14' wide x 90' length
STRUCTURE EXCAVATION AND BACKFILL	440	CY	$35	$15,400	depth of excavation = 9', also includes wingwall areas
TEMPORARY SHORING	1,620	SF	$3	$4,860	
REMOVE AND DISPOSE OF EXISTING CULVERT	1	LS	$2,000	$2,000	
GRAVEL BEDDING	53	CY	$45	$2,385	
8'-2" x 5'-9" CORRUGATED GALVANIZED STEEL PIPE ARCH	1	EA	$17,000	$17,000	vendor quote, delivered to site
WING WALLS FOR ENTRANCE PROTECTION	1	LS	$15,000	$15,000	timbers or cast-in-place concrete with minor bank modifications
CULVERT INSTALLATION	1	LS	$30,000	$30,000	
GRADE CONTROL STRUCTURE(S) TO MAINTAIN UPSTREAM WETLANDS	1	LS	$10,000	$10,000	
STREAMBED GRAVEL	33	CY	$50	$1,650	12" depth for total length of 110' of stream channel /culvert
RIPARIAN PLANTINGS	1	LS	$10,000	$10,000	assume minor streambank replanting for 10' length at each end of culvert
WETLAND MITIGATION	1	LS	$30,000	$30,000	assume accomplished onsite
CRUSHED SURFACING TOP COURSE	14	CY	$75	$1,050	4" depth for 80' length of roadway width; high unit proce for small quantity
PAVEMENT, HOT MIX ASPHALT	36	TN	$300	$10,800	4" thickness
CEMENT CONCRETE SIDEWALK	120	SF	$16	$1,920	
CEMENT CONCRETE CURB AND GUTTER	24	LF	$30	$720	
METAL HANDRAIL	40	LF	$120	$4,800	
			Earthwork and Material Subtotal:	$161,085	does not include any utility relcations that may be necessary
OTHER ITEMS					
SUPPLEMENTAL SITE SURVEY DATA				$3,000	
GEOTECHNICAL INVESTIGATION				$20,000	assume necessary for culvert foundation design
MOBILIZATION			10%	$16,109	
STREAM CHANNEL DEWATERING / FLOW BYPASS				$20,000	
TEMPORARY EROSION AND SEDIMENT CONTROL			10%	$16,109	
TRAFFIC CONTROL			10%	$16,109	
CONTINGENCY			100%	$161,085	
SALES TAX			9%	$14,498	
			Subtotal Construction Cost:	$428,000	
DESIGN			30%	$128,400	
PERMITTING				$40,000	assume JARPA, SEPA checklist, wetland effects assessment, ESA no effect letter, and City of Lynnwood critical areas report
CONSTRUCTION MANAGEMENT			8%	$34,240	
			Total Estimated Project Cost:	**$630,000**	

PROJECT SUMMARY SHEET

Project Title: Scriber Creek culvert replacement at 189th Street SW

Problem Description: Scriber Creek overtops 189th Street SW in a 10-yr recurrence interval flood event, disrupting traffic, endangering motorists and pedestrians, and causing flooding damage to adjacent properties.

Project Description: Replace existing 42-inch diameter culvert with a 42-foot long, 12'-4"-by-7'-9"[1] corrugated metal pipe arch that accommodates fish passage.

Design Assumptions:

- Cut-and-cover construction.
- Temporary traffic detour during installation
- Stream dewatering via temporary sandbag dams and bypass pipe
- Bottomless concrete box structure placed on strip footing
- Geotechnical exploration needed for design
- Instream grade controls needed on downstream side to raise water surface profile through culvert

Project Benefits: Improved public safety, increased flow conveyance capacity, improved instream habitat, and improved fish passage.

Maintenance Requirements: Same as with all other city culverts.

Estimated Project Cost: $410,000

Notes.

1. Culvert is countersunk 3.82 feet below existing channel grade.

Figure 1. Proposed location for Scriber Creek culvert replacement at 189th Street SW.

Table 1. Planning level design, permitting, and construction cost estimate for Scriber Creek culvert replacement at 189th Street SW.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
REMOVE PAVEMENT	70	SY	$25	$1,750	assume 18' wide x 35' length
STRUCTURE EXCAVATION AND BACKFILL	350	CY	$35	$12,250	depth of excavation = 11' (overexcavate to countersink approx 3' of pipe)
TEMPORARY SHORING	924	SF	$3	$2,772	
REMOVE AND DISPOSE OF EXISTING CULVERT	1	LS	$3,000	$3,000	
GRAVEL BEDDING	39	CY	$45	$1,755	
12'-4" x 7'-9" CORRUGATED GALVANIZED STEEL PIPE ARCH	1	EA	$11,400	$11,400	vendor quote, delivered to site
WING WALLS FOR ENTRANCE PROTECTION	1	LS	$15,000	$15,000	timbers or cast-in-place concrete with minor bank modifications
CULVERT INSTALLATION	1	LS	$20,000	$20,000	
CHANNEL GRADE CONTROL STRUCTURES	1	LS	$5,000	$5,000	to backwater culvert from downstream side
STREAMBED GRAVEL	27	CY	$50	$1,350	12" depth for total length of 60' of stream channel /culvert
RIPARIAN PLANTINGS	1	LS	$10,000	$10,000	assume minor streambank replanting for 10' length at each end of culvert
CRUSHED SURFACING TOP COURSE	8	CY	$75	$600	4" depth for 80' length of roadway width; high unit price for small quantity
PAVEMENT, HOT MIX ASPHALT	22	TN	$300	$6,600	4" thickness
GUARDRAIL REMOVAL AND REPLACEMENT	1	LS	$3,000	$3,000	
			Earthwork and Material Subtotal:	$94,477	
OTHER ITEMS					
SUPPLEMENTAL SITE SURVEY DATA				$3,000	
GEOTECHNICAL INVESTIGATION				$20,000	assume necessary for culvert foundation design
MOBILIZATION			10%	$9,448	
STREAM CHANNEL DEWATERING / FLOW BYPASS				$25,000	deeper excavation requires more dewatering than at shallow culvert installations
TEMPORARY EROSION AND SEDIMENT CONTROL			10%	$9,448	
TRAFFIC CONTROL			10%	$9,448	
CONTINGENCY			100%	$94,477	
SALES TAX			9%	$8,503	
			Subtotal Construction Cost:	$273,800	
DESIGN			30%	$82,140	
PERMITTING				$30,000	assume JARPA, SEPA checklist, ESA no effect letter, and City of Lynnwood critical areas report; no wetland impacts
CONSTRUCTION MANAGEMENT			8%	$21,904	
			Total Estimated Project Cost:	**$410,000**	

PROJECT SUMMARY SHEET

Project Title:	Scriber Creek culvert replacement at 190th Street SW
Problem Description:	Scriber Creek overtops 190th Street SW in a 10-yr recurrence interval flood event, disrupting traffic, endangering motorists and pedestrians, and causing flooding damage to adjacent properties.
Project Description:	Replace existing 6-by-4 foot precast concrete box culvert with a 46-foot long, 10-by-4-foot[1] precast concrete 3-sided culvert that accommodates fish passage.
Design Assumptions:	▪ Cut-and-cover construction. ▪ Temporary traffic detour during installation ▪ Stream dewatering via temporary sandbag dams and bypass pipe ▪ Bottomless concrete box structure placed on strip footing ▪ Geotechnical exploration needed for design ▪ Instream grade controls needed on downstream side to raise water surface profile through culvert
Project Benefits:	Improved public safety, increased flow conveyance capacity, improved instream habitat, and improved fish passage.
Maintenance Requirements:	Same as with all other city culverts.
Estimated Project Cost:	$670,000

Notes.
1. Culvert is countersunk 1 foot below existing channel grade.

Figure 1. Proposed location for Scriber Creek culvert replacement at 190th Street SW.

Table 1. Planning level design, permitting, and construction cost estimate for Scriber Creek culvert replacement at 190th Street SW.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
REMOVE PAVEMENT	50	SY	$25	$1,250	assume 16' wide x 30' length
STRUCTURE EXCAVATION AND BACKFILL	190	CY	$35	$6,650	depth of excavation = 7' (overexcavate to countersink 1' of culvert bottom)
TEMPORARY SHORING	644	SF	$3	$1,932	
REMOVE AND SALVAGE EXISTING CULVERT	1	LS	$7,000	$7,000	
10' x 4' CONCRETE 3-SIDED CULVERT STRUCTURE	1	EA	$27,600	$27,600	vendor quote, delivered to site, 46' culvert length
WING WALLS FOR ENTRANCE PROTECTION	1	LS	$15,000	$15,000	timbers or cast-in-place concrete with minor bank modifications
CULVERT INSTALLATION	1	LS	$30,000	$30,000	
CHANNEL REGRADING AND GRADE CONTROL STRUCTURES	1	LS	$20,000	$20,000	
STREAMBED GRAVEL	28	CY	$50	$1,400	12" depth for total length of 75' of stream channel /culvert
RIPARIAN PLANTINGS	1	LS	$10,000	$10,000	assume minor streambank replanting for 10' length at each end of culvert
CRUSHED SURFACING TOP COURSE	6	CY	$75	$450	4" depth for 30' length of roadway width; high unit price for small quantity
PAVEMENT, HOT MIX ASPHALT	17	TN	$300	$5,100	4" thickness
GUARDRAIL REMOVAL AND REPLACEMENT	1	LS	$3,000	$3,000	
			Earthwork and Material Subtotal:	$129,382	
OTHER ITEMS					
SUPPLEMENTAL SITE SURVEY DATA				$3,000	
GEOTECHNICAL INVESTIGATION				$20,000	assume necessary for culvert foundation design
MOBILIZATION			10%	$12,938	
STREAM CHANNEL DEWATERING / FLOW BYPASS				$20,000	
TEMPORARY EROSION AND SEDIMENT CONTROL			10%	$12,938	
TRAFFIC CONTROL			10%	$12,938	
CONTINGENCY			100%	$129,382	
SALES TAX			9%	$11,644	
			Subtotal Construction Cost:	$352,200	
DESIGN			30%	$105,660	
PERMITTING				$30,000	assume JARPA, SEPA checklist, ESA no effect letter, and City of Lynnwood critical areas report; no wetland impacts
CONSTRUCTION MANAGEMENT			8%	$28,176	
			Total Estimated Project Cost:	**$520,000**	

PROJECT SUMMARY SHEET

Project Title:	Scriber Creek culvert replacement at 191st Street SW
Problem Description:	Scriber Creek overtops 191st Street SW in a 20-yr recurrence interval flood event, disrupting traffic, endangering motorists and pedestrians, and causing flooding damage to adjacent properties. This culvert also contributes to flooding of the roadway and single family residences at 190th Street.
Project Description:	Replace existing 48-inch diameter culvert with a 42-foot long, 8-by-5-foot[1] precast concrete 3-sided culvert that accommodates fish passage.
Design Assumptions:	▪ Cut-and-cover construction. ▪ Temporary traffic detour during installation ▪ Stream dewatering via temporary sandbag dams and bypass pipe ▪ Bottomless concrete box structure placed on strip footing ▪ Geotechnical exploration needed for design ▪ Instream grade controls needed on downstream side to raise water surface profile through culvert
Project Benefits:	Improved public safety, increased flow conveyance capacity, improved instream habitat, and improved fish passage.
Maintenance Requirements:	Same as with all other city culverts.
Estimated Project Cost:	$450,000

Notes.
1. Culvert is countersunk 1 foot below existing channel grade.

Figure 1. Proposed location for Scriber Creek culvert replacement at 191st Street SW.

Table 1. Planning level design, permitting, and construction cost estimate for Scriber Creek culvert replacement at 191st Street SW.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
REMOVE PAVEMENT	50	SY	$25	$1,250	assume 14' wide x 35' length
STRUCTURE EXCAVATION AND BACKFILL	160	CY	$35	$5,600	depth of excavation = 7'
TEMPORARY SHORING	630	SF	$3	$1,890	
REMOVE AND DISPOSE OF EXISTING CULVERT	1	LS	$2,000	$2,000	
8' x 5' CONCRETE 3-SIDED CULVERT STRUCTURE	1	EA	$25,000	$25,000	vendor quote, delivered to site
FOUNDATION PREPARATION	1	LS	$8,000	$8,000	
WING WALLS FOR ENTRANCE PROTECTION	1	LS	$15,000	$15,000	timbers or cast-in-place concrete with minor bank modifications
CULVERT INSTALLATION	1	LS	$25,000	$25,000	
CHANNEL GRADE CONTROL STRUCTURES	1	LS	$5,000	$5,000	to backwater culvert from downstream side
STREAMBED GRAVEL	18	CY	$50	$900	12" depth for total length of 60' of stream channel /culvert
RIPARIAN PLANTINGS	1	LS	$10,000	$10,000	assume minor streambank replanting for 10' length at each end of culvert
CRUSHED SURFACING TOP COURSE	6	CY	$75	$450	4" depth for 40' length of roadway width; high unit price for small quantity
PAVEMENT, HOT MIX ASPHALT	17	TN	$300	$5,100	4" thickness
GUARDRAIL REMOVAL AND REPLACEMENT	1	LS	$3,000	$3,000	
			Earthwork and Material Subtotal:	$108,190	
OTHER ITEMS					
SUPPLEMENTAL SITE SURVEY DATA				$3,000	
GEOTECHNICAL INVESTIGATION				$20,000	assume necessary for heavier culvert foundation design
MOBILIZATION			10%	$10,819	
STREAM CHANNEL DEWATERING / FLOW BYPASS				$20,000	
TEMPORARY EROSION AND SEDIMENT CONTROL			10%	$10,819	
TRAFFIC CONTROL			10%	$10,819	
CONTINGENCY			100%	$108,190	
SALES TAX			9%	$9,737	
			Subtotal Construction Cost:	$301,600	
DESIGN			30%	$90,480	
PERMITTING				$30,000	assume JARPA, SEPA checklist, ESA no effect letter, and City of Lynnwood critical areas report; no wetland impacts
CONSTRUCTION MANAGEMENT			8%	$24,128	
			Total Estimated Project Cost:	**$450,000**	

PROJECT SUMMARY SHEET

Project Title: Scriber Creek Culverts at 44th Avenue W. Phase 2

Problem Description:[1] Scriber Creek has overtopped the roadway at 44th Avenue during previous flood events. Scriber Creek crossing at 44th Avenue W was identified as a problem in the 1998 Comprehensive Flood and Drainage Management Plan.

Project Description:[1] This project is the second phase of project SD2003017A. The existing roadway has experienced substantial settlement due to poor underlying soils. Scriber Creek has experienced substantial sediment accumulation resulting in a higher creek profile. As a result, roadway flooding occurs during high storm events and is expected to increase in frequency as roadway settlement and creek siltation continues. The first phase of the project will improve roadway flooding but not ultimately. Phase two will raise the existing roadway.

Design Assumptions:[1]

- Problem and project solution were not evaluated during development of this plan.

Project Benefits:[1] Improved public safety and reduced frequency of flooding at 44th Avenue W.

Maintenance Requirements:[1] Same as with all other city culverts.

Estimated Project Cost:[1] $4,500,000

Notes.
1. Problem and solution were not evaluated during development of this plan. Causes, solution, and cost presented here are based on the City's 2008-2013 Capital Facilities Plan (Lynnwood, 2007).

PROJECT SUMMARY SHEET

Project Title:	Flood study at Maple Road and Ash Way
Problem Description:	The intersection of Maple Road and Ash Way floods during every significant rain event and the intersection is closed approximately two times per year due to severe flooding, disrupting arterial traffic flow for hours.
Project Description:	Conduct detailed study of causes of flooding, evaluate potential solutions, and identify a preferred solution.
Study Assumptions:	▪ Field survey required ▪ Hydrogeology investigation ▪ Hydrologic and hydraulic modeling
Project Benefits:	Identification of a solution that will solve flooding problems at Maple Road and Ash Way, thereby improving public safety, reducing the number of traffic disruptions, and reducing traffic congestion during rain storms.
Maintenance Requirements:	Not applicable.
Estimated Project Cost:	$150,000

Figure 1. Proposed location for flood study at Maple Road and Ash Way.

Table 1. Planning level cost estimate for detailed study of flooding at Maple Road and Ash Way intersection and planning level solution development and cost estimate.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
HYDROLOGIC MODELING	1	EA	$13,200	$13,200	Develop input for hydraulic model. Assumes revisions to existing Swamp Creek and Tunnel Creek hydrologic models previously prepared for Snohomish County Drainage Needs Reports.
FIELD RECONNAISSANCE	1	EA	$8,800	$8,800	Redelineate tunnel creek and drainage basins tributary to problem area. Drainage system and roadway reconnaissance. Other field work as required.
SURVEY DATA COLLECTION	1	EA	$15,000	$15,000	Topographic survey of drainage system and roadway. Survey of 500 feet of Swamp Creek channel. Traffic control. Assumes LIDAR will be adequate for modeling floodplain.
REVIEW AS BUILTS	1	EA	$2,400	$2,400	
2-DIMENSIONAL HYDRAULIC MODELING	1	EA	$40,000	$40,000	Model to simulate flow interaction between Tunnel Creek (upstream) and Swamp Creek (downstream) at drainage system and landscape scale in project vicinity. Includes modeling of 4 flow scenarios and 3 alternative solutions.
GEOTECHNICAL EVALUATION AND REPORT	1	EA	$25,000	$25,000	Est. from HWA Geosciences Inc.
REPORT PREPARATION	1	EA	$20,000	$20,000	
ENGINEERING PREDESIGN	1	EA	$10,000	$10,000	Conceptual design and planning level cost estimate. Basic graphics (not CAD).
MODEL DOCUMENTATION	1	EA	$15,000	$15,000	Modeling methods and design documentation.
			Study Subtotal:	$149,400	
			Total Estimated Project Cost:	**$150,000**	

PROJECT SUMMARY SHEET

Project Title:	Scriber Creek culvert replacement at Casa Del Rey condominiums driveway (extension of 194th Street SW) and embankment construction upstream of Casa Del Rey condominiums
Problem Description:	Scriber Creek overtops driveway in a 100-yr recurrence interval flood event, endangering motorists and pedestrians and causing flooding damage to adjacent properties and several residences in a condominium.
Project Description:	Replace existing twin 42-inch diameter concrete culverts with a 42-foot long, 12-by-5-foot[1] precast concrete 3-sided culvert that accommodates fish passage.
Design Assumptions:	▪ Cut-and-cover construction. ▪ Temporary traffic detour during installation ▪ Stream dewatering via temporary sandbag dams and bypass pipe ▪ Bottomless concrete box structure placed on strip footing ▪ Geotechnical exploration needed for design
Project Benefits:	Improved public safety, increased flow conveyance capacity, improved instream habitat, and improved fish passage.
Maintenance Requirements:	Same as with all other city culverts.
Estimated Project Cost:	$570,000

Notes.
1. Culvert is countersunk 1 foot below existing channel grade.

Figure 1. Proposed location for Scriber Creek culvert replacement at Casa Del Rey condominiums driveway.

Table 1. Planning level design, permitting, and construction cost estimate for Scriber Creek culvert replacement at 194th Street SW / Casa Del Rey Driveway and embankment construction upstream of Casa Del Rey.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
REMOVE PAVEMENT	80	SY	$25	$2,000	assume 18' wide x 40' length
STRUCTURE EXCAVATION AND BACKFILL	220	CY	$35	$7,700	depth of excavation = 7'
TEMPORARY SHORING	588	SF	$3	$1,764	
REMOVE AND DISPOSE OF EXISTING CULVERT	1	LS	$3,000	$3,000	
12’ x 5’ CONCRETE 3-SIDED CULVERT STRUCTURE	1	EA	$40,000	$40,000	vendor quote, delivered to site
FOUNDATION PREPARATION	1	LS	$10,000	$10,000	
WING WALLS FOR ENTRANCE PROTECTION	1	LS	$15,000	$15,000	timbers or cast-in-place concrete with minor bank modifications
CULVERT INSTALLATION	1	LS	$30,000	$30,000	
STREAMBED GRAVEL	27	CY	$50	$1,350	12" depth for total length of 60' of stream channel /culvert
RIPARIAN PLANTINGS	1	LS	$10,000	$10,000	assume minor streambank replanting for 10' length at each end of culvert
CRUSHED SURFACING TOP COURSE	9	CY	$75	$675	4" depth for 80' length of roadway width; high unit price for small quantity
PAVEMENT, HOT MIX ASPHALT	25	TN	$300	$7,500	4" thickness
CHAIN LINK FENCE REMOVAL AND REPLACEMENT	1	LS	$4,000	$4,000	
CONSTRUCTION GEOTEXTILE FOR PERMANENT SOIL STABILIZATION	500	SY	$8	$4,000	on embankment faces; high unit price for small quantity
BACKFILL FOR STRUCTURAL EARTH WALL INCL HAUL	150	CY	$50	$7,500	berm/embankment fill; high unit price for small quantity
EMBANKMENT COMPACTION	150	CY	$10	$1,500	high unit price for small quantity
WET NATIVE SEEDING AND MULCHING	250	SY	$5	$1,250	high unit price for small quantity
			Earthwork and Material Subtotal:	$147,239	
OTHER ITEMS					
SUPPLEMENTAL SITE SURVEY DATA				$3,000	
GEOTECHNICAL INVESTIGATION				$15,000	assume necessary for culvert foundation design
MOBILIZATION			10%	$14,724	
STREAM CHANNEL DEWATERING / FLOW BYPASS				$20,000	
TEMPORARY EROSION AND SEDIMENT CONTROL			10%	$14,724	
TRAFFIC CONTROL			10%	$14,724	
CONTINGENCY			100%	$147,239	
SALES TAX			9%	$13,252	
			Subtotal Construction Cost:	$389,900	
DESIGN			30%	$116,970	
PERMITTING				$30,000	assume JARPA, SEPA checklist, ESA no effect letter, and City of Lynnwood critical areas report; no wetlands impacts
CONSTRUCTION MANAGEMENT			8%	$31,192	
			Total Estimated Project Cost:	**$570,000**	

PROJECT SUMMARY SHEET

Project Title: Backflow preventers on outfalls to Scriber Creek and embankments upstream of 200th Street SW and 50th Avenue W

Problem Description: High water in Scriber Creek causes flooding of apartments and businesses upstream of the culvert under 200th Street SW and 50th Avenue W resulting in private property damage.

Project Description[a]: Install backflow preventers on low lying parking lot storm drain outfalls and construct embankments that protect buildings from high water levels in the creek.

Design Assumptions:

- Simple access to outfalls
- 1989 design solution and quantities are correct
- Additional design will be performed to evaluate outfalls and embankments size and locations prior to budgeting for this project

Project Benefits: Reduced flooding of apartments and businesses.

Maintenance Requirements:

- Annual inspection of check valves and embankments by property owners.
- Maintenance of embankment vegetation by property owners

Estimated Project Cost: $410,000

Notes.
a. This is an update of the solution developed in the Scriber Creek Watershed Management Plan (Snohomish County et al. 1989). Additional field reconnaissance and design must be conducted prior to CIP budgeting.

Figure 1. Install backflow preventers on storm drain outfalls and construct embankments along Scriber Creek upstream of 200th Street SW and 50th Avenue W.

Table 1. Planning level design, permitting, and construction cost estimate for installation of backflow preventers and berms near apartments and businesses directly upstream of 200th Street SW and 50th Avenue W.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
12" SLIP ON STYLE RUBBER CHECKVALVE W/ CLAMP	5	EA	$1,255	$6,275	vendor quote from Greaves
CHECK VALVE INSTALLATION	5	EA	$500	$2,500	40 percent of material cost. Simple access to outfall.
WET NATIVE SEEDING AND MULCHING	3,000	SY	$3	$9,000	
CONSTRUCTION GEOTEXTILE FOR PERMANENT SOIL STABILIZATION	6,000	SY	$4	$24,000	
BACKFILL FOR STRUCTURAL EARTH WALL INCL HAUL	2,000	CY	$35	$70,000	
EMBANKMENT COMPACTION	2,000	CY	$5	$10,000	
			Earthwork and Material Subtotal:	$121,775	
OTHER ITEMS					
SUPPLEMENTAL SITE SURVEY DATA				$3,000	
MOBILIZATION			10%	$12,177	
TEMPORARY EROSION AND SEDIMENT CONTROL			10%	$12,177	
TRAFFIC CONTROL			10%	$12,177	
CONTINGENCY			100%	$121,775	
SALES TAX			9%	$10,960	
			Subtotal Construction Cost:	$294,000	
DESIGN			25%	$73,500	
PERMITTING				$15,000	assume work completed in upland areas such that no in-water permits needed, but JARPA needed for work in wetland buffer, SEPA checklist, ESA no effect letter, and City of Lynnwood critical areas report
CONSTRUCTION MANAGEMENT			8%	$23,520	
			Total Estimated Project Cost:	**$410,000**	

PROJECT SUMMARY SHEET

Project Title: Scriber Creek channel stabilization south of 191st Street SW

Problem Description: The Scriber Creek channel is incising where the creek passes through a forested area between 191st Street SW and the school district property north of the Case Del Rey condominiums. The incising channel exports sediment in streamflow, increasing sediment loading to lower reaches of the creek where it deposits in lower-energy locations, thereby reducing streamflow conveyance capacity, contributing to flooding problems, and adding to the City's maintenance burden.

Project Description: Stabilize approximately 200 linear feet of stream channel with grade control structures made of logs and boulders.

Design Assumptions:

- Property owners will allow the City to access to the channel for construction work
- Stream dewatering via temporary sandbag dams and bypass pipe
- Bank regrading not necessary
- Installation of logs embedded into bank and channel bottom, backfilled with boulders and stream substrate
- Geotechnical exploration not needed for design
- Treatments will not be continuous between 191st Street SW and the school district property

Project Benefits: Improved instream habitat; greater connectivity of channel to floodplain wetland areas, providing flood storage capacity; retention of sediments transported from upstream; reduced sediment removal burden on the City in downstream locations.

Maintenance Requirements:

- Inspections to determine if long-term stabilization is accomplished.
- Minor log or boulder adjustment as necessary with hand-held equipment

Estimated Project Cost: $290,000

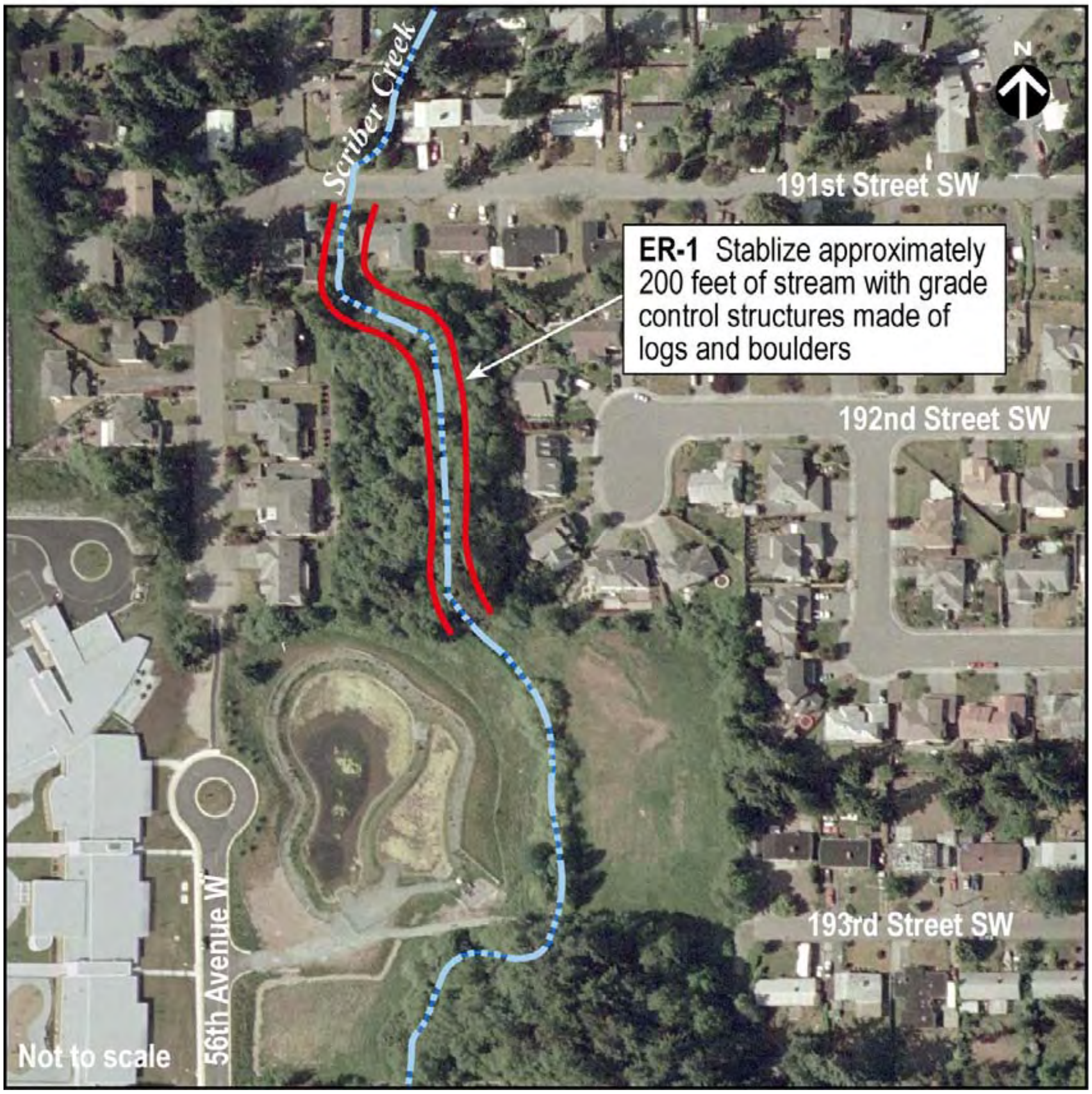


Figure 1. Proposed location for Scriber Creek channel stabilization.

Table 1. Planning level design, permitting, and construction cost estimate for Scriber Creek bed and bank stabilization between 191st Street SW and 193rd Street SW.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
GRADE CONTROL STRUCTURES	10	EA	$5,000	$50,000	log weirs on 20' spacing along channel length
STREAMBED GRAVEL	20	CY	$50	$1,000	8" depth for total length of 200' of stream channel
RIPARIAN PLANTINGS	1	LS	$20,000	$20,000	
			Earthwork and Material Subtotal:	$71,000	
OTHER ITEMS					
MOBILIZATION			10%	$7,100	
STREAM CHANNEL DEWATERING / FLOW BYPASS				$25,000	
TEMPORARY EROSION AND SEDIMENT CONTROL			10%	$7,100	
TRAFFIC CONTROL			5%	$3,550	
CONTINGENCY			100%	$71,000	
SALES TAX			9%	$6,390	
			Subtotal Construction Cost:	$191,100	
DESIGN			30%	$57,330	assume a few design plan sheets with typical details is sufficient
PERMITTING				$25,000	assume JARPA, SEPA checklist, ESA no effect letter, and City of Lynnwood critical areas report; no wetlands impacted; all work completed within 2 yrs
CONSTRUCTION MANAGEMENT			8%	$15,288	
			Total Estimated Project Cost:	**$290,000**	

PROJECT SUMMARY SHEET

Project Title: Scriber Creek bank stabilization

Problem Description: Scriber Creek is eroding its banks in several areas between 176th Street SW and State Route 99, increasing sediment loading to lower reaches of the creek where it deposits in lower-energy locations, thereby reducing streamflow conveyance capacity, contributing to flooding problems, and the City's maintenance burden.

Project Description: Stabilize approximately 1,000 linear feet of streambank using bioengineering techniques.

Design Assumptions:

- Private property owners will be willing to allow to the City access to the bank for construction work
- Stream dewatering via temporary sandbag dams and bypass pipe
- Minor bank regrading, and installation of vegetated geogrids or similar means to stabilize the bank with reinforced soil and native riparian vegetation plantings
- Some geotechnical exploration needed for design

Project Benefits: Increased flow conveyance capacity, improved instream habitat, reduced downstream flooding, and reduced sediment removal burden on the City in downstream locations.

Maintenance Requirements:

- Inspections to determine if long-term stabilization is accomplished.
- Maintenance of new vegetation plantings for approximately 3 years

Estimated Project Cost: $1,250,000

Figure 1. Proposed location for Scriber Creek bank stabilization.

Table 1. Planning level design, permitting, and construction cost estimate for Scriber Creek bank stabilization between 176th Street SW and SR 99.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
BANK EXCAVATION	740	CY	$40	$29,600	typical excavation per foot of channel length = 5' high bank * 4' bank face
REMOVE STRUCTURES AND OBSTRUCTIONS	1	LS	$25,000	$25,000	
BIOENGINEERED BANK TREATMENTS	1000	LF	$300	$300,000	planting and minor channel improvements included (gravel, wood pieces)
SEEDING ON DISTURBED GROUND	10,000	SF	$0.75	$7,500	
			Earthwork and Material Subtotal:	$362,100	
OTHER ITEMS					
GEOTECHNICAL INVESTIGATION				$30,000	several locations along stream length where easy access accommodated
MOBILIZATION			10%	$36,210	
STREAM CHANNEL DEWATERING / FLOW BYPASS			25%	$90,525	
TEMPORARY EROSION AND SEDIMENT CONTROL			10%	$36,210	
TRAFFIC CONTROL			10%	$36,210	
CONTINGENCY			100%	$362,100	
SALES TAX			9%	$32,589	
			Subtotal Construction Cost:	$985,900	
DESIGN			15%	$147,885	assume typical design details applicable to numerous locations; much of design effort focused on site-specific issues from landowner coordination
PERMITTING				$35,000	assume JARPA, SEPA checklist, ESA no effect letter, and City of Lynnwood critical areas report; no wetland impacts; all work completed within 2 yrs
CONSTRUCTION MANAGEMENT			8%	$78,872	
			Total Estimated Project Cost:	**$1,250,000**	

PROJECT SUMMARY SHEET

Project Title:	Aeration system retrofit for Scriber Lake
Problem Description:	Scriber Lake was included on the Department of Ecology's Section 303(d) list for total phosphorus in 1996, 1998, and 2002/2004. Low levels of dissolved oxygen in the hypolimnion are also a concern.
Project Description:	Retrofit of aeration system installed in 1989 to aerate the hypolimnion of the lake.
Design Assumptions:	▪ Existing system is no longer functional. ▪ Aerators, pumps, and a new pipe network will be installed.
Project Benefits:	Increased dissolved oxygen levels in the lake hypolimnion, reduced total phosphorus concentrations, and decreased frequency of algae blooms.
Maintenance Requirements[a]:	▪ Aerators: Consult manufacturer's operation and maintenance data ▪ Pumps: Consult manufacturer's operation and maintenance data ▪ Vault: Inspect weekly, open enclosures. Touch up damaged painting. Check for leakage and corrosion. ▪ Diffusers and Intake Screens: Unless there are indicators of flow restriction that cannot be resolved otherwise, there is no need to inspect the diffusers and intake screens. Excessive local bubbling at one or more diffuser ports may indicate plugging at other diffuser ports. ▪ Alarm Light: The alarm light in the park's restroom building should be visually observed on a daily basis.
Estimated Project Cost:	$90,000

[a] Source: Manufacturer's recommendations and Scriber Lake Restoration Aeration, Surface Water Dilution, and Oil Separation Operations and Maintenance Manual (URS 1989).

Figure 1. Proposed location for aeration system retrofit in Scriber Lake.

Table 1. Planning level design, permitting, and construction cost estimate for the aeration system retrofit in Scriber Lake.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions / Notes
AERATOR	2	EA	$5,336	$10,672	2 HP freshwater submersible aerator (Quote received via electronic mail from Aeromix, January 14, 2009)
PUMP	2	EA	$6,865	$13,730	Flygt Model CP3085.436, 3-inch impeller, 2.4 HP, 230 Volt, single-phase motor (Quote received via electronic mail from Aeromix, January 22, 2009)
PVC PIPE	1,600	LF	$1.40	$2,240	4-inch schedule 40 PVC pipe, comes in 10-foot lengths. Telephone conversation with Home Depot sales associate, Seattle, Washington.
			Material Subtotal:	$26,642	
OTHER ITEMS					
MOBILIZATION			10%	$2,664	
CONTINGENCY			100%	$26,642	
SALES TAX			9%	$2,398	
			Subtotal Construction Cost:	$58,300	
DESIGN			30%	$17,490	Coordination with vendor to confirm sizing, installation procedures, etc.
PERMITTING				$10,000	Assumes simple JARPA submittal/review process and no ESA documentation
CONSTRUCTION MANAGEMENT			8%	$4,664	
			Total Estimated Project Cost:	**$90,000**	

PROJECT SUMMARY SHEET

Project Title: Floating island treatment system for Scriber Lake

Problem Description: Scriber Lake was included on the Department of Ecology's Section 303(d) list for total phosphorus in 1996, 1998, and 2002/2004. Low levels of dissolved oxygen in the hypolimnion are also a concern.

Project Description: Installation of a floating island treatment system planted with sod, garden plants, or wetland plants.

Design Assumptions: The treatment system will include a series of semi-circular islands and an in-lake aerator to promote circulation between the islands. This design assumes that the aeration system retrofits described in WQ-1A will not be implemented.

Project Benefits: Reduced total phosphorus, nitrate, ammonia, and heavy metals concentrations. Decreased frequency of algae blooms. Increased dissolved oxygen concentrations.

Maintenance Requirements:

- Initial Maintenance: Keep the plants and sod damp until the roots grow down below the waterline. Remove rocks after a week or two, if desired.
- Ongoing Maintenance: The two maintenance options include tending to the floating island like a garden or allowing it to grow naturally. Avoid using chemicals such as algaecides, pesticides, and fertilizers.

Estimated Project Cost: $140,000

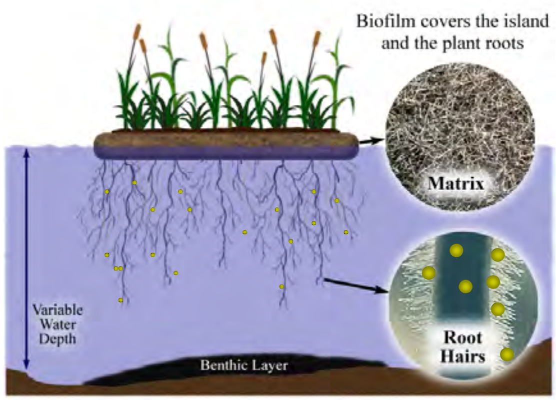


Figure 1. Example of a floating island treatment system (Floating Island International 2008).

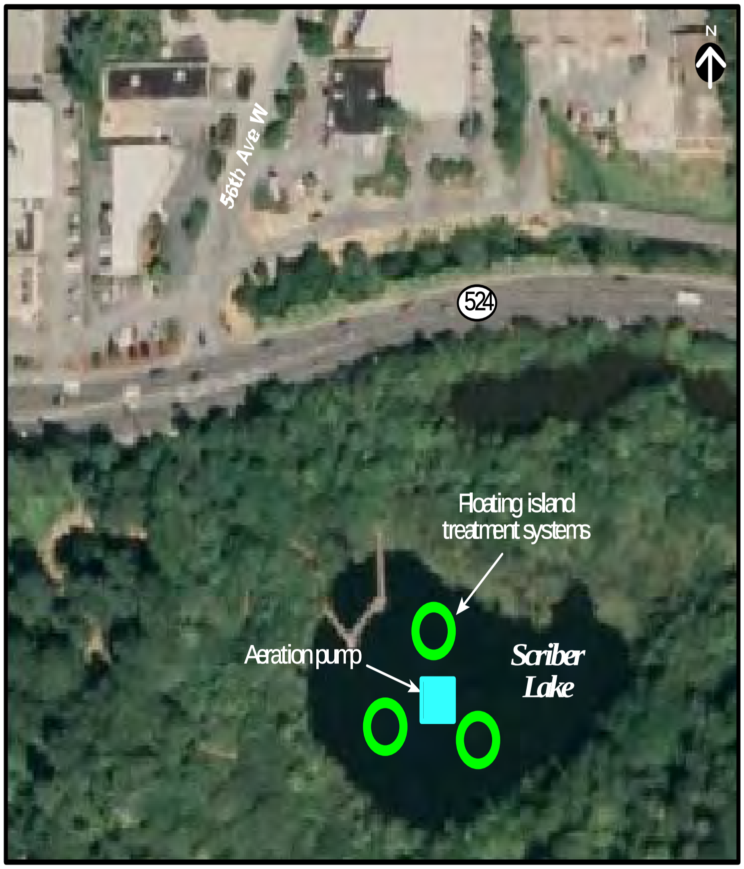


Figure 2. Proposed location for a floating island treatment system in Scriber Lake.

Table 1. Planning level design, permitting, and construction cost estimate for a floating island treatment system in Scriber Lake.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions / Notes
FLOATING ISLANDS	1,000	SF	$29	$29,000	1,000 SF total, semi-circle islands. Includes conceptual design, construction, and plant specification. Telephone conversation with Tim Mulholland (Floating Islands International).
NATIVE PLANTINGS	1,000	SF	$5	$5,000	Telephone conversation with Tim Mulholland (Floating Islands International)
IN-LAKE AERATOR	1.0	LS	$10,000	$10,000	Blue Frog 1/2-hp pump with slow moving impellor, 5,000 gallons/minute. Telephone conversation with Tim Mulholland (Floating Islands International).
			Material Subtotal:	$44,000	
OTHER ITEMS					
MOBILIZATION			10%	$4,400	
CONTINGENCY			100%	$44,000	
SALES TAX			9%	$3,960	
			Subtotal Construction Cost:	$96,400	
DESIGN			25%	$24,100	Coordination with vendor to confirm sizing, installation procedures, etc.
PERMITTING				$10,000	Assumes simple JARPA submittal/review process and no ESA documentation
CONSTRUCTION MANAGEMENT			8%	$7,712	
			Total Estimated Project Cost:	**$140,000**	

PROJECT SUMMARY SHEET

Project Title: Street Edge Runoff Treatment Retrofits in the Hall Lake Basin

Problem Description: Nutrient and metals loading to Hall Lake and downstream water bodies from urban development in the watershed.

Project Description: Installation of compost-amended soil, small trees, shrubs, and groundcover in roadside swales, and decreasing street width (e.g., impervious area) within the existing right-of-way.

Design Assumptions:

- Minimum road width of 20 feet based on the Lynnwood Fire Code.
- Vegetation will be selected by the City and local residents and will include a variety of small trees, shrubs, and groundcover. Plants should be selected to be drought tolerant and not require watering after establishment (2-3 years).
- Maximum ponding depth will be 12 inches.
- Planting soil depth approximately 12 inches.
- Mulch layer depth = 3 inches.
- 6-8" diam. underdrain - slotted PVC pipe.

Project Benefits: Enhanced runoff storage, infiltration, and pollutant removal (e.g., heavy metals, phosphorus, oil, and suspended solids).

Maintenance Requirements[a]:

- Watering: First 2-3 years until plants are established, watering during prolonged dry periods.
- Erosion Control: Inspect periodically and replace soil, plant material, and/or mulch layer in areas where erosion has occurred.
- Plant Material: Occasional pruning and removing dead plant material. Periodic weeding is necessary until plants are established.
- Nutrients and Pesticides: Nutrient and pesticide inputs should not be required since the soil mix and plants are selected for plant establishment and growth.
- Mulch: Add mulch as needed to maintain a 2-3 inch depth at least once every 2 years.
- Soil: The soil mix is designed to maintain long-term pollutant processing capability and should not need to be replaced for at least 20 years.

Estimated Project Cost[b]: $2,120,000 (to retrofit 50% of candidate streest identified)

Notes.
[a] Source: Low Impact Development Technical Guidance Manual for Puget Sound (PSAT 2005).
[b] Assumes implementation of Simple Green Streets at half of the potential locations. Total project cost depends on the number of blocks treated the type of retrofit (i.e., Simple Green Streets of SEA Streets).

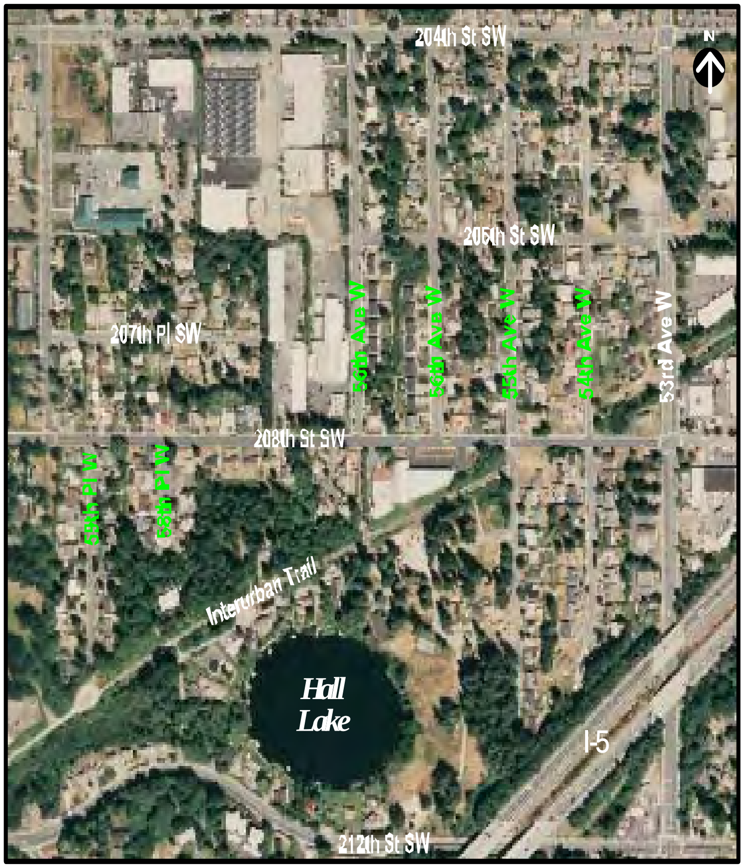


Figure 1. Potential locations for street edge runoff treatment retrofits in the Hall Lake drainage basin (highlighted in green).

Figure 2. Seattle Street Edge Alternative (SEA) (Seattle Public Utilities 2002).

Figure 3. Portland Simple Green Street (Elkin 2008).

Table 1. Planning level design, permitting, and construction cost estimate for street edge runoff treatment retrofits in the Hall Lake Basin.

Street	Current ROW Width (ft)	Current ROW Length (ft)	ROW Area (sf)	Local SEA Street Cost/LF ($)[a]	Total SEA Street Cost ($)	Simple Green Street Cost/LF ($)[b]	Total Simple Green Street Cost ($)
59th Pl W (S of 208th St SW)	59.1	723	42,729	$1,125	$813,214	$990	$715,647
58th Pl W (S of 208th St SW)	59.1	180	10,638	$1,125	$202,460	$990	$178,169
56th Ave W (N of 208th St SW)	59.1	610	36,051	$1,125	$686,114	$990	$603,796
55th Ave W (N of 208th St SW)	65	603	39,195	$1,125	$678,241	$990	$596,867
54th Ave W (N of 208th St SW)	58	605	35,090	$1,125	$680,490	$990	$598,847
53rd Ave W (N of 208th St SW)	65	603	39,195	$1,125	$678,241	$990	$596,867
53rd Ave W (S of 208th St SW)	65	555	36,075	$1,125	$624,251	$990	$549,356
Subtotal Construction Cost					**$4,363,000**		**$3,840,000**
Design (10%)					**436,000**		**384,000**
Permitting					**10,000**		**10,000**
First 2-3 yrs maintenance					**5,000**		**4,000**
Total Estimated Cost					**4,815,000**		**4,238,000**

[a] Low Impact Development Technical Guidance Manual for Puget Sound (PSAT 2005). Jan. 2005 costs updated to Jan. 2008 using the Engineering News Record (ENR) construction cost index (CCI), 3% added for inflation to estimate 2009 costs. Cost estimate includes 1 sidewalk per block, new street paving, traffic calming design, and enhanced landscaping.
[b] Source: Elkin 2008. 3% added for inflation to estimate 2009 costs. Cost estimate includes widening the existing planter strip, step-out zones to accommodate pedestrian access to vehicles, and enhanced landscaping/streetscapes. Cost estimate assumes road repaving not required.
ft = feet.
LF = linear foot.
ROW = right-of-way.
SEA = Street Edge Alternative.
sf = square feet.

Figure 5. Wide residential streets in the Hall Lake basin are also ideal for street Edge treatment swale retrofits.

Figure 4. Wide road shoulders in the Hall Lake basin are ideal for street edge treatment swale retrofits.

PROJECT SUMMARY SHEET

Project Title: Drainage ditch retrofit to a create a bioretention swale in the Golde Creek basin

Problem Description: Sedimentation in Golde Creek due to runoff from urban development in the watershed. Potential source of fecal coliform bacteria in Swamp Creek downstream (which has a TMDL for fecal coliform bacteria).

Project Description: Conversion of a drainage ditch along the south side of Alderwood Mall Parkway between 28th Ave and Poplar Way to a bioretention swale.

Design Assumptions:

- Vegetation will be selected by the City and local residents and will include a variety of small trees, shrubs, and groundcover. Plants should be selected to be drought tolerant and not require watering after establishment (2-3 years).
- Maximum ponding depth will be 12 inches.
- Planting soil depth should be approximately 1 foot.
- Mulch layer will be 3 inches.
- Underdrain of 6-8 inches slotted PVC pipe.

Project Benefits: Enhanced storage, infiltration, and pollutant removal (e.g., heavy metals, phosphorus, oil, and suspended sediments).

Maintenance Requirements[a]:

- Watering: First 2-3 years until plants are established, watering during prolonged dry periods
- Erosion Control: Inspect periodically and replace soil, plant material, and/or mulch layer in areas where erosion has occurred
- Plant Material: Occasional pruning and removing dead plant material. Periodic weeding is necessary until plants are established.
- Nutrients and Pesticides: Nutrient and pesticide inputs should not be required since the soil mix and plants are selected for plant establishment and growth.
- Mulch: Add mulch as needed to maintain a 2-3 inch depth at least once every 2 years.
- Soil: The soil mix is designed to maintain long-term pollutant processing capability and should not need to be replaced for at least 20 years.

Estimated Project Cost: $120,000

[a] Source: Low Impact Development Technical Guidance Manual for Puget Sound (PSAT 2005).

Figure 1. Potential location for a bioretention swale in the Golde Creek basin.

Figure 2. Current condition of drainage ditch along the south side of Alderwood Mall Parkway between 28th Ave and Poplar Way.

Table 1. Planning level design, permitting, and construction cost estimate for drainage ditch retrofit in the Golde Creek basin.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
REMOVE EXISTING ASPHALT	89	SY	$36	$3,200	Assume existing walkway has approximate dimensions 200-feet long by 4-feet wide. Unit cost is from Jan. 2007 Seattle Public Utilities (SPU) Unit Cost Report, 5% added for inflation.
POROUS CONCRETE	800	SF	$10	$8,000	Assume dimensions 200-feet long by 4-feet wide by 6-inch thickness. Telephone conversation with Glacier NW sales person and Robin Kirschbaum on 10-2-2007. Cost includes materials, placement, and environmental surcharge. Unit cost is high end, 5% added for inflation.
TOP COURSE	4.9	CY	$63	$311	2-inch depth. Unit cost is from Jan. 2007 SPU Unit Cost Report. 5% added for inflation.
AGGREGATE BASE	30	CY	$57	$1,689	12-inch depth. Unit cost is from Jan. 2007 SPU Unit Cost Report, 5% added for inflation.
GEOTEXTILE FOR SEPARATION	89	SY	$5.25	$467	Unit cost is from Jan. 2007 SPU Unit Cost Report, 5% added for inflation.
EXCAVATION	119	CY	$37	$4,385	Assume small bobcat access, 1.5-foot depth of bioretention soil mix and 0.5-foot swale depth, 2-foot bottom width, 3:1 side slopes.
INITIAL ROTOTILLING	52	CY	$0.75	$39	6-inch depth. Unit cost from SPU Raincatchers Project
COMPOST	12	CY	$50	$602	3-inch depth. Includes material, installation, and rototilling. Unit cost is from Jan. 2007 SPU Unit Cost Report, 5% added for inflation.
BIORETENTION SOIL	72	CY	$55	$3,972	1.5-foot depth. Includes material, installation, and rototilling. Unit cost is from Jan. 2007 SPU Unit Cost Report, $5/CY price difference from compost quoted by Cedar Grove, 5% added for inflation.
INFLOW SPREADER AND CHECK DAMS	1	LS	$3,000	$3,000	Use quarry spalls, treated timber, or other inexpensive materials. Based on professional judgment.
NATIVE PLANTINGS	1,950	SF	$5.00	$9,750	Tracy Tackett (SPU), personal communication
			Earthwork and Material Subtotal:	$35,415	
OTHER ITEMS					
SUPPLEMENTAL SITE SURVEY DATA				$3,000	
MOBILIZATION			10%	$3,541	
TEMPORARY EROSION AND SEDIMENT CONTROL			10%	$3,541	
TRAFFIC CONTROL			10%	$3,541	
CONTINGENCY			100%	$35,415	
SALES TAX			9%	$3,187	
			Subtotal Construction Cost:	$87,600	
DESIGN			20%	$17,520	Assume a few design plan sheets and no special provisions
PERMITTING				$10,000	Assumes only City permits needed
CONSTRUCTION MANAGEMENT			8%	$7,008	
			Total Estimated Project Cost:	**$120,000**	

PROJECT SUMMARY SHEET

Project Title: Street edge or parking lot runoff treatment retrofits in the Golde Creek drainage basin

Problem Description: Sedimentation in Golde Creek due to increased runoff from urban development in the watershed. Potential source of fecal coliform bacteria to Swamp Creek downstream (which has a TMDL for fecal coliform bacteria).

Project Description: Installation of a street edge or parking lot treatment system such as a Bacterra™ bioretention system.

Design Assumptions:

- Design infiltration rate of 65 inches per hour.
- Sizing infiltration rate from the Washington State Department of Ecology of 33 inches per hour.
- One 6 foot X 8 foot unit would treat 0.5 acre of impervious area (flat slope = 0-5%).
- Unit will be filled with Bacterra™ media to remove fecal coliform bacteria.

Project Benefits: Pollutant removal (e.g., heavy metals, oil, total suspended solids, fecal coliform bacteria).

Maintenance Requirements: The following maintenance activities should occur twice per year (once in the spring and once in the fall):

- Remove foreign debris, silt, mulch, and trash.
- Prune and replace plant, if necessary.
- Replace mulch.

Estimated Project Cost[a]: $94,000

Notes.
[a] Assumes treatment for 1 acre. Total project cost depends on the amount of drainage area treated and the total number of units installed.

Figure 1. Example of a Filterra ® bioretention system (Americast, Inc. 2007).

Table 1. Planning level design, permitting, and construction cost estimate for street edge or parking lot runoff treatment retrofits in the Golde Creek Basin.

	One 6' x 8' Bacterra™ Unit Treating 0.5 Acre	Two 6' x 8' Bacterra™ Units Treating 1.0 Acre
Capital Cost[a]	$13,700	$26,800
Vault Installation Cost (est.)	$15,000	$25,000
Patch Adjacent Pavement	$3,000	$6,000
Subtotal	$31,700	$57,800
Mobilization (10%)	$3,170	$5,780
Traffic Control (10%)	$3,170	$5,780
Temporary Erosion and Sediment Control (5%)	$1,585	$2,890
Design	$10,000	$12,000
Permitting	$5,000	$5,000
Construction Management (8%)	$2,536	$4,624
Total Cost	$55,000	$94,000

[a] Source;Americast, Inc. (Evans 2008). Cost includes delivery, Bacterra unit, plant, mulch, start-up, and 1-year maintenance fee.

Figure 2. Potential locations for street edge or parking lot retrofits in the Golde Creek basin.

Figures 3 and 4. Potential location for a street edge retrofit along Alderwood Mall Parkway (left) and an example of commercial development in the Golde Creek basin (above).

PROJECT SUMMARY SHEET

Project Title: Conversion of existing unimproved ditch to a bioretention swale along 180th Ave. SW between Hwy. 99 and Scriber Creek

Problem Description: Stormwater runoff from urban development transports sediment, oil and heavy metals into Scriber Creek

Project Description: Installation of compost-amended soil, small trees, shrubs, groundcover, and decreasing street width (e.g., impervious area) within the existing right-of-way.

Design Assumptions:

- Vegetation will be selected by the City and local residents and will include a variety of small trees, shrubs, and groundcover. Plants should be selected to be drought tolerant and not require watering after establishment (2-3 years).
- Maximum ponding depth 12 inches.
- Planting soil depth approximately 12 inches.
- Mulch layer depth 3 inches.
- 6-8" diam. slotted PVC underdrain pipe.

Project Benefits: Enhanced runoff storage, infiltration, and pollutant removal (e.g., heavy metals, phosphorus, oil, and suspended sediments)

Maintenance Requirements[a]:

- Watering: First 2-3 years until plants are established, watering during prolonged dry periods
- Erosion Control: Inspect periodically and replace soil, plant material, and/or mulch layer in areas where erosion has occurred
- Plant Material: Occasional pruning and removing dead plant material. Periodic weeding is necessary until plants are established.
- Nutrients and Pesticides: Nutrient and pesticide inputs should not be required since the soil mix and plants are selected for plant establishment and growth.
- Mulch: Add mulch as needed to maintain a 2-3 inch depth at least once every 2 years.
- Soil: The soil mix is designed to maintain long-term pollutant processing capability and should not need to be replaced for at least 20 years.

Estimated Project Cost: $120,000

[a] Source: Low Impact Development Technical Guidance Manual for Puget Sound (PSAT 2005).

Figure 1. Proposed location for a bioretention swale in the Scriber Creek basin.

Figure 2. Current condition of unimproved ditch along 180th Ave SW between Hwy. 99 and Scriber Creek.

Table 1. Planning level design, permitting, and construction cost estimate for bioretention swale retrofit along 180th Ave. between SR 99 and Scriber Creek.

Item	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
REMOVE EXISTING ASPHALT	89	SY	$36	$3,200	Assume existing walkway has approximate dimensions 200-feet long by 4-feet wide. Unit cost is from Jan. 2007 Seattle Public Utilities (SPU) Unit Cost Report, 5% added for inflation.
POROUS CONCRETE	800	SF	$10	$8,000	Assume dimensions 200-feet long by 4-feet wide by 6-inch thickness. Telephone conversation with Glacier NW sales person and Robin Kirschbaum on 10-2-2007. Cost includes materials, placement, and environmental surcharge. Unit cost is high end, 5% added for inflation.
TOP COURSE	4.9	CY	$63	$311	2-inch depth. Unit cost is from Jan. 2007 SPU Unit Cost Report. 5% added for inflation.
AGGREGATE BASE	30	CY	$57	$1,689	12-inch depth. Unit cost is from Jan. 2007 SPU Unit Cost Report, 5% added for inflation.
GEOTEXTILE FOR SEPARATION	89	SY	$5.25	$467	Unit cost is from Jan. 2007 SPU Unit Cost Report, 5% added for inflation.
EXCAVATION	119	CY	$37	$4,385	Assume small bobcat access, 1.5-foot depth of bioretention soil mix and 0.5-foot swale depth, 2-foot bottom width, 3:1 side slopes.
INITIAL ROTOTILLING	52	CY	$0.75	$39	6-inch depth. Unit cost from SPU Raincatchers Project
COMPOST	12	CY	$50	$602	3-inch depth. Includes material, installation, and rototilling. Unit cost is from Jan. 2007 SPU Unit Cost Report, 5% added for inflation.
BIORETENTION SOIL	72	CY	$55	$3,972	1.5-foot depth. Includes material, installation, and rototilling. Unit cost is from Jan. 2007 SPU Unit Cost Report, $5/CY price difference from compost quoted by Cedar Grove, 5% added for inflation.
INFLOW SPREADER AND CHECK DAMS	1	LS	$3,000	$3,000	Use quarry spalls, treated timber, or other inexpensive materials. Based on professional judgment.
NATIVE PLANTINGS	1,950	SF	$5.00	$9,750	Tracy Tackett (SPU), personal communication
			Earthwork and Material Subtotal:	$35,415	
OTHER ITEMS					
SUPPLEMENTAL SITE SURVEY DATA				$3,000	
MOBILIZATION			10%	$3,541	
TEMPORARY EROSION AND SEDIMENT CONTROL			10%	$3,541	
TRAFFIC CONTROL			10%	$3,541	
CONTINGENCY			100%	$35,415	
SALES TAX			9%	$3,187	
			Subtotal Construction Cost:	$87,600	
DESIGN			20%	$17,520	Assume a few design plan sheets and no special provisions
PERMITTING				$10,000	Assumes only City permits needed
CONSTRUCTION MANAGEMENT			8%	$7,008	
			Total Estimated Project Cost:	**$120,000**	

APPENDIX F

Scriber Creek Flood Study

SCRIBER CREEK FLOOD STUDY

188th Street SW to 44th Avenue W.

Prepared for

City of Lynnwood

June 2009

SCRIBER CREEK FLOOD STUDY

188th Street SW to 44th Avenue W.

Prepared for

City of Lynnwood
Public Works Department
19100 44th Avenue W.
Lynnwood, Washington 98036

Prepared by

Herrera Environmental Consultants, Inc.
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
Telephone: 206/441-9080

June 12, 2009

Contents

Tables

Figures

Background

Starting in 1989, the City of Lynnwood (City) began systematically identifying and evaluating specific drainage problems using a combination of hydrologic and hydraulic analysis. Hydrologic analysis is performed to quantify the amount surface water that drains to a particular location and hydraulic analysis is performed to evaluate how that water is conveyed across the landscape in culverts, ditches, and streams. The City has used these analyses to support capital facilities planning and engineering design of projects, paid for using Surface Water Utility Fund 411, that solve drainage and flooding problems. Previous projects that were supported by hydrologic and hydraulic analysis include the construction of the North Scriber Detention Facility, Meadowdale Glen Facility, and drainage improvements at the 44th Avenue W. crossing of Scriber Creek.

City staff determined that drainage problems along Scriber Creek from the crossing of 188th Street SW to the intersection of 200th Street SW and 50th Avenue W. (termed the Scriber Creek problem area in this report) were in need of additional study. This report describes the hydrologic modeling, hydraulic modeling, and geomorphic analysis that were conducted to evaluate flooding problems in the Scriber Creek problem area and identify and evaluate solutions.

Problem Description

Flooding has occurred in the Scriber Creek problem area for several decades, and taken the form of standing water in the City right-of-way, stream flooding over arterial streets, stream flooding over residential streets, and stream flooding that damages private property. Figure 1 identifies the major problems that have been identified in the Scriber Creek problem area during flood response, stormwater maintenance, field observations, and hydrologic modeling described in later sections of this report.

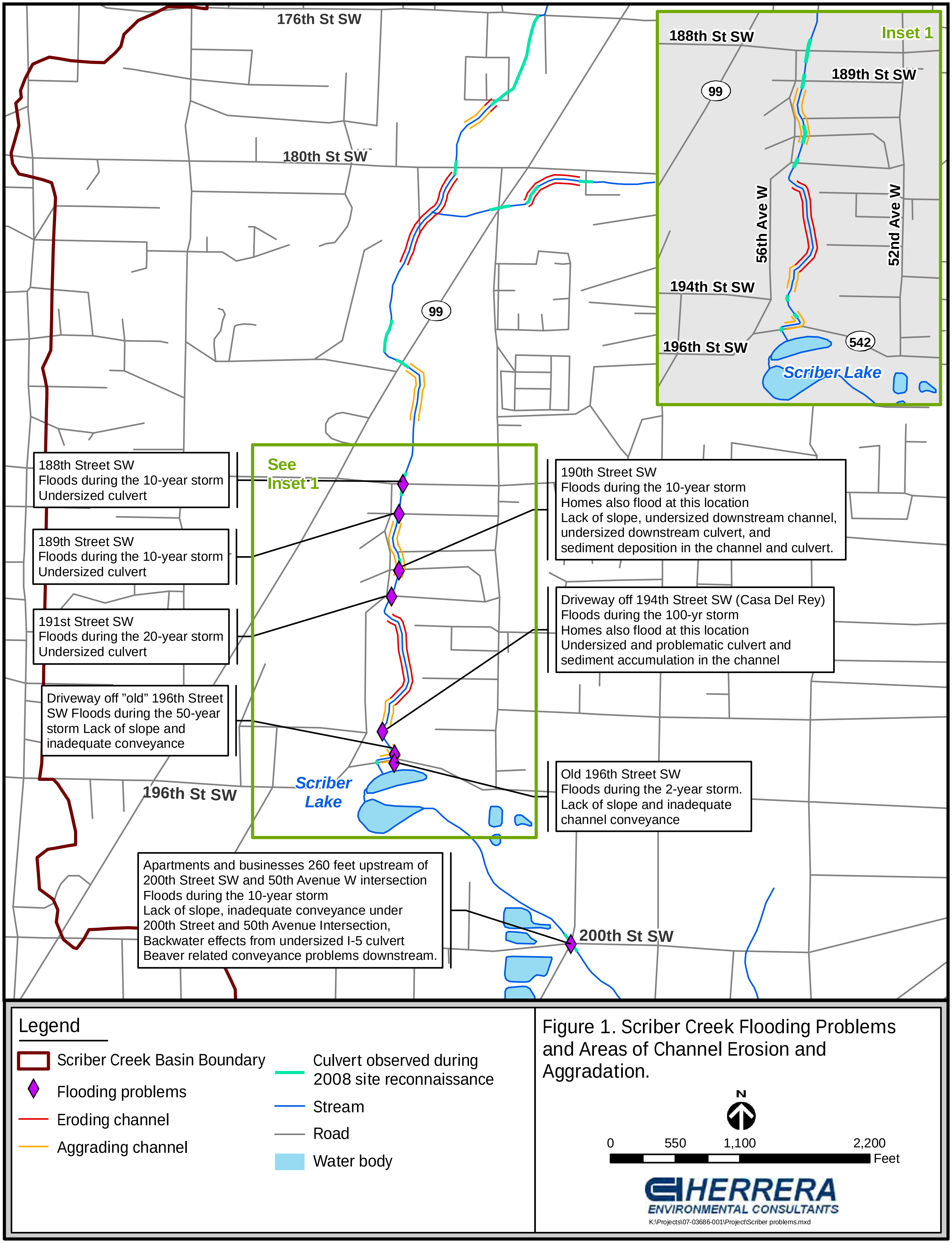


Figure 1. Scriber Creek Flooding Problems and Areas of Channel Erosion and Aggradation.

K:\Projects\07-03686-001\Project\Scriber problems.mxd

Hydrologic Modeling

Scriber Creek Hydrologic Model

The purpose of the hydrologic analysis was to determine the flood frequency and runoff characteristics in the Scriber Creek problem area. The hydrologic analysis for the Scriber Creek basin was performed using the Hydrological Simulation Program–FORTRAN (HSPF) model. This model was selected because it uses historical rainfall records to simulate a long time series of streamflow, making it well suited to address issues related to the cumulative impacts of development on drainage in urban creeks. Continuous simulation is particularly important in the City of Lynnwood, where flooding is often caused by a series of storms that occur back-to-back rather than by a single large event. The model also simulates streamflow at multiple locations during a single model run, making it ideal for analyzing problems and solutions over the length of the Scriber Creek problem area. The following section describes HSPF model development and application for the Scriber Creek basin. The results of the hydrologic modeling are used as input to the hydraulic model described in the following section.

Scriber Creek Hydrologic Model History

The initial hydrologic model for the Scriber Creek basin was developed in 1989 using HSPF in support of the Scriber Creek Watershed Management Plan (RW Beck 1989). Since 1989, several modifications have been made to the subbasin delineations, land use, and hydraulic routing in the model. These improvements were made to simulate the additional urban development in the Scriber Creek basin and changes to runoff detention and conveyance structures in the basin. Model revisions also incorporated improved modeling protocols and additional model calibration. Table 1 lists the date, modeler, and documentation for the three primary model revisions between 1989 and 2002. Readers are referred to the applicable hydrologic model documentation for details on each model revision.

Table 1. Summary of Scriber Creek basin hydrologic model development.

Date	Modeler	Documentation
1990	Northwest Hydraulic Consultants Inc. (NHC)	Scriber Creek Floodplain Mapping Study
1994	KCM	Swamp Creek Watershed Management Plan
2002	RW Beck	Snohomish County. 2002. Swamp Creek Drainage Needs Report
2007	NHC	HSPF model user control input file

The most recent revision to the model was completed in January 2007 by NHC. During this revision the basin boundaries were updated using information provided by the City, the existing land use was updated using 2005 aerial photos, and the hydrologic parameters for pervious and impervious landcover types were updated based on calibration to the Scriber Creek streamflow gauge at Oak Way. Snohomish County extended the precipitation and evaporation timeseries for the model to include the extreme flood event on December 3, 2007. The version of the model used for this study (Scriber Creek HSPF model) incorporated both the January 2007 revisions by NHC and the extended precipitation and evaporation timeseries.

Existing Model Input Data

The Scriber Creek HSPF model uses precipitation and evapotranspiration input data to simulate rainfall over the Scriber Creek basin (Figure 2). Table 2 displays the sources of the precipitation and evapotranspiration data used in the model.

Table 2. Precipitation and evapotransipration input to the Scriber Creek HSPF model.

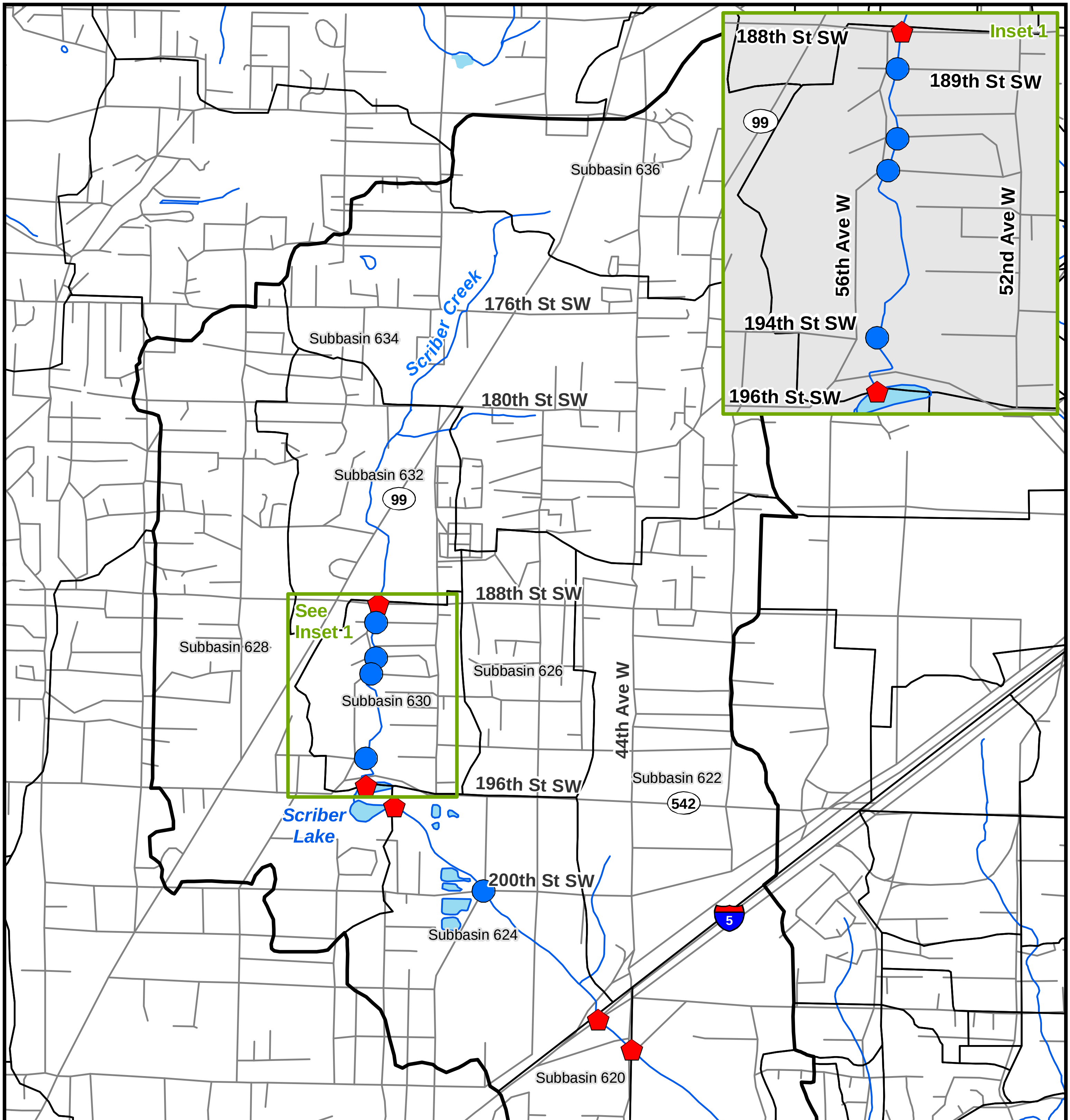
Station	Time Period
NOAA Everett Gauge	October 1, 1948, to October 1987
Snohomish County Alderwood Water District Office Rain Gauge at 15204 35th Avenue W., Lynnwood, WA	October 1987 to December 4, 2007

The proportion of rainfall that becomes runoff in Scriber Creek is a function of the timing and intensity of precipitation and the hydrologic properties of the land cover and soils in the basin. These properties depend on the type of development that has occurred in the basin and hydrologic properties of the underlying soils. As discussed above, the Scriber Creek HSPF model land use breakdown was recently revised based on 2005 aerial photography and the parameters that simulate underlying soil properties have been adjusted during calibration to measured flows in Scriber Creek at Oak Way.

Model Scenario and Analysis of Results

The Scriber Creek HSPF model was used to simulate runoff and streamflow in the Scriber Creek basin from October 1, 1948, to December 4, 2007. The HSPF model calculates the cumulative flow in Scriber Creek at each subbasin boundary using a 15-minute timestep. Subbasin boundaries are shown in Figure 2. The model calculates flows at several locations along Scriber Creek in Lynnwood, including the crossings of 188th Street SW, 196th Street SW, the outlet of Scriber Lake, Interstate 5 (I-5), and 44th Avenue W.

The instantaneous annual peak flow was identified in the HSPF model output for each water year at each subbasin boundary. Log Pearson Type-III (LP3) flow frequency analysis was conducted for the annual peak flows following the protocol in USGS Bulletin 17B (USGS 1982) and using Frequency Curve Spreadsheet Version 2.09 (NRCS 2007) to estimate the flow for large,



Legend

Hydrologic model subbasin boundary

Scriber Creek basin

Road

Stream

Water body

Interpolated flow location

Modeled flow location

Figure 2. Scriber Creek Hydrologic Model Subbasins and Modeled and Interpolated Flow Locations.

N

0 900 1,800 3,600 Feet

HERRERA ENVIRONMENTAL CONSULTANTS

K:\Projects\07-03686-001\Project\Scriber flow.mxd infrequent storms with recurrence intervals from 2 to 100 years. Flows at intermediate culverts were linearly interpolated, based on change in drainage area, from LP3 results at the nearest upstream and downstream modeled location. Figure 2 illustrates the subbasins of the hydrologic model, the locations where simulated flows were generated, and the locations where peak flows were interpolated. Interpolation was only used in cases where the additional contributing area between the interpolated point and the nearest upstream modeled location was a very small percentage of the drainage basin.

Hydrologic Modeling Results

Peak flows for the 2-, 10-, 20-, 50-, and 100-year storms are presented in Table 3 for seven locations in Scriber Creek.

Table 3. Estimated peak flow for the 2- through 100-year storms at several locations in and downstream of the Scriber Creek problem area based on flow frequency analysis of the HSPF hydrologic model output.

Recurrence Interval (yrs)	188th Street SW Flow (cfs)	189th Street SW Flow (cfs)	190th Street SW Flow (cfs)	191st Street SW Flow (cfs)	193rd Street SW (ped bridge) Flow (cfs)	196th Street SW Flow (cfs)	Scriber Lake Outlet Flow (cfs)	200th Street SW and 50th Avenue W. Flow (cfs)	Immediately downstream of 200th Street and 50th Avenue W. Flow (cfs)	I-5 Culvert Flow (cfs)	44th Avenue W. Flow (cfs)
2-year	50	51	52	53	56	58	76	80	84	91	121
10-year	82	83	85	87	92	96	131	137	142	146	193
20-year	96	98	100	102	108	112	152	159	164	165	220
50-year	116	119	122	124	131	135	180	187	193	188	254
100-year	133	136	139	141	149	154	200	208	214	205	279

Hydraulic Modeling

This section summarizes hydraulic modeling that was performed to assess flooding problems in the Scriber Creek problem area under existing conditions. Hydraulic modeling was performed using Hydrologic Engineering Center – River Analysis System (HECRAS) software program (version 4.0) developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center. The HEC-RAS program is a flood hazard mapping tool and is used by the Federal Emergency Management Agency for the development of Flood Insurance Rate Maps. HEC-RAS is a one-dimensional water surface profile program that is capable of modeling steady and unsteady, gradually varied flow. The computational procedure of a steady-state HEC-RAS model is based on solving of the energy equation and energy losses between channel/floodplain cross-sections. Energy losses are evaluated based on friction (Manning's equation) and contraction/expansion (coefficient multiplied by the change in velocity head).

A steady-state HEC-RAS model was developed to simulate the flow of water through the existing creek channel and hydraulic structures in and around the Scriber Creek problem area. Figures 3 and 4 show the locations of cross-sections in the Scriber Creek floodplain that were entered into the HEC-RAS model. The model was also used to perform planning-level evaluation of proposed capital improvement program (CIP) project solutions between 188th Street SW and 200th Street SW. The range of flows input into this hydraulic analysis is limited to the 2-, 10-, 20-, 50-, and 100-year flood events determined from the hydrologic modeling described previously in this report (Table 3).

HEC-RAS Model Setup

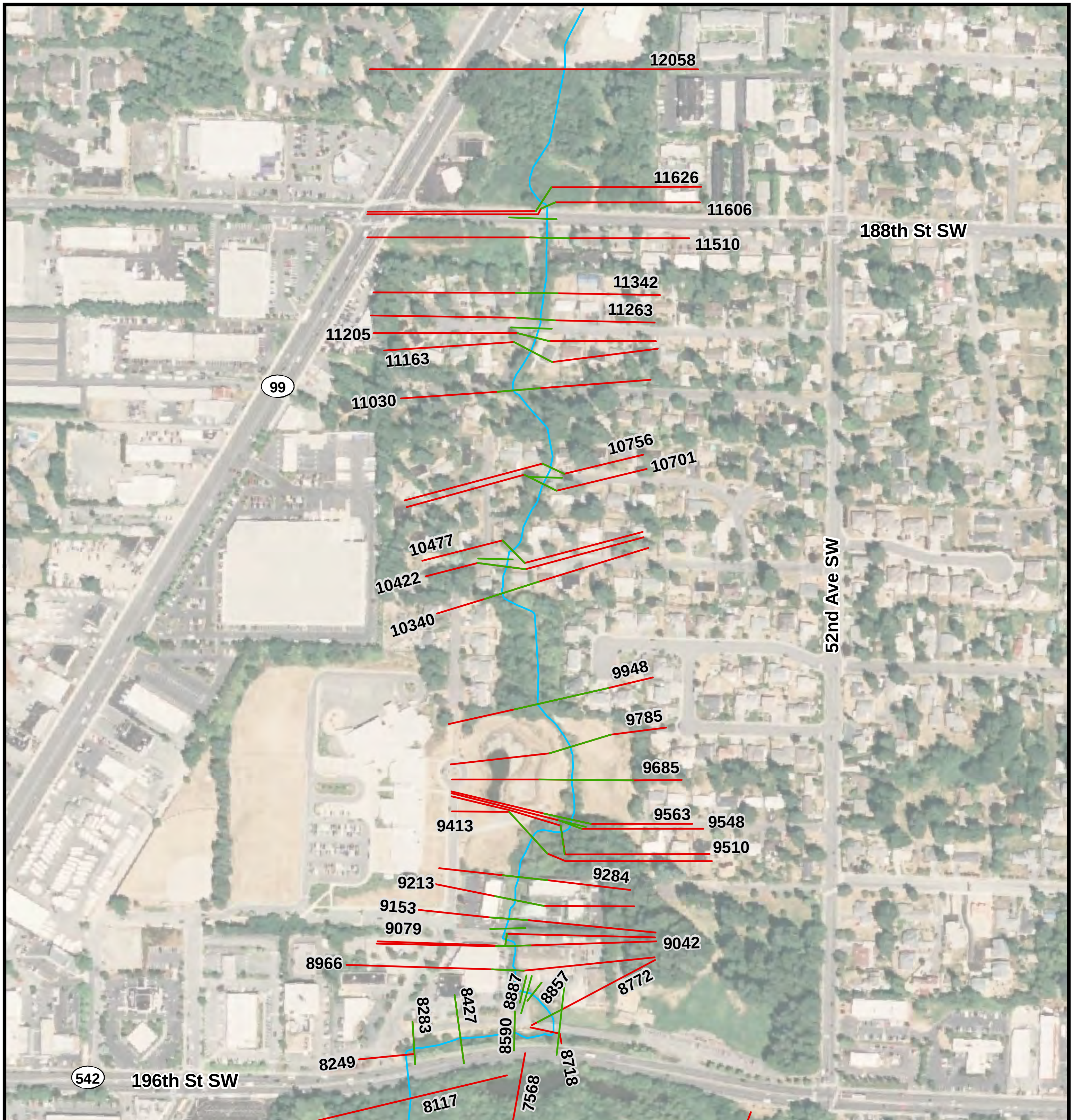
A steady-state HEC-RAS model was created to simulate specific hydraulic characteristics of Scriber Creek as it flows through the many culverts and bridges before its confluence with Swamp Creek. In order to initiate the step-backwater surface profile calculations of the HEC-RAS model, three general data elements are required:

1. Geometric data, such as cross-sections (transects) of the channel-floodplain area, hydraulic structures, and obstructions

2. Flow data

3. Defined boundary conditions

Once these data elements are input into the model, geometric data files are combined with flow data files to produce "plans". The following discussion briefly summarizes the geometric layouts, flow file, plans, boundary conditions, and the HEC-RAS model calibration for the study reach of Scriber Creek between 188th Street SW and 44th Avenue W.



Legend

Surveyed cross section

LiDAR cross section

Interpolated cross section

Scriber Creek

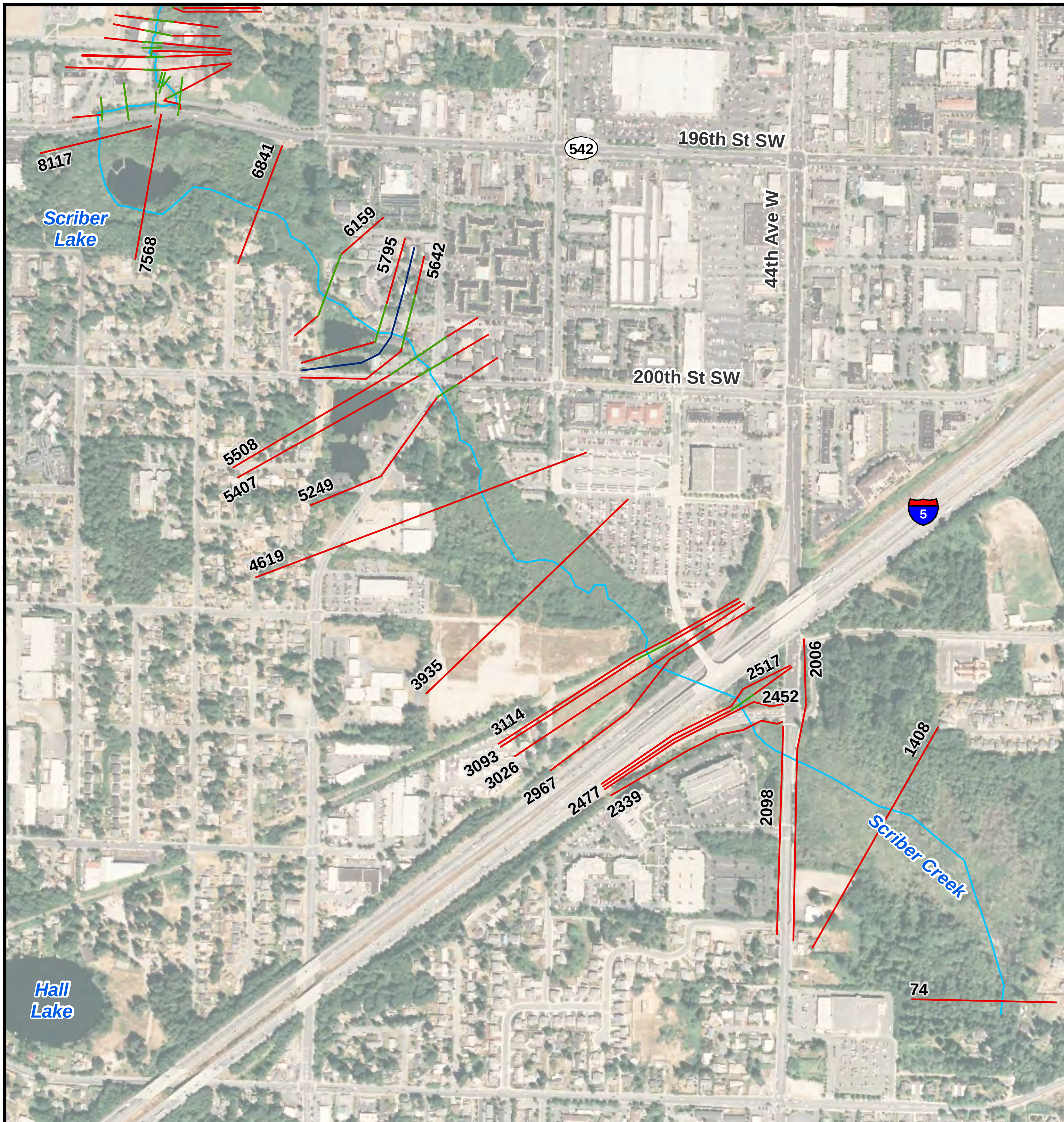
Figure 3. Scriber Creek HEC-RAS Cross Sections Upstream of State Route 542 (196th Street SW).

N

0 200 400 800 Feet

HERRERA ENVIRONMENTAL CONSULTANTS

K:\Projects\07-03686-001\Project\Scriber_XS.mxd



Legend

- Surveyed cross section
- LiDAR cross section
- Interpolated cross section
- Scriber Creek

Figure 4. Scriber Creek HEC-RAS Cross Sections Downstream of State Route 542 (196th Street SW).

N

0 375 750 1,500 Feet

HERRERA ENVIRONMENTAL CONSULTANTS

K:\Projects\07-03686-001\Project\Scriber_XS.mxd

Geometric Data

The geometric data files for this HEC-RAS model simulate the creek channel, ground surface, and hydraulic structures in the modeled reach of Scriber Creek. Geometric data were developed primarily using topographic data from both on-the-ground survey and LiDAR. The survey data were collected by CTS Engineers, Inc. in September 2008. The survey captured all relevant hydraulic structure data (i.e., culvert or bridge type, dimensions, invert elevations, and road surface profiles) as well as a majority of the channel cross sections depicted in Figures 3 and 4. The LiDAR data were used to extend the limits of the surveyed cross sections and to create additional cross sections mainly through wetland/storage areas. LiDAR data were downloaded from the Puget Sound LiDAR Consortium, based on LiDAR survey processed in 2005 to a resolution of 6 feet. Since the LiDAR cross sections are not considered as accurate as surveyed cross sections, they were only used to provide model continuity. The accuracy of some surveyed cross sections and hydraulic structure inverts was field-verified by Herrera staff during the modeling process. These topographic data were processed using HEC-GeoRAS, which is an extension in ArcGIS software that enables geospatial data to be extracted using a graphical user interface (GUI). The geometric data were then imported into HEC-RAS.

Cross section geometric data for Scriber Creek includes both channel and floodplain topography. The survey captured the main channel and immediate overbank areas, whereas the LiDAR extensions of the surveyed cross sections captured the broader floodplain area that extends further away from the creek across public and private property. Cross sections were assigned a river station (RS) identifier, which corresponds with each section's respective location along the low flow channel upstream of the downstream boundary of the model near the cul-de-sac at 209th Place SW. This section numbering scheme is based on the actual creek flow path (in feet) progressing upstream from the origin of the step-backwater hydraulic model. The upstream and downstream extents of the modeled reach are bounded by cross sections, with additional cross sections spaced at locations of geomorphic and hydraulic significance, such as near hydraulic structures and horizontal bends of the creek. For reference to describe the overall model layout, the following cross section locations are highlighted:

- The downstream extent of the model is at roughly RS 74
- The concrete box culvert at the intersection of 200th Street and 50th Avenue W. is approximately 1 mile upstream at RS 5328
- The twin pipe arch culverts under State Route (SR) 524 are at RS 8183
- The concrete pipe culvert at 188th Street SW is at RS 11558
- The upstream extent of the model is at approximately RS 12058

One geometric data file was created to represent existing channel and floodplain conditions. The existing conditions geometric data file and subsequent proposed conditions geometric data files account for the channel and floodplain hydraulic roughness characteristics. Manning's roughness coefficients (*n*-values) for the modeled reaches were determined by correlating channel and floodplain surface characteristics with analogous roughness coefficients. These roughness values were adjusted to produce stream water surface elevations that approximately coincide with estimated stage-discharge observations made in the field at specific locations along this reach on two separate occasions. The field observations served as a substitute for gauge data, because the Scriber Creek stream gauge nearest to the study area is significantly downstream at Oak Way, at which point the streamflow includes significant tributary inflow downstream of the Scriber Creek problem area from both Poplar and Golde creeks. Long-term, official records of flow data do not exist to precisely calibrate the HEC-RAS hydraulic model along the study reach. In general, Manning's roughness coefficients were kept constant throughout the study reach to reflect the relatively homogeneous geomorphology of this urbanized stream and its riparian corridor. An exception to these consistent channel and overbank roughness values in the model is in the Casa Del Rey Condominiums reach (i.e., cross sections RS 9284, 9213, and 9153), where roughness values were increased in the channel and decreased in the adjacent overbank floodplain area to conservatively estimate potential streambank overtopping and preferential overbank flow in the proposed conditions scenario. These Manning's roughness coefficients are listed in Table 4.

Table 4. Manning's roughness coefficient (*n*-values) used in the HEC-RAS hydraulic model of the Scriber Creek problem area.

Reach	Left Overbank	Left Bank	Channel	Right Bank	Right Overbank
Scriber Creek except Casa Del Rey reach	0.045	0.035	0.035	0.035	0.045
Casa Del Rey Condominiums reach	0.03	0.075	0.045	0.075	0.03

Flow Data

Flow data for the HEC-RAS model includes five calculated flow events ranging from 50 cubic feet per second (cfs) at the upstream end of the model to 279 cfs near the downstream end. These calculated flows are the result of HSPF hydrologic modeling described previously in this report. Additionally, two measured flow events were used for HEC-RAS model calibration. The two measured events occurred on November 7 and 12, 2008. Flow measurements in the study reach were between 6.6 cfs and 10.0 cfs for the November 7 event and between 21.5 cfs and 25.0 cfs for the November 12 event. Flows were measured by recording flow velocity at depth across multiple cross sections using standard streamflow measurement equipment (e.g., a Marsh McBirney Flo-Mate™ on November 7, 2008, and a Swoffer Instruments Flow Meter on November 12, 2008). Water surface elevations were measured immediately after flow measurements and referenced to known elevation points from the CTS Engineers survey data described earlier in this section.

Plans

The geometric data file was combined with the flow data file to create a "plan" for simulation of Scriber Creek flow. Each plan created in the HEC-RAS model was simulated using a mixed subcritical-supercritical flow regime to capture any critical or supercritical flow occurrences within this predominately subcritical-flowing reach.

Boundary Conditions

A "normal depth" boundary condition was used at both the upstream and downstream boundary cross sections of the HEC-RAS model to simulate one dimensional flow in Scriber Creek (Table 5). This boundary condition assumes uniform flow (channel bed slope equals the water surface slope) at the extents of the model. This was done since actual flow or stage data for the modeled reach do not exist. The normal depth assumption at the upstream and downstream extents of a reach is a common hydraulic modeling procedure that approximates both subcritical and supercritical flow. A mixed flow regime was selected so that the HEC-RAS model would allow supercritical flow to be approximated during the HEC-RAS simulations in addition to the standard subcritical flow.

Table 5. Boundary conditions used in the HEC-RAS hydraulic model.

Reach	Upstream Normal Depth Slope (slope between 188th St. SW & 196th St. SW)	Downstream Normal Depth Slope (slope between 196th St. SW &d 209th Pl. cul-de-sac)
Scriber Creek	0.00734	0.00174

Calibration

As stated previously, flow magnitude and stage in Scriber Creek have never been officially monitored within this modeled reach; therefore, comparison of modeled flows to actual flows in the creek was not possible. Consequently, calibration of the HEC-RAS model required correlation of surface cover with analogous roughness coefficients, culvert hydraulic losses with entrance and exit coefficients, and bridge hydraulic losses with contraction and expansion coefficients. These coefficients were then used to produce water surface elevations (stages) that coincided with field observations. Even if official site-specific flow data were available, the dynamic nature of sediment production and transport throughout the Scriber Creek system and the effect of historic hydromodifications (dredging) would make calibration nearly impossible without highly detailed maintenance records and corresponding stage data.

Anecdotal information and photographic evidence provided by local residents and City employees were used as the best available information with which to calibrate the HEC-RAS hydraulic model at various locations of the modeled reach.

HEC-RAS Results for Existing Conditions

In general, the steady-state HEC-RAS model results for existing conditions in the study reach of Scriber Creek show that known areas of flooding are mainly due to backwater conditions caused by existing culverts, low-gradient channel slope, and other flow constrictions within the modeled reach.

Results within City Right-of-Way

This report focuses on the culverts underlying three main roads within City right-of-way that contribute to backwater flooding conditions along Scriber Creek during the estimated 10-, 20-, 50-, and 100-year flow events. Analysis of the HEC-RAS results for existing conditions at these three roads shows that:

- At 188th Street SW, the existing 36-inch concrete pipe culvert passes the peak 2-year recurrence interval flow, but the 10-year and greater peak flows surcharge the culvert and overtop the roadway until the flow recedes.

- At 189th Street SW, the existing 42-inch concrete pipe culvert passes the 2-year recurrence interval flow, but the 10-year and greater flows surcharge the culvert and overtop the roadway until the flow recedes.

- At 190th Street SW, the existing 6-foot by 4-foot concrete box culvert passes the 2-year recurrence interval flow, but the 10-year and greater flows surcharge the culvert and overtop the roadway until the flow recedes. It should be noted that the backwater caused by the downstream culvert at 191st Street SW contributes to the flooding experienced at this location.

- At 191st Street SW, the existing 48-inch corrugated metal pipe culvert passes the 2- and 10-year recurrence interval flows, but the 20-year and greater flows surcharge the culvert and overtop the roadway until the flow recedes. Despite the fact that this culvert passes these two modeled flows, the backwater caused by this culvert during the 10-year and greater flows reduces the conveyance through the 6-foot by 4-foot concrete box culvert at 190th Street SW.

Additional Results within City Right-of-Way

Although this report focuses on the culverts underlying 188th Street SW, 189th Street SW, 190th Street SW, and 191st Street SW, there are additional locations within City right-of-way that cause or experience flooding. Analysis of the HEC-RAS results for existing conditions at these locations shows that:

- At the existing pedestrian/access bridge on "Old 196th Street", the bridge is nearly inundated during the 2-year recurrence interval flow and is completely inundated during the 10-year and greater flows.

- At the intersection of 200th Street SW and 50th Avenue W., the existing 12-foot by 3-foot concrete box culvert passes all modeled flows without overtopping the roadway, but causes a backwater effect that inundates the businesses and low-lying apartment buildings immediately upstream. It should be noted that the culvert inlet was completely submerged during all site visits as the HEC-RAS model and supporting survey data were developed, even during the driest months of the year. Also, a significant backwater effect is potentially caused by the downstream culvert underneath I-5 during the 10-year and greater flows. This backwater effect ultimately contributes to the flooding experienced in this area upstream of the intersection of 200th Street SW and 50th Avenue W.

Flooding occurs infrequently around the Scriber Creek culvert crossing of 44th Avenue W. The geographical limits of the HEC-RAS model were extended downstream beyond this crossing to be certain the downstream conditions are not affected by any man-made hydraulic structures. However, this steady-state model is not capable of accurately simulating the complex hydraulic conditions that exist downstream of 44th Avenue W. The hydraulic conditions downstream of the road crossing include extensive wetlands and, according to city staff, large beaver dams and other significant flow obstructions that were not mapped or surveyed as part of the work described above. Therefore, the results of this modeling effort cannot be used to accurately evaluate existing flooding conditions at the 44th Avenue W. crossing of Scriber Creek. This solution could be more accurately modeled in unsteady-state HEC-RAS or using a two-dimensional model such as FLO-2D with additional data to accurately simulate downstream boundary conditions.

Results on Private Property and Areas Beyond the Scope of this Analysis

Though private property flooding issues in the study area are not necessarily the responsibility of the City, they were considered on a system-wide scale in order to effectively analyze proposed measures that aim to attenuate flooding and backwater conditions at multiple locations. Analysis of the HEC-RAS results for existing conditions on private property shows that:

- At the driveways of the Casa Del Rey Condominiums and the alternative entrance to the businesses between Casa Del Rey and Wilcox Park on the east side of Scriber Creek, the dual existing 42-inch concrete and corrugated metal pipes pass all flows from the 2- to the 50-year recurrence interval, but the 100-year and greater flows surcharge the culvert and overtop the roadway until the flow recedes.

- At the driveway to businesses off "Old 196th Street", the existing 60-inch corrugated metal pipe passes all flows from the 2- to the 20-year recurrence interval, but the 50-, 100-year, and greater flows surcharge the culvert and overtop the roadway until the flow recedes. In addition, flows greater than the 2-year recurrence interval flow inundate the 90 degree bend in the roadway adjacent to the pedestrian bridge.

- At I-5, the existing 66-inch corrugated metal pipe passes all modeled flows; however, the backwater caused by this culvert has significant impacts on the conveyance of flows through the existing 12-foot by 3-foot culvert box culvert underlying the intersection of 200th Street SW and 50th Avenue W. The conveyance impacts due to this culvert become most apparent during the 10-year recurrence interval flow and worsen with increasing flow.

Conclusions and Recommendations for Culvert Replacements to Solve Flooding Problems

Fish-passage design guidelines have been established by the Washington Department of Fish and Wildlife (WDFW) and other state and federal agencies to protect and restore marine, freshwater, and riparian fish and wildlife habitat. For a system such as the study reach of Scriber Creek where the slope of the stream channel and the length of roadway culverts precludes practical installation of "zero slope" culverts, the WDFW guidelines require "stream simulation" in culverts designed for fish passage. These stream simulation guidelines require that new culverts have a minimum width equal to 1.2 times the channel bankfull width plus 2 feet (WDFW 2003). Scriber Creek does not currently support a salmonid fishery; however, it is likely that salmonids would inhabit the entire Scriber Creek system if the existing man-made fish barriers were not in place (Holser 2008 personal communication). Thus, it is assumed for this analysis that any replaced culverts in the study reach would have to meet the WDFW stream simulation design criteria. Culvert vendors were contacted to determine prefabricated culvert dimensions that would meet the stream simulation design criteria and HEC-RAS was used to select culverts that would reduce the flooding problems in the study reach within the constraints of the existing City right-of-way.

Proposed Conditions within City Right-of-Way

As stated previously, this report focuses on the culverts underlying 188th Street SW, 189th Street SW, and 191st Street SW. Multiple HEC-RAS iterations were performed at these three road crossings in order to optimize hydraulic efficiency and cost of construction of all three culverts collectively while meeting WDFW fish-passage design guidelines. The results of the optimized, steady-state HEC-RAS model of proposed conditions show that:

- At 188th Street SW, an 8'2" x 5'9" corrugated galvanized steel pipe arch culvert would pass all modeled flows up to and including the 100-year event while providing suitable fish passage.

- At 189th Street SW, a 12'4" x 7'9" corrugated galvanized steel pipe arch culvert would pass all modeled flows up to and including the 100-year event while providing suitable fish passage.

- At 190th Street SW installation of a 10' x 4' box culvert accompanied by channel improvements in the form of streambed regrading between 190th Street SW and 191st Street SW would pass all modeled flows up to and including the 100-year peak flow. Regrading the channel between 190th Street SW and 191st Street SW would require significant work on private property. If channel regrading is not feasible due to constraints on private property, then the 10' x 4' concrete box culvert would pass all flows from the 2-year through the 50-year recurrence interval peak flow, but greater flows would surcharge the culvert and overtop the roadway until the flow recedes. It is possible that the City would be able to reuse the existing 6’ x 4’ concrete box culvert (which was recently installed at this location) at another location in the city when and where a need is identified.

- At 191st Street SW, an 8’ x 5’ concrete box culvert would pass all modeled flows up to and including the 100-year event while providing suitable fish passage. Installation of this larger culvert would also increase the conveyance through the existing 6’ x 4’ concrete box culvert at 190th Street SW and enable conveyance of flows from the 2-year through the 20-year peak flows. However, installation of an 8’ x 5’ box culvert at 191st Street SW would allow for conveyance of even larger flows at 190th Street SW if the existing culvert at 190th Street SW is replaced with a 10’ x 4’ box culvert and the channel is regraded between 190th Street and 191st Street as described above.

For each of the proposed replacement culvert installations, the highest planning-level design priority was given to WDFW fish passage design criteria, followed by hydraulic conveyance, and culvert material cost, respectively. In order to minimize culvert material cost, corrugated galvanized steel pipe arch culverts that meet WDFW stream simulation fish passage criteria were modeled at each location in the proposed conditions. As indicated above, this culvert type would provide adequate conveyance of all modeled flows at 188th Street SW and 189th Street SW. The model results indicate that a concrete box culvert would be required at 190th Street SW in order to provide adequate conveyance of the flows of interest. At 191st Street SW, a corrugated galvanized steel pipe arch culvert could meet the stream simulation fish passage design criteria and pass all modeled flows, but would cause a backwater effect resulting in significantly higher water surface elevations immediately upstream in comparison with an 8’ x 5’ concrete box culvert. Installation of a pipe arch culvert at 191st Street SW would reduce the water-surface-lowering benefits that could be attained by an 8’ x 5’ concrete box culvert and would also eliminate the upstream conveyance benefits of the 10’ x 4’ concrete box culvert at 190th Street SW.

Additional Proposed Conditions within City Right-of-Way

This section of the report revisits the additional locations within City right-of-way that either cause or experience flooding along the modeled reach of Scriber Creek. For each location listed below, a potential solution is noted along with a brief rationale as to why this solution is not included in the higher priority list of proposed conditions above. The proposed conditions steady-state HEC-RAS model results for these additional locations show that:

- At the pedestrian/access bridge on “Old 196th Street”, the construction of any potential solution was determined to be cost-prohibitive because a large utility line runs along the north side of this bridge. The bridge is presumably only used for pedestrian access to Wilcox Park. Therefore, it was assumed that frequent inundation of this bridge could be accurately categorized as "nuisance" flooding rather than "problematic" flooding. The bridge is within a larger low-lying area such that the bridge is inundated during low flows also. As this is one of several areas that exhibit hydrologic storage characteristics, hydraulics in this area could be more accurately modeled using unsteady-state HEC-RAS (which entails simulation of hydrographs, not just a single flow value).

- At the intersection of 200th Street SW and 50th Avenue W, installing an additional concrete box culvert underneath 50th Avenue W. could provide some flood relief to affected properties upstream of the intersection. This culvert could be constructed under 50th Avenue W. to the south of 200th Street SW and would connect Mini Park Pond with Scriber Creek downstream of the roadway intersection. However, because the area upstream of 200th Street SW provides significant flood storage and this intersection is potentially affected by backwater induced by the I-5 culvert, this solution could be more accurately modeled in unsteady-state HEC-RAS or a two-dimensional model such as FLO-2D.

Proposed Conditions on Private Property and Areas Beyond the Scope of this Analysis

The proposed solutions in this section are not located in City-owned right-of-way, and are thus presented for informational purposes and for the benefit of the affected landowners. These proposed solutions could greatly improve the overall hydraulic efficiency of the modeled reach of Scriber Creek. Any culvert replacements with fish-passable culverts would greatly improve habitat for salmonids and other wildlife. The proposed conditions steady-state HEC-RAS model results for these locations show that:

- At the driveways of the Casa Del Rey Condominiums and the secondary entrance to the businesses between Casa Del Rey and Wilcox Park on the east side of Scriber Creek, a 12' x 5' concrete box culvert would pass all modeled flows up to and including the 100-year recurrence interval peak flow. It should be noted that the HEC-RAS model results suggest that the flooding of the left overbank area through this Casa Del Rey reach of Scriber Creek likely originates upstream of the condominiums and flows south through the parking lot. Although this cannot accurately be modeled using a one-dimensional model like HEC-RAS, cross-sectional analysis and photographic evidence suggest this occurs. It is recommended that in addition to the installation of a 12' x 5' box culvert beneath the driveways, a berm be constructed on the left overbank floodplain of Scriber Creek at this location along the northern perimeter of the Casa Del Rey condominiums to prevent left bank overtopping immediately upstream of the Casa Del Rey reach of Scriber Creek.

- At the driveway to businesses off “Old 196th Street”, an 8’ x 5’ concrete box culvert would pass all modeled flows up to and including the 100-year recurrence interval peak flow.

- At I-5, a solution was not investigated because the problem complexity exceeds the capabilities of steady-state HEC-RAS, but could likely be analyzed using unsteady-state HEC-RAS. Replacing the Scriber Creek culvert under I-5 would have extensive upstream and downstream impacts. The area between the intersection of 200th Street SW and 50th Avenue W. and I-5 contains a large wetland that provides flood storage. If a fish-passable culvert with adequate conveyance was installed under I-5, then water surface elevations upstream of I-5 would decrease under all flow conditions. This would have beneficial flood reduction effects all the way to the intersection of 200th Street SW and 50th Avenue W. during the 10-year and greater recurrence interval flows, and available storage would increase during very large flow events. The replacement culvert beneath I-5 would also have significant downstream impacts, which would need to be considered, including effects on the culvert under the northbound I-5 off-ramp and the culvert beneath 44th Avenue W. Replacement of any culvert in this area would also need to preserve the hydroperiod and existing integrity of nearby wetlands.

To reiterate, it is highly recommended that the culverts underlying 188th Street SW, 189th Street SW, 190th Street SW, and 191st Street SW be replaced with the type and size of culverts listed at the beginning of the Conclusions and Recommendations Section. If the City proceeds with a plan to replace these culverts, it is imperative that these six actions be undertaken as part of final design:

1. Geotechnical investigation to assess soil conditions in the immediate vicinity of the culvert

2. Accurate determination of type, size, depth, and location of all utilities within the project area

3. Additional topographic survey to be used for accurate final modeling, design, and construction layout

4. Additional model runs of proposed conditions using the exact type, size, and designed layout of the culvert

5. A thorough analysis of upstream and downstream hydrologic and hydraulic effects

6. A thorough geomorphic analysis of the proposed culvert and channel geometry, including evaluation of potential culvert sedimentation and

related mitigating measures that could be included in the project design, or maintenance that would be required to prevent culvert sedimentation and maintain adequate conveyance

It is equally important that the installation of these culverts be sequenced in a manner to minimize upstream and downstream hydrologic and hydraulic impacts. For instance, if the culverts at 188th Street SW and 189th Street SW are replaced without replacing the culvert at 191st Street SW, the resulting downstream impacts would exacerbate the major flooding issue that currently exists at 190th Street SW. Likewise, if the 188th Street SW culvert is replaced without first constructing grade control immediately upstream of 188th Street SW, the function of the existing wetland upstream of 188th Street SW could be severely compromised and a large quantity of sediment could be flushed down the Scriber Creek system, thereby causing additional flooding issues as well as exacerbating those which already exist.

Finally, additional modeling would confirm and improve the accuracy of the findings discussed in this hydraulic analysis section. The steady-state HEC-RAS model used for this analysis could easily serve as a foundation upon which to create an unsteady-state HEC-RAS model requiring the collection and entry of relatively few additional survey data. Unsteady HEC-RAS utilizes all of the functions of steady-state HEC-RAS but allows the modeler to incorporate storage areas and route hydrographs through the modeled reach. This could improve the accuracy of model output in a system as hydrologically “flashy” as Scriber Creek that also has well-defined areas, such as wetlands and lakes, with significant storage relative to typical creek flow rates. Running unsteady HEC-RAS could improve the accuracy of the model output and may result in reduced culvert sizes for the solutions presented above. If this is the case, capital improvement costs might also be reduced.

Geomorphic Assessment

Background

During the course of the hydraulic model development and analysis work summarized above in the study reach, sediment transport and deposition in Scriber Creek were identified as potentially important factors in channel conveyance capacity that in turn affects flooding recurrence. This section summarizes a brief geomorphic characterization that was performed for the study reach to enhance understanding of stream channel management and culvert replacement options to address flooding.

The Scriber Creek basin is urbanized with approximately 39 percent effective impervious area (EIA) (Snohomish County 2002a), including some high-density residential, commercial, and light industrial land uses. The effects of urbanization patterns on the physical processes of Puget Sound lowland creeks have been well documented (Booth and Henshaw 2001; Castro 2002; Konrad 2000; Moscrip and Montgomery 1997) and the physical character of Scriber Creek today is largely the result of such development-induced impacts to the drainage network and land cover.

This geomorphic assessment was conducted to better understand existing channel conditions within the Scriber Creek problem area and the contributing upstream drainage area, to identify areas of sediment production and deposition in the basin, and to determine the likely pattern of sediment routing from the upper watershed to the Scriber Creek problem area. When the rate of sediment delivery to a channel network or stream reach exceeds the channel's capacity to transport sediment, deposition or channel aggradation occurs. If such deposition reduces the conveyance capacity of a channel or culvert then it may result in an increased probability of flooding. During the development of the steady-state HEC-RAS model of the section of Scriber Creek between 188th Street SW and 200th Street SW, sedimentation and associated increase in channel elevation were identified as mechanisms contributing to decreased channel conveyance and recurrent flooding problems at a number of sites.

Methods and Results

A geomorphic reconnaissance was performed on December 11 and 16, 2008 by a Herrera project engineer (Matt Fontaine) and a Herrera project geomorphologist (Chase Barton). The reconnaissance survey included a visual inspection of many segments of the Scriber Creek channel network upstream of Scriber Lake. The reconnaissance had two objectives:

1. Examine problem areas where the Scriber Creek channel is aggrading to observe the magnitude and character of sediment deposits in these areas

2. Locate sediment sources in the mainstem and tributary channel network within and upstream of the Scriber Creek problem area

Based on the field reconnaissance, several reaches of the Scriber Creek channel network were classified as eroding or aggrading (Figure 1). Eroding reaches exhibit channel incision or widening that lead to a net contribution of sediment to the Scriber Creek channel. Aggrading reaches exhibit deposition of sediment that leads to local accumulation and aggradation of the channel. As noted above, sediment from the eroding reaches of the creek is deposited downstream in reaches with lower sediment transport capacity. This aggradation reduces the flood conveyance capacity of the Scriber Creek channel and contributes to flooding. Two problematic eroding reaches were identified:

- Immediately downstream of 180th Street SW and upstream of the culvert under the auto wrecking yard

- Between 191st Street SW and 193rd Place SW

Significant channel aggradation was noted in several locations in the Scriber Creek problem area that are prone to flooding based on previous observations and computer modeling:

- Approximately 100 feet downstream of 189th Street SW to approximately 50 feet downstream of the culvert under 190th Street SW

- From the culvert under "Old 196th Street" to the culvert under 196th Street SW

Sediment deposition and minor aggradation was also noted adjacent to the Casa Del Rey condominiums upstream of the culvert under 194th Street SW.

Recommendations

The City should pursue stream stabilization capital improvement program projects to address the two erosion problems noted above. Specific components of these potential projects are summarized below.

- **Downstream of 180th Street SW and upstream of the culvert under the auto wrecking yard**. The stream channel erosion may be addressed by stabilizing the streambank in this reach using bioengineering techniques. This solution would reduce the net erosion and sediment production from this reach of Scriber Creek, thereby reducing the sediment that is transported to the Scriber Creek problem area. This project would necessarily be implemented on private property, therefore the City should take the appropriate steps to ensure landowner participation prior to project design and implementation.

- **Between 191st Street SW and 193rd Place SW.** The stream channel erosion problem in this area could be addressed using grade control structures made of large woody debris. This solution would reduce the net erosion and sediment production from this reach of Scriber Creek, thereby reducing the amount of sediment that is transported to lower reaches of Scriber Creek near 196th Street SW. Project design should include further hydraulic and geomorphic analysis to verify that the proposed solution would not contribute to flooding problems upstream immediately after construction or over the long term. This solution could be implemented on public property immediately downstream of 191st Street SW and/or on school district property to the west of 193th Place SW. This project could also include increasing stream complexity, improving stream habitat, and adding amenity value.

Design of these solutions should include a more detailed geomorphic analysis to verify that the preferred alternative solution will effectively reduce the channel erosion.

Results of this geomorphic analysis also indicate that sedimentation will be a major concern for the culvert replacement projects identified above. Replacing the existing undersized culverts between 188th Street and 191st Street with wider fish passable culverts is likely to reduce the sediment transport capacity through these culverts, thereby leading to sediment deposition in the new culverts. Such sediment deposition would counter the conveyance improvements that the replacement culverts could achieve. It is highly recommended that additional geomorphic analysis be performed during design of the culvert replacement solutions presented above. This analysis should evaluate culvert sedimentation rates, design solutions that could reduce sedimentation, and the level of effort that would be required by maintenance staff to prevent sedimentation from reducing conveyance capacity of the proposed culverts.

Under a previous Hydraulic Project Approval (HPA) permit issued by WDFW, the City performed maintenance on aggrading reaches of Scriber Creek in the study area, including channel dredging. The City is in the process of renewing this permit and will need to continue dredging of the channel to minimize channel aggradation as a contributing factor to decreased conveyance capacity and flooding in the Scriber Creek problem area. The goal of the two erosion control projects listed above is to reduce sediment delivery to the Scriber Creek problem area, thereby reducing the rate of channel aggradation, reducing flooding, and reducing the future maintenance needs in this reach. Design of the solutions described above should include additional hydraulic and geomorphic analysis and should be consistent with the goals of improving stream habitat, reducing maintenance costs, and increasing amenity value to the public.

References

Booth, D. and P. Henshaw. 2001. Rates of Channel Erosion in Small Urban Streams. Land Use and Watersheds: Human Influence on Hydrology and Geomorphology in Urban and Forest Areas. Mark Wigmosta and Stephen Burges (eds.). American Geophysical Union, Washington, D.C. pp. 17-38.

Castro, J.M. and P.L. Jackson. 2002. Bankfull Discharge Recurrence Intervals and Hydraulic Geometry Relationships: Patterns in the Pacific Northwest, USA. Journal of the American Water Resources Association 37(5):1249-1262.

Holser, Ginger. 2008. Personal communication (telephone conversation with Mark Ewbank of Herrera Environmental Consultants, Inc., Seattle, Washington, regarding Washington Department of Fish and Wildlife stream simulation design criteria. Washington Department of Fish and Wildlife. December 22, 2008.

KCM. 1994. Swamp Creek Watershed Management Plan. Prepared for the Swamp Creek Watershed Management Committee and Snohomish County Public Works, Surface Water Management Division, by Kramer Chin and Mayo, Inc., Seattle, Washington.

Konrad, C.P. 2000. The Frequency and Extent of Hydrologic Disturbances in Streams in the Puget Lowland, Washington. Water Resources Series Technical Report No. 164.

Moscrip, A.L. and D.R. Montgomery. 1997. Urbanization, Flood Frequency, and Salmon Abundance in Puget Lowland Streams. Journal of the American Water Resources Association 33(6):1289-1297.

Northwest Hydraulic Consultants Inc. (NHC). 1990. Scriber Creek Floodplain Mapping Study. Prepared for the City of Lynnwood by Northwest Hydraulic Consultants, Inc., Seattle, Washington.

NRCS. 2007. Frequency Curve Streadsheet Version 2.09. Developed by Dan Moore. Natural Resources Conservation Service, Portland, Oregon. September 2007.

Snohomish County. 2002. Swamp Creek Drainage Needs Report, DNR No. 2. Snohomish County Department of Public Works Surface Water Management Division. Accessed via agency website on December 18, 2008: <http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/SWM/Library/Publications/Urban_Drainage/DNR/Swamp_DNR.htm>. December 2002.

Snohomish County, Lynnwood, City of, and Brier, City of. 1989. Scriber Creek Watershed Management Plan. Prepared by RW Beck, Inc., Seattle, Washington. December 1989.

USGS. 1982. Interagency Advisory Committee on Water Data, 1982, Guidelines for determining flood flow frequency. Bulletin 17-B of the Hydrology Subcommittee, U.S. Geological Survey, Office of Water Data Coordination, Reston, Virginia. Accessed via agency website on March 27, 2008: <http://water.usgs.gov/osw/bulletin17b/bulletin_17B.html>.

APPENDIX G

Gap Analysis and Needs Assessment Report

GAP ANALYSIS AND NEEDS ASSESSMENT REPORT

City of Lynnwood Surface Water Management Comprehensive Plan

Prepared for

City of Lynnwood
19100 44th Avenue W.
Lynnwood, Washington 98036

Prepared by

Herrera Environmental Consultants
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
Telephone: 206/441-9080

June 9, 2009

Contents

Introduction

The City of Lynnwood, in southeast Snohomish County, covers an area of approximately 7 square miles, and has a population of approximately 35,000 people. Since its founding in 1959, the City has transformed from a quiet rural community to a largely developed urban environment of dense residential, commercial, and light industrial land uses. This development has negatively affected the quantity and quality of stormwater within and downstream of the City limits, increasing peak stormwater flow rates and pollutant loadings. The City is subject to regulatory requirements that address these problems, and prevent them from worsening with future land use changes. In addition, the City is considering large-scale annexations of areas with similar problems, which would increase the burden on the City's stormwater management program (or SWMP, as defined in the NPDES Phase II Permit) resources.

Regulatory requirements have changed since the City prepared the Comprehensive Flood and Management Plan in 1998 (R.W. Beck). The most significant change was the January 17, 2007 issuance of the National Pollutant Discharge Elimination System (NPDES) Western Washington Phase II Municipal Stormwater Permit (NPDES Phase II Permit) by the Washington State Department of Ecology (Ecology). This new permit expands the City's responsibility for:

- Public education and outreach
- Public involvement and participation
- Illicit discharge detection and elimination
- Controlling runoff from new development, redevelopment, and construction sites
- Pollution prevention, operation, and maintenance for municipal operations

To effectively address these new regulatory requirements and increased stormwater management program burden that would be created by the proposed annexation, the City is preparing a Surface Water Management Comprehensive Plan. This document describes gaps in the current stormwater program, and how to meet regulatory requirements and address chronic drainage problems.

To limit the negative effects of stormwater on the environment and citizens of Lynnwood, the current City stormwater program focuses on the following:

- Educating the public
- Permitting new development and redevelopment projects
- Operating and maintaining City-owned surface water drainage facilities

- Planning and executing drainage improvement projects
- Updating City ordinances and programs to meet state and federal regulatory requirements

The City of Lynnwood Comprehensive Flood and Drainage Management Plan (R.W. Beck, 1998) provides guidelines for implementing the City stormwater program by establishing goals, objectives, and policies for current and future stormwater management. This report is intended to guide many aspects of the comprehensive plan update, while also identifying issues not addressed in the 1998 plan. The remainder of this report presents the methods used to perform the gap analysis and needs assessment, followed by a summarization of the findings.

Methods

As part of the stormwater program gap analysis process, Herrera Environmental Consultants (Herrera), in cooperation with City staff, compared the current City stormwater program activities to existing stormwater requirements. Stormwater issues were identified by reviewing available documents and through a half-day workshop involving Herrera and City staff. During the analysis, existing and planned City programs were compared to regulatory requirements, with particular attention given to the new NPDES Phase II Permit requirements.

Available Documents Review

To perform a thorough evaluation of the City's stormwater program, Herrera reviewed all available and pertinent documents. These documents include surface water resource studies, drainage and land use maps, and City planning documents. See Attachment A for a complete list of background documents.

Workshop

On February 6, 2008, several City staff members representing all aspects of the City's stormwater program attended a workshop to examine the components of the City's SWMP in more detail and identify previously undocumented issues. The workshop was held at the City of Lynnwood Public Works Department office. A SWMP status survey was used to facilitate discussion of NPDES Phase II Permit requirements, other regulatory requirements (e.g., total maximum daily load (TMDL) requirements, underground injection control [UIC] requirements), current drainage problems, staffing and funding needs, and other issues of concern. See Attachment B for the stormwater program status survey, and Attachment C for a list of workshop attendees. Not all items listed in the status survey were discussed in the workshop, but most were discussed as appropriate and as time allowed.

Gap Analysis and Needs Assessment

Following the workshop with City staff, the current City of Lynnwood SWMP was compared to the NPDES Phase II requirements, other regulatory requirements, and non-regulatory requirements. The findings of this process, including SWMP needs, are presented in the following sections.

City of Lynnwood Stormwater Management Program

The City of Lynnwood's current SWMP has several significant strengths that provide a foundation for program expansion and improvement. These areas of focus for program expansion and improvement are identified in the next section of this report. The City's primary strengths are public education and outreach, controlling runoff from new development, redevelopment, and construction sites, and operations and maintenance.

Public Education and Outreach

The City's Department of Public Works Web site provides contact information to report flooding problems. The City's existing SWMP also includes public education and outreach activities, such as providing educational material to classrooms, providing stormwater-related public information through *Inside Lynnwood* (a quarterly news and information publication), administering a grant program for stormwater education in the classroom, and providing storm drain signage materials for citizen use.

The City has purchased an informational booth to promote stormwater awareness at City fairs and public gatherings. The booth will provide general stormwater information for the public and specific information related to the TMDL or illicit discharge detection and elimination (IDDE) programs. The City also plans to use to the booth as an opportunity to measure public stormwater awareness.

Controlling Runoff from New Development, Redevelopment, and Construction Sites

The City has a thorough development project permitting process that includes plan review, inspection, and code enforcement for new development, redevelopment, and construction sites. City staff uses this process to issue permits, review drainage plans, and perform inspections. Inspections are performed during construction to ensure that erosion and sediment control measures are implemented, after construction to ensure that the drainage plan was implemented, and during and after the 2-year maintenance covenant to confirm that appropriate maintenance is being performed. Inspections are performed prior to construction when environmentally critical areas are present near the project. A database is used to track each permit, plan review, and inspection.

A drainage and maintenance covenant is attached to each City of Lynnwood new plat document. This covenant includes maintenance standards (checklists) for typical stormwater facilities and requires private stormwater facility owners to perform annual inspections and perform maintenance as needed to conform with standards. The drainage and maintenance covenant grants the City perpetual right of entry to inspect the facilities and conduct the required maintenance. The covenant also grants the City the authority to perform necessary maintenance in cases where the owner is unwilling to perform necessary maintenance, or when neglected structures create an imminent or present danger. The covenant authorizes the City to collect all reasonable fees for maintenance expenses or to bring suit to recover such costs. Upon obtaining a judgment, unpaid fees, including lawyer fees, may become a lien against the property. According to City code, older facilities (i.e. constructed prior to the latest revision of the maintenance covenant), must be maintained in accordance with arrangements approved by the public works department. City code also grants staff the right to inspect facilities and older plat documents include a maintenance agreement without explicit maintenance standards.

Staff receive training based on their responsibilities. For example, erosion and sediment control plan reviewers and construction site inspectors attend state-sanctioned erosion and sediment control certification classes. Training records are maintained for all staff members.

City staff involved in the program assessment workshop stated that plan review is conducted to an extent that prevents major oversights in verifying adequate stormwater facility selection and design to satisfy City requirements.

Pollution Prevention, and Operation and Maintenance for Municipal Operations

Pollution Prevention

All City vehicles are washed in designated wash racks. As a pollution prevention measure, the City cleans stormwater facilities at vehicle wash station on a monthly basis. However, the City performs many activities on a regular basis (e.g., paving, painting) that have the potential to produce stormwater pollution from roadway and non-roadway surfaces and has not yet established procedures or training for staff to prevent or minimize pollution from these activities. The City has not developed or implemented site-specific Stormwater Pollution Prevention Plans (SWPPP) for any municipal facilities.

Operations and Maintenance

The City tracks maintenance of catch basins and inlets using a poster-sized catch basin map, kept at the Joint Maintenance Facility. Field staff track their work on section maps and completed inspections are logged on the poster-sized map. At the current inspection and maintenance rate, all city catch basins and inlets are inspected during a 4-year period, and cleaning is performed for those with greater than 8 inches of sediment in the sump. Removal of sediment accumulations in catch basins helps to minimize transport of stormwater pollutants to downstream waters, while also maintaining conveyance capacity in the storm drainage system.

The City also performs street sweeping throughout the city. The City street network has been divided into 1,000 segments which are grouped into seven zones. Each zone is swept approximately once each month, which reduces the need for catch basin cleaning. Arterial streets are swept approximately two times per month. The City does not track the amount of sediment and debris that is collected from each zone.

The City performs maintenance of City-owned stormwater ponds two to three times per year. This maintenance is limited to mowing, pruning, and trash removal, and typically does not include detailed evaluation of each facility's functional components (e.g., inlet, outlet structure, overflow, sediment accumulation). The City performs maintenance on the Meadowdale Glen Flood Protection Project (infiltration ponds) on an annual basis. Before, during, and after major storms, City staff visit known "hot spots" to clear debris from trash racks and troubleshoot drainage problems. The "hot spots" are recorded on a map and visited approximately 10 times per year. In addition, City maintenance staff are frequently required to deal with miscellaneous drainage issues; these issues can detract from their ability to adequately maintain City facilities.

The City maintains an inventory of public stormwater facilities in a Cartêgraph database. When field staff identify structural or functional deficiencies at any facilities during the routine maintenance described above, the problems are logged into the database. The City has tried to implement a formal field tracking system on several different occasions with minimal success. There is currently no formal process for routinely inspecting facilities and tracking inspection results.

Despite the drainage and maintenance covenant described above, City staff are concerned that privately owned facilities are a liability for the City's interests downstream, and that very little inspection and maintenance is occurring at these private sites. Under Lynnwood Municipal Code (LMC) 13.40, the Lynnwood Public Works Department may assume responsibility for operation and maintenance of privately owned stormwater facilities after a 2-year period of satisfactory maintenance. Private facilities are also required to be bonded and insured. However, if the City chooses to assume maintenance responsibility, the LMC Section 13.40.120 doesn't require that facility owners provide long term funding for maintenance performed by the City.

Stormwater Management Requirements

NPDES Phase II Permit

The NPDES Phase II Permit became effective for Lynnwood and numerous other jurisdictions in western Washington on February 16, 2007. This permit represents the most significant new surface water regulation since the comprehensive plan was last updated in 1998. Much of this gap analysis focuses on analyzing the adequacy of the City's stormwater program in meeting the NPDES Phase II requirements.

The NPDES Phase II Permit is organized into nine special conditions (S1 through S9) and 21 general conditions (G1 through G21). The special conditions (summarized below) are the focus of this analysis because they describe requirements for the City's SWMP and the comprehensive plan update. These summaries do not address every aspect of the nine special conditions, and they should not be used as a substitute for the actual permit, which can be obtained from the Ecology Web site.

S1. Permit Coverage Area and Permitees

- Identifies Lynnwood as a regulated small municipal separate storm sewer system (MS4) and a permittee under this permit

S2. Authorized Discharges

- Authorizes Lynnwood to discharge stormwater to surface waters and groundwaters of the state
- Requires that all municipal separate storm sewers constructed after February 16, 2007, receive all applicable state and local permits

S3. Responsibilities of Permittees

- Requires Lynnwood to comply with all conditions of the NPDES Phase II Permit

S4. Compliance with Standards

- Reduce the discharge of pollutants from City storm drainage systems to the maximum extent practicable
- Use all known, available, and reasonable methods of prevention, control, and treatment (AKART) to reduce stormwater pollution
- Control the discharge of toxicants
- Report violations of the state water quality standards

S5. SWMP for Cities, Towns, and Counties

- Develop and implement a SWMP that meets NPDES permit requirements by August 19, 2011
- Prepare and maintain written documentation of the SWMP
- Gather, track, and maintain information to evaluate SWMP implementation

- Incorporate mechanisms for interjurisdictional and interdepartmental coordination
- Design the SWMP to reduce discharge of pollutants to the maximum extent practicable, meet AKART requirements, and protect water quality
- Address the following components in the SWMP:
  - Public education and outreach
  - Public involvement and participation
  - Illicit discharge detection and elimination
  - Controlling runoff from new development, redevelopment, and construction sites
  - Pollution prevention and operation and maintenance for municipal operations

S6. SWMP for Secondary Permittees

- Not applicable to Lynnwood

S7. Compliance with Total Maximum Daily Load Requirements (TMDL)

- Comply with the special requirements identified in Appendix 2 of the NPDES Phase II Permit. Currently, a TMDL and TMDL implementation plan have only been developed for Swamp Creek. Therefore, Appendix 2 only includes requirements related to Swamp Creek.
  - Address commercial animal handling and commercial composting facilities in the illicit discharge detection and elimination (IDDE) program
  - Prepare a Bacterial Pollution Control Plan
  - Track TMDL related activities (e.g., public education, stormwater monitoring)
  - Incorporate bacterial pollution awareness into the public education program
  - Monitor water quality

S8. Monitoring

- Perform monitoring required by the TMDLs and as required for IDDE
- Document all monitoring
- Prepare for future long-term monitoring

S9. Reporting Requirements

- Submit annual report and supporting documents by March 31 of each year beginning with first year reporting by March 31, 2008

Other Regulatory Requirements

Other requirements considered in this gap analysis include federal, state, and local requirements affecting stormwater management and water quality. These requirements are listed below.

Federal Requirements

The Federal Water Pollution Control Act (Clean Water Act) establishes the goal of restoring and maintaining clean surface waters to support the propagation of fish, shellfish, wildlife, and human recreation. Portions of the Clean Water Act that are administered by Ecology are discussed below under state requirements.

State Requirements

NPDES Permit Requirements

The NPDES Phase II Permit requirements specific to municipal stormwater management are described above. In addition to the NPDES Phase II Permit, Ecology regulates several businesses in Lynnwood under a separate-but-related NPDES permit program for industrial site stormwater runoff. Ecology also requires NPDES permits for construction projects encompassing disturbance of greater than 1 acre of soil, or that will discharge stormwater runoff to storm drainage systems leading to surface waters. The industrial stormwater NPDES permits and construction site stormwater NPDES permits require all individual sites, public and private, to manage onsite stormwater for protection of downstream water quality. While Ecology bears the responsibility of overseeing compliance with those other NPDES permits, the City should consider projects and properties that are subject to those permits when crafting and implementing its SWMP.

State Water Quality Standards

Washington Administrative Code (WAC) 173-201A lists water quality standards for fresh water bodies. Surface water bodies with impaired water quality are listed in Washington State's Water Quality Assessment (303[d]) List for 2004 (Ecology 2004a). Scriber Lake and Swamp Creek are listed as Category 5 water bodies (polluted waters). Scriber Lake exceeds state standards for phosphorus, and the reach of Swamp Creek that is nearest to Lynnwood exceeds state standards for fecal coliform bacteria. Requirements for Swamp Creek are listed in the Swamp Creek Fecal Coliform TMDL Plan and Water Quality Improvement Report and Implementation Plan, and also in Appendix 2 of the NPDES Phase II Permit.

Stormwater Management Manual for Western Washington

Ecology prepared this stormwater guidance manual (most recently updated in 2005) as a benchmark for jurisdictions in western Washington to follow. For larger jurisdictions such as Snohomish County that prepare their own stormwater manuals, the *Stormwater Management Manual for Western Washington* is used as a basis for evaluating equivalency. The manual consists of five volumes that describe requirements for site planning, construction stormwater pollution prevention, hydrologic analysis and flow control, source control, and runoff treatment. The NPDES Phase II Permit requires the City of Lynnwood to implement an ordinance or other enforceable mechanisms that are as protective as portions of the *Stormwater Management Manual for Western Washington*.

Growth Management Act (GMA)

The GMA, established in Chapter 36.70A of the Revised Code of Washington (RCW), requires most urban jurisdictions in Washington (including Lynnwood) to develop comprehensive plans that address land use and review drainage, flooding, and stormwater runoff, including stormwater infrastructure planning.

Shoreline Management Act (SMA)

The SMA, established in WAC 173-18 through 173-26, requires the City of Lynnwood to develop a shoreline master program that includes consideration of water quality and critical areas (e.g., wetlands, fish and wildlife habitat areas, and frequently flooded areas).

Underground Injection Control (UIC) Regulations

The UIC program requirements, established in WAC 173-218, require registration of underground injection systems such as infiltration trenches and dry wells. Ecology enforces these regulations. In general, Lynnwood does not contain significant ground water recharge areas, and therefore the UIC regulations are not a major factor for the City's SWMP.

Local Requirements

Lynnwood Municipal Code (LMC)

City of Lynnwood policies and regulations relating to flood and drainage management are included in LMC Chapters 13.40 Drainage Ordinance, 16.46 Flood Hazard Area Regulations, 17.02 State Environmental Policy Act, 17.05 General Policy, and 17.10 Environmentally Sensitive Areas.

Non-Regulatory Issues

In addition to measuring the City's current SWMP against regulatory requirements, several other stormwater management issues that the City must address were examined. These issues include the current stormwater management utility rate structure, flooding problems, adequacy of department staffing, West Nile Virus monitoring or prevention, and possible future annexation of areas within the Lynnwood Municipal Urban Growth Area.

Gaps

NPDES Phase II Permit

Attachment D provides a summary of SWMP needs, based on detailed comparison of NPDES Phase II Permit requirements and the current City of Lynnwood SWMP. Special Condition 5 of the permit defines five components that must be developed and implemented in the SWMP. Implementation strategies for each of these five components are presented in Attachment E. The primary purpose of the implementation strategies for these components is to provide an initial assessment of how these requirements will be met, and which requirements will be accomplished through revision of the comprehensive plan. Needs for the five components are summarized below.

Public Education and Outreach

Development of this program is underway. Current activities include identification of target audiences, development of an educational booth for use at public events, and production of educational material for the booth. The program will also need to be documented in the comprehensive plan, which will include identification of target behaviors, a plan to measure understanding and adoption of target behaviors, and incorporation of TMDL and IDDE material into the program.

Public Involvement and Participation

This component has not been developed. It must include an opportunity for public involvement in the SWMP review process. The City must make the comprehensive plan, the annual NPDES permit compliance report, and any annual report attachments available to the public. The City currently intends to provide the public with opportunities to comment on the draft and final Stormwater Management Comprehensive Plan documents, and on the final LMC revisions. This process should be documented.

Illicit Discharge, Detection, and Elimination

The City is aware of some locations where potentially illicit sources of stormwater pollution are occurring. However, the City has not proactively sought out such sources by prioritizing and sampling outfalls, as required by the NPDES Phase II Permit. The City has developed a

CartêGraph database of municipal stormwater assets, which will provide most of the data necessary for mapping the municipal outfalls. The City needs to develop an ordinance prohibiting illicit discharges, and needs to develop a program for detection and elimination of illicit discharges.

Controlling Runoff from New Development, Redevelopment, and Construction Sites

The City currently has a well developed permitting process that requires plan review and site inspections. However, stormwater management requirements identified in the LMC are outdated and the review process relies, in part, on SEPA review to impose more stringent requirements for larger projects. The requirements of this permitting process must be updated to meet all NPDES Phase II Permit requirements. The City will need to adopt a new ordinance or revise an existing ordinance or ordinances to include requirements commensurate with the *Stormwater Management Manual for Western Washington*. To ensure that facility-specific drainage maintenance standards contained in the drainage and maintenance covenant, are equivalent to the standards of the *Stormwater Management Manual for Western Washington*, the following discrepancies must be addressed:

Major Discrepancies:

- Table No 1. Detention Ponds appears to be missing Pages 1 and 2 (pages 4-30 and 4-31 from Volume 5 of the *Stormwater Management Manual for Western Washington*).

- Table No 14. Sand Filters (Above Ground/Open) contains criteria which is inconsistent with the *Stormwater Management Manual for Western Washington* and the type of facility. The criteria appear to be erroneously copied from No 15. Sand Filter (Below Ground/Enclosed).

Minor Discrepancies:

- Table No 18. Coalescing Plate OWS is missing criteria for “damaged pipes”.

- Table No 5. Catch Basins is missing criteria for “contamination and pollution”.

Pollution Prevention and Operation and Maintenance for Municipal Operations

Pollution Prevention

The City’s primary activities with the potential to generate stormwater pollution from roadway and non-roadway surfaces (e.g., buildings, parking lots, storage areas) are listed in Attachment H. The City will need to evaluate the need for procedures to prevent pollution from these sorts of activities. These practices may include appropriate BMPs and additional staff training. The

City will also need to develop a SWPPP that covers all heavy equipment maintenance or storage yards and material storage facilities.

Operation and Maintenance

City staff currently inspects all catch basins and storm drain inlets approximately once every four years, which meets the requirements of this NPDES Phase II Permit. This frequency is sufficient to maintain conveyance capacity and provide reasonable water quality benefits. However, the catch basin inspections and cleaning consume significant O&M staff time, such that inspection and maintenance is only performed on an as-needed basis for most stormwater flow control and water quality treatment facilities. The City will need to refine its O&M program for stormwater facilities to incorporate maintenance requirements equivalent to Volume 5 of the *Stormwater Management Manual for Western Washington*. This will include a more regimented inspection process for catch basins and inlets, improved inspection and maintenance tracking, and additional inspection requirements for stormwater treatment and flow control facilities. It is likely that the City will also need to perform more frequent maintenance on stormwater treatment and flow control facilities.

Other Regulatory Requirements

Outside of the NPDES requirements, The City's regulatory requirement needs (other than NPDES) are summarized below.

Swamp Creek TMDL

The City of Lynnwood has already established an ordinance requiring citizens to clean up after their pets (LMC 6.02.160). This ordinance is not in need of revision for pet waste purposes, but the City will also need to establish stormwater management requirements for commercial animal handling and commercial composting facilities, including related BMPs identified in the *Stormwater Management Manual for Western Washington*. City storm drainage outfalls that discharge to tributaries of Swamp Creek should be designated as high priority within the City's prioritized outfall list. To comply with Ecology's Swamp Creek TMDL cleanup plan, the SWMP will need to include a Bacterial Pollution Control Plan and address TMDL-related monitoring and public education and outreach. A Quality Assurance Project Plan (QAPP) has been developed associated with the TMDL, and fecal coliform monitoring will soon be implemented at two locations on Scriber Creek, one on Poplar Creek, and one on Golde Creek (City of Lynnwood 2008). A detailed list of TMDL requirements and needs is provided in Attachment D under Special Requirement 7 (S7): *Compliance with the Total Maximum Daily Load Requirements*.

Scriber Lake TMDL

Scriber Lake exceeds state standards for phosphorus, but a TMDL implementation plan has not been established.

Lake Ballinger TMDL

Lake Ballinger has a TMDL for phosphorus, and a Quality Assurance Project Plan has been established for long term monitoring of this water body. Hall Creek drains from the City of Lynnwood to Lake Ballinger. The City has evaluated water quality issues associated with Hall Lake and Hall Lake tributaries.

Increasing attention is being given to water quality and flooding problems upstream and downstream of Lake Ballinger. In 2008, the jurisdictions around Lake Ballinger formed The Hall Lake, Hall Creek, Chase Lake, Echo Lake, Lake Ballinger, McAleer Creek Watershed Forum. The Forum includes representatives from the cities of Edmonds, Lake Forest Park, Lynnwood, Mountlake Terrace, Shoreline, and Snohomish County. Using grant money from the Department of Ecology, the Forum hired a consultant to develop a strategic action plan for the watershed, which includes specific actions and projects to address specified water resource issues. Lynnwood will need to continue active participation in the Forum. To comply with the Lake Ballinger TMDL and meet the future requirements of the Lake Ballinger strategic action plan, the City will need to make the Hall Lake basin a priority for programmatic stormwater improvements, especially improvement of water quality and increasing flow control.

2005 Stormwater Management Manual for Western Washington

The City of Lynnwood will need to adopt and implement a new ordinance and requirements as stringent as those in the *Stormwater Management Manual for Western Washington* for new development, redevelopment, and construction sites. At a minimum, these requirements must apply to all sites larger than 1 acre, and smaller sites that are part of a development plan that is larger than 1 acre. The City must also establish maintenance guidelines for City stormwater facilities that are as stringent as the requirements in Volume V of the *Stormwater Management Manual for Western Washington*. These requirements are summarized above under the NPDES Phase II Permit requirements and described in detail in Attachment D.

Growth Management Act

Drainage problems were addressed in the City's 1998 Comprehensive Flood and Drainage Management Plan. Some of these problems have been addressed by capital projects and others will be addressed by capital improvement projects that are currently programmed in the City's capital facilities plan. The status of these problems is described in Attachment F. During the workshop conducted with City staff, several drainage problems were identified that were not included in the 1998 plan. A list of drainage problems identified by City of Lynnwood staff during the workshop is provided in Attachment G.

Underground Injection Control

The City of Lynnwood has fewer than 50 underground injection wells (e.g., infiltration systems, dry wells). Currently, City staff are only aware of two wells, which are located at the Meadowdale Glen facility. These wells have already been registered with the state. If any other currently unregistered wells are identified in the future, the wells must be registered with the

State by February 3, 2009 and a well assessment must be completed by February 3, 2011 (Ecology 2006).

Non-Regulatory

The non-regulatory needs that the City faces in relation to stormwater management are summarized below.

Utility Rate Structure

Ratepayers provide the primary revenue for the stormwater utility. The City of Lynnwood currently charges a flat rate per equivalent residential unit (e.g., a single family home is one equivalent residential unit) (FCS Group 2007). The stormwater utility rate has risen significantly since 2005 and is currently in line with rates charged by other jurisdictions in western Washington; however, looming program expenses to comply with NPDES Phase II Permit requirements and "catch up" with deferred stormwater program work far exceed current stormwater utility revenue. The City will need to evaluate alternative rate structures, rate increases, additional fees, or alternative methods for generating revenue to meet future expenses associated with NPDES Phase II Permit compliance. The City should strongly consider incorporating a maintenance incentive and additional fee into this new rate structure to encourage private owners of flow control and water quality treatment facilities to perform the required maintenance in accordance with the *Stormwater Management Manual for Western Washington*, or pay an additional fee for inspection and maintenance performed by City staff.

Staffing Adequacy

The City currently has two full-time equivalent (FTE) personnel allocated to stormwater program management, four FTEs allocated to stormwater facility O&M, and 1.1 FTE allocated to street sweeping. Under the current level of staffing, the stormwater management personnel are able to address stormwater problems that arise on a daily basis and troubleshoot specific issues with development project reviews, but are not able to perform activities that would enable continual improvement of the stormwater system. Current staffing for stormwater-related O&M is meeting NPDES Phase II Permit requirements for cleaning of catch basins and inlets, but is inadequate for inspection and maintenance of City-owned flow control and water quality treatment facilities. Based on an analysis of City operations and maintenance staffing and equipment (Herrera 2008), the City will need to increase O&M staffing by approximately 1.8 FTEs before February 15, 2010. Because O&M staff spend nearly 50 percent of their time mowing and cleaning catch basins, the City may consider hiring additional staff or contract support to perform these functions, freeing up existing stormwater staff to perform additional inspection, cleaning, maintenance, and repair. The City may also consider obtaining additional administrative staff to assist with NPDES related recordkeeping requirements.

West Nile Virus

Several City staff have received training on West Nile Virus related sampling activities (dipping), and the City has incorporated West Nile Virus prevention into its public education program. However, the City is not required to monitor for West Nile Virus presence or to perform West Nile Virus prevention within the City's stormwater system. If the City chooses to begin applying pesticides (e.g., larvacide) to waters contiguous with streams or navigable waters of the state, then the City would be required to obtain an Aquatic Mosquito Control NPDES Permit from Ecology. Near-water application of adulticides will be incorporated into this permit by 2009 (McLain 2008). In the case of a West Nile Virus outbreak, a State or local health officer may suspend the conditions of the Aquatic Mosquito Control NPDES Permit to protect public health (Ecology 2002). To obtain coverage under the Aquatic Mosquito Control NPDES Permit, the City must submit a notice of intent (NOI) to Ecology, advertise the NOI submission twice in a local newspaper, and implement one of the following: 1) Ecology's "Best Management Practices for Mosquito Control" (2004b) or 2) an integrated pest management plan. The permit also requires annual reporting. The Washington Department of Health, the Center for Disease Control, and Snohomish Health District host webpages with additional West Nile Virus resources:

- Washington Department of Health West Nile Virus Resources
- Snohomish Health District West Nile Virus Resources
- Center for Disease Control West Nile Virus Resources

Annexation Areas

The entire Lynnwood Municipal Urban Growth Area, except for Meadowdale Gap, is currently being considered for annexation to the City of Lynnwood by 2010. After annexation, this area would be subject to City of Lynnwood requirements and utility rates. The City of Lynnwood will need to inventory the stormwater facilities of the annexation areas, and determine funding and personnel needs to meet requirements of the NPDES Phase II Permit in these additional areas. The City will also need to perform a thorough evaluation of the proposed annexation areas to identify existing drainage or water quality problems that capital projects must address.

Summary and Recommendations

The City's current stormwater program provides a good foundation for meeting the expanded needs of the NPDES Phase II Permit requirements. Though all areas of the existing stormwater program must expand to meet NPDES Phase II Permit requirements, the existing program is particularly strong in public education and outreach, and in controlling runoff from new development, redevelopment, and construction sites. Significant gaps in stormwater program coverage are evident in public involvement and participation, pollution prevention at municipal facilities, and illicit discharge detection and elimination. Detailed recommendations for fulfilling all requirements of the NPDES Phase II Permit, and other regulatory requirements, are presented in Attachment D.

References

Center for Watershed Protection and Pitt, R. 2004. Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments. Accessed via Web site on March 20, 2008: <http://www.cwp.org/IDDE/IDDE.htm>.

Ecology. 2002. Focus on Mosquitos – General Permit for Insecticides Advocates Larvae Control to Halt Spread of West Nile Virus. Publication Number 02-10-057. Washington Department of Ecology, Olympia, Washington. October 2002.

Ecology. 2004a. Washington State's Water Quality Assessment (303[d]) List for 2004. Accessed from agency Web site on May 1, 2008: <http://www.ecy.wa.gov/programs/wq/303d/2002/2002-index.html>.

Ecology. 2004b. Best Management Practices for Mosquito Control. Publication Number 03-10-023. Washington Department of Ecology, Olympia, Washington. October 2002.

Ecology. 2005. Stormwater Management Manual for Western Washington. Publication Number 05-01-029 through 05-10-033. Washington Department of Ecology, Olympia, Washington. February 2005.

Ecology. 2006. Guidance for UIC Wells that Manage Stormwater. Publication Number 05-10-067. Washington Department of Ecology, Olympia, Washington. December 2006.

Ecology. 2007. Western Washington Phase II Municipal Stormwater Permit. Washington Department of Ecology, Olympia, Washington. January 17, 2007.

FCS Group. 2007. Utility Rate Study Final Report. Prepared for City of Lynnwood by FCS Group, Seattle, Washington.

Herrera. 2008. Operations and Maintenance Staffing and Equipment Technical Memorandum. Herrera Environmental Consultants, Inc., Seattle, Washington. July 15, 2008.

Jull, P.M. 2003. Evaluating Education and Outreach Programs: Workshop Materials Developed for the Washington State Department of Ecology Coordinated Prevention Grant Recipients. Applied Research Northwest. May 2003. Accessed from agency Web site on March 18, 2008: <http://www.ecy.wa.gov/PROGRAMS/WQ/stormwater/municipal/public_outreach_resources.html>.

Lynnwood, City of. 2007. Resolution No. 2007-__: A Resolution of the City Council of the City of Lynnwood, Washington, Committing to and giving direction for associated studies, staff work and other preparations necessary to make decisions on initiating municipal growth area annexations. Accessed via Web site on May 5, 2008: <http://www.ci.lynnwood.wa.us/CouncilAgendas/ItemAgenda.aspx?ItemID=3836>.

Lynnwood, City of. 2008. Swamp Creek Fecal Coliform Bacteria Total Maximum Daily Loads, Water Quality Study Design (Quality Assurance Project Plan) for the City of Lynnwood. Lynnwood, Washington. March 10, 2008.

McLain, Kelly. 2008. Personal communication (email to Matt Fontaine, Herrera Environmental Consultants, Inc., Seattle, Washington). Washington Department of Ecology, Aquatic Pesticide Specialist/Permit Writer, Water Quality Program. April 14, 2008.

R.W. Beck. 1998. Comprehensive Flood and Drainage Management Plan. Prepared for City of Lynnwood by R.W. Beck, Seattle, Washington.

ATTACHMENT A

Background Document List

Table A-1. Background document list.

Title	Author	Year
2008-2015 Capital Facilities Plan	City of Lynnwood	2008
City of Lynnwood Comprehensive Plan: Captial Facilities and Utilities Element	City of Lynnwood	1999
Lynnwood Municipal Code - Chapters 13.40 Drainage Ordinance, 16.46 Flood Hazard Area Regulations, 17.02 State Environmental Policy Act, 17.05 General Policy, and 17.10 Environmentally Sensitive Areas	City of Lynnwood	
City of Lynnwood, Stormwater Utility Rate Study	FCS Group, Inc.	2007
GIS data: City of Lynnwood Drainage Infrastructure and Zoning	City of Lynnwood	2008
Stormdrain Facilities Database (private facilities)	City of Lynnwood	2000
City of Lynnwood Comprehensive Plan: Official Comprehensive Plan Map	City of Lynnwood	
Stream Habitat Assessment	Jones and Stokes	Oct-00
Lower Scriber Creek Study	Gray and Osborne	2002
Scriber Lake Study	Gray and Osborne	2002
Hall Lake Water Quality and Quantity	Gray and Osborne	2002
City of Lynnwood Comprehensive Flood and Drainage Management Plan	RW Beck	1998
Swamp Creek Fecal Coliform Bacteria Water Quality Improvement Report and Implementation Plan	Ecology	Jun-06
Scriber Creek Watershed Management Plan	RW Beck	Dec-89
Swamp Creek Watershed Mangement Plan	Swamp Creek Watershed Management Committee and Snohomish County Public Works, Surface Water Management Division	Oct-94

ATTACHMENT B

SWMP Status Survey

City of Lynnwood Stormwater Management Program Status Survey

Program Analysis

- Has the City completed the NPDES Phase II Appendix 3 annual report form?
- What local compliance needs have been identified (e.g., code changes, manual changes)?
- Will the city need to establish or modify agreements with other jurisdictions to achieve NPDES permit compliance?
- What elements of the stormwater program work well?
- What elements have been successfully integrated into the City's "normal" operating procedures?
- What are the stormwater program problem areas and needs (i.e., what is not getting done, what needs to be done better)?
- What elements of the stormwater program pose the greatest challenges to City staff?
- What elements are most disruptive to daily operations activities and does this change seasonally (e.g., wet season, dry season)?

Public Education and Outreach

- Does the city currently conduct any stormwater education and outreach, aside from the school grant program?
- Does the City do any of the following education/outreach?
  - ☐ Distribute educational brochures
  - ☐ Stencil storm drains
  - ☐ Provide water quality educational materials to school districts
  - ☐ Provide water quality educational materials when requested
  - ☐ Collaborate with volunteer organizations on education projects

- ☐ Host stormwater discussions
- ☐ Issue stormwater public service announcements or news releases? What media?
- ☐ Display stormwater exhibits at community locations
- ☐ Have a stormwater page on the Web site.

- Has any other City department developed a body of literature to provide education or assistance to the public? Could the same format be used for stormwater (e.g., how to build a rain garden)?

Public Involvement and Participation

- Has the City created an opportunity for the public to participate in the decision making process related to development, implementation, and update of the SWMP (due February 17, 2008)?
- How will the annual report be made publicly available?
- Has the City ever held public meetings on stormwater issues?
- Is there an established stakeholder advisory panel related to stormwater? If not, has the City ever considered it?
- If there is such a panel, who is on the panel and how do they provide input?
- Does the City have a system (phone number, Web site, etc) for the public to log general stormwater-related complaints in addition to flooding problems (e.g., construction site runoff)? How is the system advertised? How does the City respond to calls from the public?
- Does the City pass public complaints related to construction site runoff to field inspectors?

Illicit Discharge Detection and Elimination

- Does the City storm sewer mapping data include each stormwater outfall and connection?
- Does City code prohibit illicit discharges on private property or discharge of waste to the public stormwater system?

- How is related code compliance monitored (e.g., outfall inspections, other inspections, other methods)?
- Does the City have a spill response plan for the storm drain system?
- Does the City provide training to educate staff about spill prevention and control and illicit discharges?

Controlling Runoff from New Development, Redevelopment and Construction Sites

- When was/were the City's ordinance(s) regulating stormwater last updated?
- Does the City currently have any plans to update Chapter 13.35 through 13.40 of the Lynnwood Municipal Code?
- What content will be updated?
- Is the City interested in blanket adoption of the Ecology stormwater manual for western Washington, or tailoring manual requirements?
- Does the City review site plans prior to construction to ensure compliance with:
    - Erosion and sediment control requirements? Are TESC plans scrutinized for adequacy to truly work in the field as part of permit approval?
    - Flow control and water quality requirements?
- Does the City inspect all construction sites that are required to implement erosion and sediment control plans?
- Are erosion control measures usually implemented correctly?
- Does the City provide training on erosion control and stormwater BMPs?
- Does the City provide contractors, developers, and staff with information on external training opportunities?

Pollution Prevention and Operations and Maintenance for Municipal Facilities

- What municipal facilities does the City operate (e.g., fleet vehicle yard, maintenance shop(s), parking garage(s), etc.)?

- Does the City have a municipal facilities operation and maintenance (O&M) plan? When was it last updated? Does it cover all facilities?

- Does the O&M plan cover:

  - ☐ Pollution prevention
  - ☐ Equipment fueling and maintenance
  - ☐ Equipment washing practices
  - ☐ Dust control
  - ☐ Catch basin cleaning
  - ☐ Catch basin sediment waste management
  - ☐ Street sweeping
  - ☐ Deicing and snow removal
  - ☐ Other waste disposal
  - ☐ Others?

- Does maintenance staff engage in projects/work that should be covered in the plan, but currently are not covered?

- Is the O&M plan followed and updated diligently?

- Are portions of the O&M plan hard to follow? Which ones?

- Which areas of the O&M plan need further definition and/or guidelines to be effective?

- Does the O&M plan cover parks and open spaces?

- Does the O&M plan include a waste disposal procedure?

- What is the City's street sweeping procedure?

- Does the City anticipate any major upcoming O&M equipment purchases?

- Does the City provide O&M training for City employees?

- Is much O&M performed by contract staff?

- How many full time equivalent personnel are currently required to meet maintenance needs?

- How does current maintenance frequency compare to the optimal frequency identified in the 1998 stormwater management comprehensive plan?

- Do street and storm drain system maintenance staff adhere to any BMP guidelines developed regionally?

Compliance with Total Maximum Daily Load Requirements

- Have the requirements of the Swamp Creek water quality improvement plan been successfully implemented?
- Are any other TMDLs currently under consideration?
- Are the results of ongoing TMDL related work (e.g. water quality monitoring results, pollution source identification) currently available?
- Is there a local or regional program to monitor baseline conditions and evaluate surface water program effectiveness?

Capital Improvement Projects

- What is the status of capital improvement projects identified in the 1998 comprehensive plan?
- What are major roadblocks to execution of projects in the current capital facilities plan?
- What capital improvement projects are still needed, but not addressed in the current capital facilities plan? Why?

Staffing

- What is the current level of staffing (i.e. full time equivalents) for the stormwater program?
- What are the current unmet staffing needs?
- What staffing decisions could be used to meet NPDES Phase II requirements (e.g., training on IDDE, additional water quality monitoring staff)?

Program Funding

Which of the following funding sources are currently used to fund SWM Program activities?

- Stormwater Utility
- Grants

- Loans
- Development review (permit) fees
- Revenue bonds for CIP projects
- Fee in-lieu of on-site stormwater control (to pay for regional stormwater facilities)
- General fund
- Special Purpose / Local Improvement District(s)
- Drainage for Flood Control Zone District(s)
- System development charges
- Intergovernmental coordination/leveraging
- Charges paid by upstream jurisdictions.

Other

Tracking and Reporting

- Who in the City is responsible for NPDES permit compliance reporting?
- Is the City aware of industrial (stormwater) NPDES permittees and other regulatory requirements targeting specific businesses?

Underground Injection Control Rule

- How many infiltration facilities are publicly owned? How many privately owned?
- Are publicly owned infiltration facilities located, mapped, and registered?
- Is any City-owned drainage infrastructure draining to drywells?
- Are privately-owned dry wells or other infiltration facilities documented?
- Does the City have a risk based strategy for permitting/approving future stormwater infiltration systems (based on soils, groundwater, drinking water wells, etc.)? Are there design standards for locating and constructing infiltration facilities?

- Does the City have an ordinance relating to UIC? When was it last updated? How does the City enforce construction standards for infiltration facilities?
- Do public systems receive annual maintenance after construction is complete?
- What is the City's pollution prevention plan for public infiltration systems?
- Has the City identified existing publicly owned infiltration systems in areas of high risk for groundwater degradation?
- Does the City have a written plan for the management and/or replacement strategy that will reduce pollutant loading to groundwater in high-risk areas? (If so, please provide a copy of the management plan.)
- If applicable, which of the following elements are included in the replacement strategy: monitoring, effectiveness assessment, report preparation, enhanced O&M, source control, spill control/response, opportunistic retrofits?
- Does the City provide UIC training for staff?
- Does the City participate in any regional interlocal agreements relating to UIC?
- Does the City report to the Department of Ecology regularly concerning UIC?

Endangered Species Act

- Does the City assess stormwater impacts on listed species when making land use decisions?
- What (if any) policies are in place to reduce stormwater runoff, reduce impervious surfaces, and retain native vegetation?
- What challenges do ESA considerations create for stormwater management?
- Does the City coordinate its ESA compliance strategy with other agencies (e.g., Snohomish County or WDFW)?

ATTACHMENT C

Roster from City of Lynnwood SWMP Workshop, February 6, 2008

Table C-1. City of Lynnwood Stormwater Management Program Workshop, February 6, 2008.

Attendee	Organization	Email	Phone
Jared Bond	City of Lynnwood	jbond@ci.lynnwood.wa.us	(425) 670-5207
Les Rubstello	City of Lynnwood	lrubstello@ci.lynnwood.wa.us	(425) 670-6262
Arnold Kay	City of Lynnwood	akay@ci.lynnwood.wa.us	(425) 670-6680
Norm Nesting	City of Lynnwood	nnesting@ci.lynnwood.wa.us	(425) 670-5200
Steve Swain	City of Lynnwood	sswain@ci.lynnwood.wa.us	(425) 670-6269
Jay Konopinski	City of Lynnwood		(425) 670-5212
Mark Ewbank	Herrera Environmental Consultants, Inc.	mewbank@herrerainc.com	(206) 441-9080
Rebecca Dugopolski	Herrera Environmental Consultants, Inc.	rdugopolski@herrerainc.com	(206) 441-9080
Matthew Fontaine	Herrera Environmental Consultants, Inc.	mfontaine@herrerainc.com	(206) 441-9080

ATTACHMENT D

SWMP Needs Related to NPDES Phase II Permit

SWMP Needs Related to the NPDES Phase II Permit

Appendix D presents the results of a comprehensive comparison between the City Stormwater Management Program (SWMP) and the NPDES Phase II Permit requirements. In order to make referencing this table easy, the results are listed by permit section and each requirement includes references to the applicable annual report question number and due date. The table presents the permit requirements, current City practices related to each requirement, and SWMP needs. The table also includes current City plans for meeting these needs. This table will provide a tool for tracking SWMP improvements and generating annual reports for Ecology.

Complete NPDES Reference	Annual Report Question Number	Requirement	Current City Practices	Needs	Ecology Deliverable or Documentation in Annual Report	Due Date	Planned Action (If Known)	Other Suggestions	Comments/Questions/Notes
S1.Permit Coverage Areas and Permittees									
S1.D.2.		Submit a Notice of Intent to Ecology				February 16, 2007			
S2.Authorized Discharges									
S2.A.		Stormwater may be discharged to surface waters and to ground waters of the state (Authorized by this condition of the permit).							
S2.B.		Non-stormwater may be discharged to surface waters and ground waters of the state only under the following conditions: Discharge is covered by another NPDES or State Waste Discharge Permit, Discharge from emergency fire fighting activities, Discharge that is already managed according to S5.C.3.b.							
S2.C.		Entities that cause illicit discharges are still responsible and liable under state and federal laws and regulations.							
S2.D.		Discharges from separate storm sewers constructed after the February 16, 2007 shall receive all applicable state and local permits and use authorizations, including compliance with SEPA.							
S3.Responsibilities of Permittees									
S3.A.1.		Comply with all the conditions of this permit.							
S4.Compliance with Standards									
S4.A.		No discharge of toxics							
S4.B.		No violation of surface water quality standards, groundwater quality standards, sediment management standards, or federal toxics rule							
S4.C.		Reduce discharge of pollutants to maximum extent practicable							
S4.D.		Use all known, available, reasonable methods of prevention, control and treatment (AKART)							
S4.E.		Comply with S3							
S4.F.	90-92	Respond to violations of water quality standards							
S4.F.1.	90-92	Notify Ecology within 30 days of becoming aware of water quality standard violation				30 days after becoming aware of a violation			
S4.F.2.	90-92	If Ecology identifies violation, then permittee will be required to submit a corrective action plan and report to ecology				60 days after receiving notice from ecology			
S4.G		Comply with any permit modifications made by Ecology							

Complete NPDES Reference	Annual Report Question Number	Requirement	Current City Practices	Needs	Ecology Deliverable or Documentation in Annual Report	Due Date	Planned Action (If Known)	Other Suggestions	Comments/Questions/Notes
S5. Stormwater Management Program for Cities, Towns, and Counties									
S5.A. Develop and Implement SWMP									
S5.A.1.		Develop and Implement SWMP				August 20, 2011			
S5.A.2.	1	Prepare written documentation of SWMP (Attachment for Annual report--stormwater management plan and documentation identified in S9.)			Attachment for Annual Report	March 31 of each year starting in 2008			
S5.A.3.	3	SWMP tracking							
S5.A.3.a.	4	Track the cost of development and implementation of each component of the SWMP.	As part of this project the City will be tracking the cost of developing each component of the SWMP.			January 1, 2009		Develop a program for gathering, tracking, maintaining, and using information.	
S5.A.3.b.	7	Track inspections, enforcement actions, and public education activities. (See S5.C.4. and S5.C.1.)			Number of Events	February 15, 2009			
S5.A.5.a.		Coordinate with other MS4s (downstream and upstream jurisdictions) as necessary				NA			
S5.A.5.b.		Coordinate between City departments				NA			
S5.B		Continue current stormwater management efforts/plans							
S5.C.SWMP Components									
S5.C.1. Public Education and Outreach									
S5.C.1.a.	5, 6, 6b	Develop and implement a public education and outreach program. Provide an education and outreach program directed at residents, businesses, industries, elected officials, policy makers, planning staff, and City of Lynnwood employees.	The City currently administers a grant program for stormwater education in area schools. The City currently provides materials for citizens to apply storm drain signage. In the past two years, the City has distributed approximately 300 anodized discs. Stormwater articles are occasionally included in "Inside Lynnwood." The City provides educational materials to schools when requested. City staff provide onsite education regarding carwash BMPs. The City has purchased an educational booth for use at public gatherings such as fairs and carnivals (i.e., Spring Clean and Arbor Day). The City has purchased pet waste cleanup bags and other educational materials for distribution in the booth.	Develop an education and outreach program through documentation in the SWMP. Implement the written plan through the following actions: Complete educational booth. Identify target audience for educational materials. Obtain and distribute educational materials according to the SWMP. Based on Appendix 2.4.4, educational materials must also include bacterial pollution and animal waste information. Based on Appendix 2.4.2, some of this educational materials must target K-12 students.		February 15, 2009	Document the education and outreach program in the SWMP. Continue developing the educational booth that can be used at City events. The booth will be designed to target a wide range of citizens. Develop specialized educational materials to target select groups of the population and distribute this information as appropriate for the group. Perform surveys at the educational booth the measure current understanding of stormwater issues and effectiveness of the booth.	Adapt or use educational materials from material developed by EPA, Snohomish County, and other jurisdictions. Adapt or use TMDL related educational material from other jurisdictions that have developed TMDL materials (e.g., Snohomish County, Bothell for North Creek). Based on the experience of City staff, the following groups should be the target of specialize materials: automotive, restaurants, bakeries, carwashes, coffee stands, taverns, and concrete pouring operations. Bookmarks for libraries, utility bill pamphlets, and door hangers are also appealing educational alternatives. Require that educational grant recipients incorporate bacterial pollution and management of animal waste.	
S5.C.1.b.	5, 8	Measure the understanding and adoption of targeted behaviors among targeted audiences.		Identify target behaviors. Identify method to measure adoption and understanding of target behaviors. Conduct ongoing measurement activities.		February 15, 2009	Count the number of people that visit the educational booth during an event. Conduct a survey at the educational booth.	Establish measurement method that includes recording of baseline data and measurement of future data against baseline. Develop a survey that will be used in association with the educational booth. Consider using a follow-up survey or phone call to booth visitors after event to measure any change in targeted behaviors.	
S5.C.1.c.	5, 7	Record education and outreach activities	The City currently tracks funding spent on the school grant program	Develop a system to track the number and type of education and outreach activities.	Number of activities implemented	February 15, 2009	The City plans to track educational opportunities provided with the new booth.	Develop a database/spreadsheet that tracks activity, date, quantity of materials distributed. Maintain appropriate records for all activities performed to measure education and outreach.	

Complete NPDES Reference	Annual Report Question Number	Requirement	Current City Practices	Needs	Ecology Deliverable or Documentation in Annual Report	Due Date	Planned Action (If Known)	Other Suggestions	Comments/Questions/Notes
S5.C.2. Public Involvement and Participation									
S5.C.2.a.	9, 10	Create an opportunity for involvement in SWMP update.	The City website provides phone numbers to report flooding activity or to contact the utility.	Create opportunities for the public to participate in the development, implementation, and update of the Permittee's entire SWMP.		February 15, 2008	Provide a public comment period for Draft SWMP. Provide a public comment period for Final SWMP. Provide an opportunity for comment on the Final Code revisions.	Add information on website such as the following statements: "SWMP is currently being updated. To access 1998 SWMP, call xxx, write xxx, or go xxx. Comments should be addressed to xxxxx contact info by xxxxx date. Opportunities for public comment on the revisions will be provided at a future date." Should an opportunity be provided for public comment on the draft revised code?	Should an opportunity be provided for public comment on the revised draft code?
S5.C.2.b.	11, 12	Make SWMP, annual report, and attachments available to the public by posting documents on the City website or Ecology's website.	The City is currently completing the annual report and supporting documentation.	Create opportunities for public to access information on SWMP. Providing public access by posting the following documents on the City website or Ecology's website: current SWMP, annual report, and any attachments to the annual report.		?		Make the required documents available and notify the public on how to obtain them. See above for an example of notification. Post 1998 SWMP on City website. Post SWMP on City website once it has been developed or send to Ecology to post on their website.	TMDL requirements require public participation in BPCP. This should be addressed in the BPCP section of the SWMP, but also mentioned in the public involvement section.
S5.C.3. Illicit Discharge Detection and Elimination									
S5.C.3.a.	14, 15, 16, 14b, 17, 18,	Develop a map of the stormwater system	The City has a database (Cartegraph) that contains most City stormwater assets and non-municipal stormwater assets within the City limits. The database includes spatial data for each asset and can be used to generate maps and track issues related to each asset. The City also has spatial data for zoning boundaries.	Develop a map of the stormwater system that includes: outfalls over 24", receiving waters, structural BMPs, tributary pipes, drainage areas, land use, private connections, closed contours, and zoning. Make the map available in electronic format upon request from Ecology.		February 15, 2011	Update the Stormdrain Facilities Database (for private facilities) to include all current facilities by the end of 2008.	Develop this map using available data. Perform reconnaissance as necessary. Consider using GIS software for data storage instead of Cartegraph depending on capabilities of software. Use as-builts to update the asset details for private storm drain lines and manholes in the Cartegraph database. Update the Stormdrain Facilities Database (for private facilities) to include all current facilities and spatial data for each facility.	
S5.C.3.b.	19, 20	Develop, adopt, and implement an ordinance that prohibits non-stormwater, illegal discharges, and dumping in stormwater system. Develop an enforcement strategy.	The City currently does not have an ordinance that prohibits illegal discharges into the stormwater system. City code does require citizens to pick up after their pets.	Develop and adopt an IDDE ordinance. The ordinance should do the following: Identify any exempt discharges. Include discharges from potable water sources, discharges from lawn watering, dechlorinated swimming pool discharges, street and sidewalk wash water, water used to control dust, routine external building wash water, and other non-stormwater discharges. Address commercial animal handling areas and commercial composting facilities by requiring source control BMP's from SWMMWW. Add any other discharges of concern. Include escalating enforcement procedures. Develop an enforcement strategy.		August 15, 2009		Revise current ordinance to include all the categories listed in S5.C.3.b.ii. and any other categories that contribute pollution. Revisions should also include escalating enforcement procedures and actions.	
S5.C.3.b.TMDL		Address commercial animal handling areas and commercial composting facilities. Include source control BMPs equivalent to SWMMWW V 4 p.2-10 to 2-12.							

Complete NPDES Reference	Annual Report Question Number	Requirement	Current City Practices	Needs	Ecology Deliverable or Documentation in Annual Report	Due Date	Planned Action (If Known)	Other Suggestions	Comments/Questions/Notes
S5.C.3.c.	21, 22, 23, 24, 25, 26, 27, 28	Develop and implement a program for detection and elimination of illicit discharges. The program should include the following: Procedures for locating priority areas based on land uses, previous complaints, and material storage (and TMDL listing--based on Appendix 2.4.7) Field assessment activities. Procedures for characterizing, tracing, and removing the discharge.	City staff informally monitor for illicit discharge when performing routine maintenance of the drainage system. When illicit discharges are suspected, attempts are made to identify the source of the discharge and resolve issues. The City maintains a file of previous IDDE tracking activities.	Develop a documented procedure for detection, field assessment, characterization, tracing, and addressing illicit discharges. This procedure should include a prioritized list of water bodies for visual inspection. Assess three high priority water bodies by Feb 15, 2011. Assess one high priority water body per year after Feb 15, 2011.		August 19, 2011 (Prioritized list of water bodies by Feb 15, 2010, Field assessment of three high priority water bodies by Feb 15, 2011, Field assessment of one high priority water body each year after Feb 15 2011)		Develop procedures based on Center for Watershed Protection, 2004.	
S5.C.3.d.	29, 30, 31,	Provide public information on IDDE and establish a hotline for IDDE reporting.		Provide public information on the hazards of illicit discharges in the public education program. Establish a hotline for illicit discharge reporting.	Number of calls received Numer of follow-up actions taken.	August 19, 2011 (Public Ed) February 15, 2009 (Establish hotline)		Include packet of illicit discharge info in the educational booth materials. Use website and "Inside Lynnwood' to advertise hotline. Include "Report illegal discharge or dumping into the stormwater system" on the website list of City contacts.	
S5.C.3.e.	32, 33, 34, 35, 36	Adopt procedures for IDDE program evaluation (number and type of spills, ID, inspections, feedback from public education efforts).		Develop and adopt a procedure for IDDE program evaluation.	Number of tracked events, summary of calls received and follow up actions taken	August 19, 2011		Define procedure in SWMP.	
S5.C.3.f.	37, 38, 39	Provide IDDE training. Provide staff with initial training, follow-up training, and develop a training program.		Provide IDDE tracking staff with initial training. Provide follow-up training. Develop a training program. Train all staff who may encounter an IDDE as part of their job functions.	Number of trainings provided, number of staff trained	August 15, 2009 (February 15, 2010 for the training program and general awareness training)		Define training needs in comprehensive plan. Track training and training requirements in a comprehensive plan spreadsheet.	Includes staff who are responsibile for identification, investigation, termination, cleanup, and reporting IDDEs. Also anyone who may encounter an IDDE (general awareness training).

Complete NPDES Reference	Annual Report Question Number	Requirement	Current City Practices	Needs	Ecology Deliverable or Documentation in Annual Report	Due Date	Planned Action (If Known)	Other Suggestions	Comments/Questions/Notes
S5.C.4. Controlling Runoff from New Development, Redevelopment, and Construction Sites									
S5.C.4.a.	44	Develop and adopt new or revised ordinance.	The City currently has permit related drainage plan review and site inspection requirements described in LMC Title 13.40 Drainage Plans. For sites under one acre, drainage plans are required to comply with the requirements of LMC Title 13.40. For sites greater than one acre, drainage plans are required to comply with the SWMMWW requirements as part of the SEPA process. Plan review and inspection is required for all sites.	Identify and adopt new development, redevelopment, and construction requirements that are equivalent to the minimum requirements in Appendix I of the NPDES Phase II Permit (i.e. equivalent to SWMMWW. Adopt a site planning process and BMP selection and design criteria. Develop an approval process for new development that includes inspections.Include provisions for non-structural preventative action and source reduction approaches (LID). Develop enforcement sanctions if the "Erosivity Waiver" in Appendix 1, Minimum Requirements #2 of the NPDES Phase II Permit is used.		August 15, 2009	Adopt new ordinance in August of 2008.	Develop and adopt an ordinance that officially adopts SWMMWW--either a blanket adoption or adoption of a geographically tailored version. Take a careful look at LID during development of the new ordinance. All LID techniques may not be feasible in all locations.	
S5.C.4.b.	53, 54	Have a permitting process in place for all sites greater than 1 acre inlcluding sites that are less than 1 acre, but are part of a larger development plan.	The City currently has a permitting process that applies to site with 2,000 square feet or more of developmental coverage (LMC 13.40). Qualifying sites must apply for a drainage permit. Before approving the permit, qualified City staff review the drainage plan. During the approval process a site inspection is scheduled. According to City staff, sites are inspected during construction to confirm TESC measures and inspected after construction to confirm construction meets drainage plan. Inspections are also conducted during and after the 2-year maintenance convenant to confirm that the necessary maintenance is being performed.	Maintain the more stringent size trigger for permit review. Review and revise the actual permitting and inspection requirements and procedure to ensure all aspects meet the permit requirements. Review/revise the current enforcement strategy.		August 15, 2009			The permit database will be revised in two years. During this revision, consider how the permit database could be improved to meet NPDES annual reporting requirements.
S5.C.4.c.	64, 66	Include provisions for long term O&M of stormwater facilities in code revisions.	According to City staff, all City plats have a drainage facility maintenance covenant, which includes maintenance criteria for most types of stormwater facilities. The City code currently includes a provision for private facility owners to defer facility O&M to the City upon inspection and approval by the City; however, this portion of the code is seldom (if ever) exercised.	Develop and adopt ordinance. Revise the facility specific maintenance standards of the maintenance covenant to be equivalent to SWMMWW. Annual inspections of treatment and flow control facilities permitted by City (unless reduced frequency can be documented). Inspections of all new flow control and water quality treatment facilities	Number of sites inspected, number of structural BMPs inspected, number of enforcement actions taken	August 15, 2009	Adopt an ordinance that enables enforcement staff to stop work on projects that don't meet stormwater requirements including the erosion and sediment control.	Examine the possibility of bringing all private facilities into City maintenance program. Examine fee in lieu of maintenance requirements.	If O&M of all private facilities is undertaken by the City, cafefully consider how the City would handle facilities that aren't constructed in a manner that makes maintenance feasible.

NPDES Special Condition Gaps

Complete NPDES Reference	Annual Report Question Number	Requirement	Current City Practices	Needs	Ecology Deliverable or Documentation in Annual Report	Due Date	Planned Action (If Known)	Other Suggestions	Comments/Questions/Notes
S5.C.4.d.	72	Record keeping procedure (inspection reports, warning letters, notices of violations, other records, projects greater than 1 acre).	The City tracks all permit-related records using a database.	Maintain records of the following program elements: inspection reports, warning letters, notices of violations, enforcement records, maintenance inspections, maintenance activities, and records of all projects that fall under the jursidiction of this ordinance. Annual report requires reporting on the following elements: number of site plan reviews, number of inspections conducted prior to construction, numer of sites inspection during construction, number of enforcement actions for construction erosion control, number of site inspections after construction, number of enforcement actions after construction, number of waivers allowed, number of sites inspected (to review maintainability and enforce maintenance standards), number of structural BMP's inspected (for maintenance requirements), number of enforcement actions (for maintenance), number of trainings provided by the City, and number of City staff trained.		August 15, 2009		Ensure that adequate records are kept to address Ecology reporting requirements.	
S5.C.4.e.	73	Make NOI letters available.		Make NOI letters available.				Make NOI letters available on the City website.	
S5.C.4.f.	74	Verify training of implementation staff	Staff is sent to state erosion control classes. Training records are maintained.	Ensure that training records continue to be maintained (permitting, plan review, construction site inspections, and enforcement).	Number of trainings provided and number of staff trained.	August 15, 2009		Develop a training plan and schedule for implementation staff.	

Complete NPDES Reference	Annual Report Question Number	Requirement	Current City Practices	Needs	Ecology Deliverable or Documentation in Annual Report	Due Date	Planned Action (If Known)	Other Suggestions	Comments/Questions/Notes
S5.C.5. Pollution Prevention and Operation and Maintenance for Municipal Operations									
S5.C.5.		Develop and implement O&M Program.	The current O&M Program has limited documentation.	Incorporate current practices and the additional items noted below into a new O&M plan. Implement the plan.		February 15, 2010		Request funding from City council to address additional maintenance staff needs to implement the O&M plan.	
S5.C.5.a.	76, 77	Develop maintenance standards equivalent to SWMMWW, perform inspections as necessary, and perform maintenance as necessary.	The City stormwater assets and asset deficiencies are tracked in the Cartegraph database. Under current informal maintenance standards, catch basins are cleaned when inspection indicates greater than 8-inches of sediment in the sump or less than 2-feet between the sediment surface and the outlet invert. The City does not have established maintenance standards for other facility types.	Develop maintenance standards equivalent to SWMMWW or adopt ecology standards.	Documentation of maintenance delays, if any.	February 15, 2010		Adopt SWMMWW requirements. Revise current field inspection forms to include all items required by SWMMWW. Implement field inspection forms. Develop and implement a procedure for tracking inspection and maintenance.	
S5.C.5.b.	78, 79	Conduct annual inspections of municipal stormwater treatment and flow control facilities (unless reduced frequency can be justified through documentation).	The City mows detention pond facilities 2-3 times per year, but has not performed detailed inspections of these facilities for several years.	Conduct annual inspections in accordance with SWMMWW Volume 5.	Number of facilities known. Number of facilities inspected. Documentation for reduced inspection frequency.	February 15, 2010		Develop an inspection schedule in the O&M plan. Incorporate inspections into the annual mowing cycle. Verify maintenance needs by performing detailed evaluations of sediment accumulation within ponds.	
S5.C.5.c.	80	Conduct spot checks after major storms (24hr-10yr)	City currently conducts spot checks before, during, and after storms. A map of flooding "hot spots" has been developed. Spot checks are conducted for approximately 12 storms per year. The 24hr-10yr storm typically causes drainage problems that need to be addressed.	Document all spot checks.	Number of facilities. Number of facilities inspected.	February 15, 2010		Document the requirement for spot checks in the O&M plan. Document the "hot spot" map in the O&M plan and the comprehensive plan. Develop a tool to record spot checks and drainage problems.	
S5.C.5.d.	81	Inspect all catch basins and inlets once during permit term	The City inspects catch basins and inlets approximately once every four years. Maintenance is performed as needed.	Document catch basin inspection and cleaning and maintain records.	Number of catch basins, number of catch basins inspected, number of catch basins cleaned.	February 15, 2012	Continue catch basins and inlet inspection cycle (i.e., once every three years) unless it can be determined that more/less frequent inspections are necessary.	Use current cleaning records to develop a maintenance log. Develop inspection checklists using SWMMWW Volume 5 checklists. Count facilities cleaned last year and add to the annual report. Begin conducting inspections/maintenance as described in SWMMWW.	
S5.C.5.e.		Establish an inspection program and achieve inspection of 95% of all sites	Catch basin inspection and maintenance is tracked on a poster-sized map. On several occasions the City has attempted to track inspections using field checklists or field computer systems. Some maintenance records are available, but past documentation has been inconsistent.	Establish an inspection program with a goal of inspecting 100% of facilities and execute inspections for 95% of facilities.				Document the City Inspection Program. Consider incorporating the checklists used by development services into standard maintenance operations. These checklists are currently part of a maintenance covenant attached to each plat document. The checklists will need to be revised slightly to achieve equivalence with SWMMWW. Develop an inspection schedule that will meet NPDES requirements. Perform inspections. Maintain records of the inspections. Track inspection results using a database and by performing daily data entry.	

NPDES Special Condition Gaps

Complete NPDES Reference	Annual Report Question Number	Requirement	Current City Practices	Needs	Ecology Deliverable or Documentation in Annual Report	Due Date	Planned Action (If Known)	Other Suggestions	Comments/Questions/Notes
S5.C.5.f.	82	Establish and implement practices to reduce the effect of roadway runoff (e.g. street sweeping).	Street sweeping is contucted as a source control measure and has a documented street sweeping plan.	As part of the operations and maintenance program, assess each of the following activities for reducing stormwater impacts: pipe cleaning, cleaning of culverts, ditch maintenance, street cleaning, road repair and resurfacing, snow and ice control, utility installation, pavement striping maintenance, maintaining roadside areas, and dust control.				Incorporate the street sweeper plan into the O&M plan. In O&M plan, document the suggested list of activities, identify which activities from the list are performed by the City, evaluate the cost and benefit of activities that are currently not performed, and select potential options for consideration by City officials.	
S5.C.5.g.	83	Establish and implement policies and procedures to reduce pollutant discharge from all City properties.	City staff perform many activities with the potential to affect stormwater. Most staff don't receive training on pollution prevention and appropriate stormwater BMPs. (Update with information from activities list)	Develop policies and procedures in the O&M plan that address pollution prevention for the following activities: Application of fertilizer, pesticides, and herbicides including the development of nutrient management and integrated pest management plans, sediment and erosion control, landscape maintenance and vegetation disposal, trash management, and building exterior cleaning and maintenance				Review current City activities to identify existing, potentially undocumented, pollution prevention (P2) activities. Document these procedures in the O&M plan. Identify other activities that should have P2 procedures/BMPs and develop these procedures as part of the stormwater program.	Still identifying of all activities that require stormwater pollution consideration/BMPs.
S5.C.5.h.	84	Develop and implement a training program for construction, operations, and maintenance staff.		Develop and implement a training program for employees who's construction, operations, and maintenance job functions may affect stormwater quality.	Number of trainings provided and number of staff trained			Identify appropriate activities and job functions. Determine appropriate BMPs. Identify appropriate training materials and training approach (e.g., SOP, classroom, OJT). Develop the training requirements and schedule for each applicable job function. Provide training. Document training.	
S5.C.5.i.	85	Develop and implement a SWPPP for all heavy equipment maintenance and storage facilities.	Vehicles are stored at the Joint Maintenance Facility (212th). Maintenance is also performed at this facility. The City currently cleans catch basins at the joint maintenance facility monthly (or bimonthly?).	Develop a SWPPP for all heavy equipment maintenance or storage yards and material storage facilities not covered by the Industrial Stormwater General Permit. Begin implementation of BMPs upon completion of the SWPPP.				Identify facilities that require a SWPPP. Inventory these facilities. Document current procedures. Identify needed procedures and BMPs. Develop a schedule and plan for implementing BMPs.	
S5.C.5.j.		Maintain records of inspections and maintenance.	The City currently maintains records of catch basin cleaning on a poster-sized City map.	In the annual report, Ecology requires documented counts for the following activities: Documentation of maintenance delays, if any. Number treatment and flow control facilities known. Number of treatment and flow control facilities inspected. Documentation for reduced inspection frequency (if pursued by the City). Number of facilities and number of facilities spot checked after a storm event equal or greater than the 24hour-10year storm. Number of catch basins, number of catch basins inspected, number of catch basins cleaned. Number of trainings provided and number of staff trained				Develop a tool for tracking the required O&M records. Potentially cartegraph.	
S5.Other SWMP requirements		Develop a Bacterial Pollution Control Plan (BPCP) as a subsection of the Stormwater Management Program. (See S7. for details)							

Complete NPDES Reference	Annual Report Question Number	Requirement	Current City Practices	Needs	Ecology Deliverable or Documentation in Annual Report	Due Date	Planned Action (If Known)	Other Suggestions	Comments/Questions/Notes
S6.Stormwater Management Program for Secondary Permittees									
Not Applicable									
S7.Compliance with Total Maximum Daily Load Requirements									
S7.A. Comply with TMDL requirements									
S7.A.	86, 87, 88, 89	Comply with TMDL requirements in Appendix 2	See practices listed below.	See needs listed below.	TMDL status report	March 31 of each year starting in 2009			
S7.A.Appendix 2.4.1.		Address commercial animal handling areas and commercial composting facilities. Include source control BMPs equivalent to SWMMWW V 4 p.2-10 to 2-12.	Passed an animal control ordinance that requires citizens to pick up after their pets (LMC 5.02.160).					Identify facilities that fall into this category Conduct inspections at facilities and recommend source control BMPs to be implemented Establish a method to enforce BMP implementation	See S4.3.b for additional information.
S7.A.Appendix 2.4.2.		Develop a Bacterial Pollution Control Plan (BPCP) as a subsection of the Stormwater Management Plan.		Develop a BPCP to facilitate public participation in advising on development, implementation, and update of TMDL-related portions of the SWMP. Plan should include the following activities: ordinance, inspection and enforcement resources and strategies, IDDE, water quality monitoring. BPCP should also evaluate the following approaches: receiving water sampling, development and implementation of pet waste ordinance, current water pollution ordinance enforcement capabilities, critical areas ordinance, educational program for students, investigation and implementation of methods to prevent additional pollution (e.g., stormwater treatment, LID retrofits, LID for new development)					
S7.A.Appendix 2.4.3.		Track BPCP activities and program changes	A brief summary of City TMDL activities has been provided in the TMDL Implementation Plan	Begin tracking BPCP activities and any deviation from the original program outlined and presented to Ecology.	Discuss BPCP activities and program changes in annual report subsection (e.g., number of activities and number of changes).				
S7.A.Appendix 2.4.4.		Incorporate bacterial pollution and animal waste management into the public education program.	City has restricted feeding of waterfowl with the installation of educational signs at two problem parks adjacent to Scriber Creek. The City has also purchased TMDL related educational material for the educational booth.	Incorporate bacterial pollution and animal waste management into the public education program.			Distribution of pet waste bags and leash dispensers at educational booth Distribution of pet waste posters developed by Snohomish County at educational booth	Increase the number of "pick up after your pet" stations.	
S7.A.Appendix 2.4.5.		Perform water quality monitoring in accordance with a Quality Assurance Project Plan (QAPP).	City currently monitors Scriber Creek?	Monitor at site SRLD, identified in Appendix 2, or monitor upstream and downstream of Lynnwood, or sample representative outfalls.		July 16, 2007		Coordinate with Mountlake Terrace and Brier to sample at SRLD.	
S7.A.Appendix 2.4.5.		Develop QAPP	QAPP has been submitted to Ecology.	Finalize QAPP	QAPP	March 17, 2007	Finalize QAPP		
S7.A.Appendix 2.4.7.		Prioritize TMDL listed water bodies as "high" in the IDDE prioritized water bodies list. (See S5.C.3.c.)							

Complete NPDES Reference	Annual Report Question Number	Requirement	Current City Practices	Needs	Ecology Deliverable or Documentation in Annual Report	Due Date	Planned Action (If Known)	Other Suggestions	Comments/Questions/Notes
S8.Monitoring									
S8.A. Monitoring									
S8.A.1.		Conduct monitoring as required by TMDL (see S7)							
S8.A.2.		Conduct sampling required for IDDE (See S5.C.3.)							
S8.B. Reporting									
S8.B.		A description of stormwater monitoring (for annual report).		Prepare a brief description of any stormwater monitoring that was conducted, including the type of information gathered or received.	Description of any monitoring information gathered/received--for the annual report.	March 31 of each year.			
S8.B.		An assessment of BMPs and summary of expected changes		Assess the appropriateness of BMP's identified by the SWMP. Describe any changes made to these BMPs. Prepare a document that summarizes the appropriateness of BMPs and any anticipated changes.	An assessment of BMP appropriateness and expected changes--for annual report.	March 31 of each year.			
S8.B.		Information in S8.C.2 (monitoring program reporting requirements)		See S8.C.2.	See S8.C.2.				
S8.C. Preparation for future Long-term Monitoring									
S8.C.1.a.		Identify two outfall or conveyance locations suitable for long term monitoring (1 commercial and 1 high density residential)		Identify two outfall or conveyance locations suitable for long term monitoring (1 commercial and 1 high density residential)		December 31, 2010			Requirement for Cities with population between 10,000 and 75,000
S8.C.1.b.		Prepare to monitor the effectiveness of the SWMP. Identify two suitable questions to monitor for and select sites to monitor. Develop a monitoring plan.		Identify two suitable questions to monitor for and select sites to monitor.					
S8.C.2.a.		Describe status of stormwater site identification. Summarize questions from S8.C.1.b.ii. and describe monitoring plan status.		Prepare a description of the status of stormwater monitoring site identification. Prepare a summary of the required questions for the SWMP effectiveness monitoring. Prepare a description of the status of monitoring plan development, including proposed purpose, design, and methods.	Description of stormwater monitoring site identification status. Summary of monitoring questions and monitoring plan development.	March 31, 2012			
S8.C.2.b.		All portions of section S8. may be submitted on collaborative reports with other MS4s.						The City may consider a collaborative monitoring report. Other jurisdictions in the Swamp Creek watershed seem ikely candidates for collaboration.	

Complete NPDES Reference	Annual Report Question Number	Requirement	Current City Practices	Needs	Ecology Deliverable or Documentation in Annual Report	Due Date	Planned Action (If Known)	Other Suggestions	Comments/Questions/Notes
S9.Reporting Requirements									
S9.A.	1	Submit annual report.		Complete the annual report. Complete a SWMP status update.	Annual Report	March 31 of each year			
S9.B.		Submit 2 hard copies and 1 electronic copy							
S9.C.		Maintain permit related records for 5 years. With the exception of annual report documentation, documentation is only required upon request from Ecology.							
S9.D.		Make Annual report, supporting docs, and SWMP available to the public							
S9.E. Annual report components									
S9.E.1.		Provide Ecology with a copy of current SWMP		Develop a document that describes the current SWMP revision process to meet requirements in S5.	Copy of the current SWMP.	March 31 of each year		Though the permit requires a copy of the SWMP, a description document may be best in the interim--for the March 2008 report.	
S9.E.2.		Provide Ecology with a completed copy of Appendix 3 and supporting documentation.		Complete a copy of Appendix 3. The Annual Report may also include documentation that covers the following items: The status of implementation of each component of the SWMP in section S5, An assessment of progress towards meeting minimum performance standards for minimum control measures, A description of activities being implemented to comply with each component of the SWMP, SWMP implementation schedule, A summary of the permittee's evaluation of their SWMP (also see S5.A.4. and S.5.B.2), Updated information from the prior annual report and any new monitoring information, Certification and signature (See G19.D. and G19.C.)	Completed copy of Appendix 3.	March 31 of each year			
S9.E.3.	2	Notification of annexation		Document any annexations and prepare the documentation to submit in the annual report.	Documentation of annexations	March 31 of each year			
S9.F.		NA							

Notes:
If no deadline is given, August 19, 2011 can be assumed. This is the deadline for development and implementation of the revised SWMP.
I've used SWMP to mean both (1) Stormwater Management Program and (2) Stormwater Management Comprehensive plan. This will need to be corrected.

VI. Status Report Covering Calendar Yr: ______ **Jurisdiction Name:** ____________________

PLEASE label any information in attachments with corresponding question numbers.
NOTE: Items that have future compliance dates must still be answered to indicate status.
NOTE: Some [bracketed language] is included to provide clarification or to address errors.
PLEASE indicate reporting year and your jurisdiction in Line 1, above.
PLEASE refer to the INSTRUCTIONS tab for assistance filling out this table.
PLEASE review your work for completeness and accuracy. Save this worksheet as you go!

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, <u>if applicable</u>
1.	**Attached** annual written update of Permittee's Stormwater Management Program (SWMP), including applicable requirements under S5.A.2 and S9?				
2.	**Attached** a copy of any annexations, incorporations or boundary changes resulting in an increase or decrease in the Permittee's geographic area of permit coverage during the reporting period, and implications for the SWMP as per S9.E.3?				
3.	Implemented an ongoing program for gathering, tracking, maintaining, and using information to evaluate SWMP development, implementation and permit compliance and to set priorities? (S5.A.3)				
4.	Began tracking costs or estimated costs of the development and implementation of the SWMP? (*Required* no later than January 1, 2009, S5.A.3.a)				
5.	SWMP includes an education program aimed at residents, businesses, industries, elected officials, policy makers, planning staff and other employees of the Permittee? (S5.C.1)				
6.	Distributed appropriate information to target audiences identified in the area served by the MS4? (*Required* by February 15, 2009, S5.C.1.a)				
6b.	Please mark a **Y** next to audiences targeted in Y/N/NA box:				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, if applicable
i	General Public				
ii	Home-based business				
iii	Elected officials				
iv	Developers				
v	Contractors				
vi	Permittee Employees				
vii	Residents				
viii	Businesses				
ix	Policy makers				
x	Engineers				
xi	Property managers				
xii	Homeowners				
xiii	Mobile businesses				
xiv	Industries				
xv	Landscapers				
xvi	Planning Staff				
7.	Tracked the types of public education and outreach activities implemented? (*Required* by February 15, 2009, S5.C.1.b and S5.A.3.b)				
7b.	Number of activities implemented:				
8.	Measured the understanding and adoption of the targeted behaviors among targeted audiences? (*Required* by February 15, 2009, S5.C.1.b)				
9.	Provided opportunities for the public to participate in the decision making processes involving the development, implementation and updates of the Permittee's SWMP? (*Required* by February 15, 2008, S5.C.2.a)				
10.	Developed and implemented a process for public involvement and consideration of public comments on the SWMP? (*Required* by February 15, 2008, S5.C.2.a)				
11.	Made the most current version of the SWMP available to the public? (S5.C.2.b)				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, <u>if applicable</u>
12.	Posted the SWMP on your website? (S5.C.2.b)				
12b.	NOTE website address in *Attachment* field:	y			
13.	Initiated or implemented an ongoing program to detect and remove illicit connections and illegal discharges into the Permittee's MS4? (*Required* August 19, 2011, S5.C.3)				
14.	Developed and currently maintain a map of your MS4? (*Required* by February 15, 2011, S5.C.3.a)				
14b.	[Initiated a program to develop and maintain a map of all connections to the MS4 authorized or allowed by the Permittee after the Permit effective date? (S5.C.3.a.ii)]				
15.	Map shows the location of all known municipal separate storm sewer outfalls, receiving waters and structural stormwater BMPs owned, operated, or maintained by the Permittee? (*Required* by February 15, 2011, S5.C.3.a.i)				
16.	Map shows all storm sewer outfalls with a 24 inch nominal diameter or larger, or an equivalent cross-sectional area for non-pipe systems and includes tributary conveyances, associated drainage areas and land use? (*Required* by February 15, 2011, S5.C.3.a.i)				
17.	Map shows geographic areas served by the Permittee's MS4 that do not discharge stormwater to surface waters? (*Required* by February 15, 2011, S5.C.3.a.iii)				
18.	Map has been made available upon request? (S5.C.3.a.iv)				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, <u>if applicable</u>
19.	Developed and implemented regulatory actions necessary to effectively prohibit non-stormwater, illegal discharges, and/or dumping into the Permittee's MS4? (*Required* by August 15, 2009, S5.C.3.b)				
20.	Developed and implemented an ongoing program to detect and address non-stormwater discharges, spills, illicit connections and illegal dumping into the Permittee's MS4? (*Required* by August 19, 2011, S5.C.3.c)				
21.	Developed procedures for locating priority areas likely to have illicit discharges, including at a minimum: evaluating land uses and associated business/industrial activities present; areas where complaints have been registered in the past; and areas with storage of large quantities of materials that could result in spills? (*Required* by August 19, 2011, S5.C.3.c.i)				
22.	Implemented field assessment activities, including visual inspection of priority outfalls identified during dry weather, and for the purposes of verifying outfall locations, identified previously unknown outfalls, and detected illicit discharges? (*Required* by August 19, 2011, S5.C.3.c.ii)				
23.	Prioritized receiving waters for visual inspection? (*Required* by February 15, 2010, S5.C.3.c.ii)				
24.	Conducted field assessments for three high priority water bodies? (*Required* by February 15, 2011, S5.C.3.c.ii)				
25.	Conducted field assessments on at least one high priority water body? (*Required* annually **after** February 15, 2011, S5.C.3.c.ii)				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, <u>if applicable</u>
26.	Developed and implemented procedures for characterizing the nature of, and potential public or environmental threat posed by, any illicit discharges found by or reported to the Permittee? (*Required* by August 19, 2011, S5.C.3.c.iii)				
27.	Developed and implemented procedures for tracing the source of an illicit discharge; including visual inspections, and when necessary, opening manholes, using mobile cameras, collecting and analyzing water samples, and/or other detailed inspection procedures? (*Required* by August 19, 2011, S5.C.3.c.iv)				
28.	Developed and implemented procedures for removing the source of the discharge, including notification of appropriate authorities; notification of the property owner; technical assistance for eliminating the discharge; follow-up inspections; and escalating enforcement and legal actions if the discharge is not eliminated? (*Required* by August 19, 2011, S5.C.3.c.v.)				
29.	Informed public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste? (*Required* by August 19, 2011, S5.C.3.d)				
30.	Distributed appropriate information to target audiences identified pursuant to S5.C.1? (*Required* by August 19, 2011, S5.C.3.d.i)				
31.	Publicized a hotline or other local telephone number for public reporting of spills and other illicit discharges? *(Required* by February 15, 2009, S5.C.3.d.ii)				
31b.	Number of calls received:				
31c.	Number of follow-up actions taken:				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, if applicable
32	Tracked the number and type of spills? (*Required* by August 19, 2011, S5.C.3.e)				
32b.	Number of spills:				
33	Tracked the number of illicit discharges identified? (*Required* by August 19, 2011, S5.C.3.e)				
33b.	Number of illicit discharges identified:				
34	Tracked the number inspections made for illicit connections? (*Required* by August 19, 2011, S5.C.3.e)				
34b.	Number of inspections:				
35	Received feedback from [IDDE] public education efforts? (*Required* by August 19, 2011, S5.C.3.e)				
36	**Attached** report on [IDDE] public education efforts? (*Required* by August 19, 2011, S5.C.3.d, S5.C.3.e)				
37	Municipal field staff responsible for identification, investigation, termination, cleanup, and reporting of illicit discharges, improper disposal and illicit connections are trained to conduct these activities? (*Required* by August 15, 2009, S5.C.3.f.i)				
37b.	Number of trainings provided:				
37c.	Number of staff trained:				
38	Provided follow-up training as needed to address changes in procedures, techniques or requirements? (*Required* by August 15, 2009, S5.C.3.f.i)				
38b.	Number of trainings provided:				
38c.	Number of staff trained:				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, if applicable
39	Developed and implemented an ongoing training program on the identification of an illicit discharge/connection, and on the proper procedures for reporting and responding to the illicit discharge/ connection for all municipal field staff, which, as part of their normal job responsibilities, might come into contact with or otherwise observe an illicit discharge or illicit connection to the storm sewer system? (*Required* by February 15, 2010, S5.C.3.f.ii.)				
39b.	Number of trainings provided:				
39c.	Number of staff trained:				
40	Developed, implemented and enforced a program to reduce pollutants in stormwater runoff to a regulated small MS4 from new development, redevelopment and construction site activities? (*Required* by August 15, 2009, S5.C.4)				
41	Applied stormwater runoff program to all sites that disturb a land area 1 acre or greater, including projects less than one acre that are part of a larger common plan of the development or sale? (*Required* by August 15, 2009, S5.C.4)				
42	Applied stormwater runoff program to private and public development, including roads? (*Required* by August 15, 2009, S5.C.4)				
43	Applied the Technical Thresholds in Appendix 1 to all sites 1 acre or greater, including projects less than one acre that are part of a larger common plan of the development or sale? (*Required* by August 15, 2009, S5.C.4)				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, if applicable
44	Adopted and implemented regulatory mechanism (such as an ordinance) necessary to address run-off from new development, redevelopment and construction site activities? (*Required* by August 15, 2009, S5.C.4.a)				
45	Retained existing local requirements to apply stormwater controls at smaller sites or at lower thresholds than required pursuant to S5.C.4?				
46	The ordinance or other enforceable mechanism includes the minimum requirements, technical thresholds, and definitions in Appendix 1 (or an equivalent approved by Ecology under the NPDES Phase I Municipal Stormwater Permit) for new development, redevelopment, and construction sites? (*Required* by August 15, 2009, S5.C.4.a.i)				
47	The ordinance or other enforceable mechanism includes exceptions and variance criteria equivalent to those in Appendix 1? (*Required* by August 15, 2009, S5.C.4.a.i., and Section 6 of Appendix 1)				
48	Were exceptions or variances to the minimum requirements in Appendix 1 granted? (*Required* by August 15, 2009, S5.C.4.a.i., and Section 6 of Appendix 1)				
48b.	If so, how many were granted?				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, <u>if applicable</u>
49	The ordinance or other enforceable mechanism includes a site planning process and BMP selection and design criteria that, when used to implement the minimum requirements in Appendix 1 (or equivalent approved by Ecology under the Phase I Permit) will protect water quality, reduce the discharge of pollutants to the maximum extent practicable and satisfy the State requirement under Chapter 90.48 RCW to apply all known, available and reasonable methods of prevention, control and treatment (AKART) prior to discharge? (*Required* by August 15, 2009, S5.C.4.a.ii)				
49b.	Cite documentation to meet this requirement in *Attachment* field:	y			
50	The ordinance or other enforceable mechanism provides the legal authority, through the approval process for new development, to inspect private stormwater facilities that discharge to the Permittee's MS4? (*Required* by August 15, 2009, S5.C.4.a.iii)				
51	The ordinance or other enforceable mechanism allows non-structural preventive actions and source reduction approaches such as Low Impact Development (LID) Techniques to minimize the creation of impervious surfaces and minimize the disturbance of native soils and vegetation? (*Required* by August 15, 2009, S5.C.4.a.iv)				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, if applicable
52	If the ordinance or regulatory mechanism allows construction sites to apply the **Erosivity Waiver** in Appendix 1, Minimum Requirement #2, does it include appropriate, escalating enforcement sanctions for construction sites that provide notice to the Permittee of their intention to apply the waiver but do not meet the requirements (including timeframe restrictions, limits on activities that result in non-stormwater discharges, and implementation of appropriate BMPs to prevent violations of water quality standards) to qualify for the waiver? (If waiver is allowed, the qualification is *required* by August 15, 2009, S5.C.4.a.v)				
53	Developed and implemented a permitting process to address runoff from new development, redevelopment and construction site activities with plan review, inspection, and enforcement capability? (*Required* by August 15, 2009, S5.C.4.b)				
54	Applied permitting process to all sites that disturb a land area 1 acre or greater, including projects less than one acre that are part of a larger common plan of the development or sale? (*Required* by August 15, 2009, S5.C.4.b)				
55	Reviewed **Stormwater Site Plans** for new development and redevelopment projects? (*Required* by August 15, 2009, S5.C.4.b.i)				
55b.	Number of site plans reviewed during the reporting period:				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, if applicable
56	Inspected, prior to clearing and construction, all known development sites that have a high potential for sediment transport as determined through plan review based on definitions and requirements in Appendix 7 **Determining Construction Site Sediment Potential**? (*Required* by August 15, 2009, S5.C.4.b.ii)				
56b.	Number of [qualifying] sites inspected [prior to clearing and construction] during the reporting period:				
57	Inspected construction-phase stormwater controls at all known permitted development sites during construction to verify proper installation and maintenance of required erosion and sediment controls? (*Required* by August 15, 2009, S5.C.4.b.iii)				
57b.	Number of sites inspected during [the construction phase for] the reporting period:				
58	Enforced as necessary based on the inspection at new development and redevelopment projects? (*Required* by August 15, 2009, S5.C.4.b.iii)				
58b.	Number of enforcement actions taken during the reporting period:				
59	Inspected [qualifying] permitted development sites upon completion of construction and prior to final approval or occupancy to ensure proper installation of permanent stormwater controls such as stormwater facilities and structural BMPs? (*Required* by August 15, 2009, S5.C.4.b.iv and v)				
59b.	Number of [qualifying] sites known during the reporting period:				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, if applicable
59c.	Number of [qualifying] sites inspected during the reporting period:				
60	Verified a maintenance plan is completed and responsibility for maintenance is assigned [for qualifying projects]? (*Required* by August 15, 2009, S5.C.4.b.iv)				
61	Enforced [regulations] as necessary based on the inspection? (*Required* by August 15, 2009, S5.C.4.b.iv)				
61b.	Number of enforcement actions taken during the reporting period:				
62	Developed and implemented an enforcement strategy to respond to issues of non-compliance [with the regulations for qualifying projects]? (*Required* by August 15, 2009, S5.C.4.b.vi)				
63	Did the Permittee choose to allow construction sites to apply the **Erosivity Waiver** in Appendix 1, Minimum Requirement #2? (S5.C.4.b.vii)				
63b.	If yes, how many waivers were allowed ?				
64	Developed and implemented a long-term operation and maintenance (O&M) program for post-construction stormwater facilities and BMPs? (*Required* by August 15, 2009, S5.C.4.c)				
65	Adopted an ordinance or other regulatory mechanism that clearly identifies the party responsible for maintenance, requires inspection of facilities and establishes enforcement procedures? (*Required* by August 15, 2009, S5.C.4.c.i)				
66	Inspected post-construction stormwater controls, including structural BMPs, at new development and redevelopment projects? (*Required* by August 15, 2009, S5.C.4.c)				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, if applicable
66b.	Number of sites inspected during the reporting period:				
66c.	Number of structural BMPs inspected during the reporting period:				
66d.	Number of enforcement actions taken during the reporting period:				
67	Established maintenance standards that are as protective, or more protective, of facility function as those specified in Chapter 4 of Volume V of the **2005 Stormwater Management Manual for Western Washington**? (*Required* by August 15, 2009, S5.C.4.c.ii)				
68	Performed timely maintenance as per S5.C.4.c.ii? (*Required* by August 15, 2009, S5.C.4.c.ii)				
68b.	**Attached** documentation of any maintenance delays. (*Required* by August 15, 2009, S5.C.4.c.ii)				
69	Annually inspected all stormwater treatment and flow control facilities (other than catch basins) permitted by the Permittee according to S5.C.4.b. unless there are maintenance records to justify a different frequency? (*Required* by August 15, 2009, S5.C.4.c.iii)				
70	If using reduced inspection frequency, **Attached** documentation as per S5.C.4.c.iii? (*Required* by August 15, 2009, S5.C.4.c.iii)				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, <u>if applicable</u>
71	Inspected all new stormwater treatment and flow control facilities owned or operated, including catch basins, for new residential developments that are a part of a larger common plan of development or sale, every 6 months during the period of heaviest house construction (i.e., 1 to 2 years following subdivision approval) to identify maintenance needs and enforce compliance with maintenance standards as needed? (*Required* by August 15, 2009, S5.C.4.c.iv)				
71b.	Number of facilities inspected during the reporting period:				
72	Implemented a procedure for keeping records of inspections and enforcement actions by staff, including inspection reports, warning letters, notices of violations, other enforcement records, maintenance inspections and maintenance activities? (*Required* by August 15, 2009, S5.C.4.d)				
73	Provided copies of the **Notice of Intent for Construction Activity** and **Notice of Intent for Industrial Activity** to representatives of proposed new development and redevelopment? (S5.C.4.e)				
74	All staff responsible for implementing the program to control stormwater runoff from new development, redevelopment, and construction sites, including permitting, plan review, construction site inspections, and enforcement were trained to conduct these activities? (*Required* by August 15, 2009, S5.C.4.f)				
74b.	Number of trainings provided:				
74c.	Number of staff trained:				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, if applicable
75	Developed and implemented an operations and maintenance (O&M) program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations? (*Required* by February 15, 2010, S5.C.5)				
76	Adopted maintenance standards as protective, or more protective, of facility function as those specified in Chapter 4 of Volume V of the 2005 **Stormwater Management Manual for Western Washington**? (*Required* by February 15, 2010, S5.C.5.a)				
77	Performed timely maintenance as per S5.C.5.a.ii? (*Required* by February 15, 2010, S5.C.5.a.ii)				
77b.	**Attached** documentation of any maintenance delays. (*Required* by February 15, 2010, S5.C.5.a.ii)				
78	Annually inspected and maintained all stormwater treatment and flow control facilities (other than catch basins)? (*Required* by February 15, 2010, S5.C.4.c.iii)				
78b.	Number of known facilities:				
78c.	Number of facilities inspected during the reporting period:				
79	If using reduced inspection frequency, **Attached** documentation as per S5.C.5.a.ii? (*Required* by February 15, 2010, S5.C.5.b)				
80	Conducted spot checks of stormwater facilities after major storms? (*Required* by February 15, 2010, S5.C.5.c)				
80b.	Number of known facilities:				
80c.	Number of facilities inspected during the reporting period:				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, if applicable
81	Inspected municipally owned or operated catch basins at least once before the end of the Permit term? (*Required* by February 15, 2010, S5.C.5.d)				
81b.	Number of known catch basins:				
81c.	Number of inspections:				
81d.	Number of catch basins cleaned:				
82	Established and implemented practices to reduce stormwater impacts associated with runoff from streets, parking lots, roads or highways owned or maintained by the Permittee, and road maintenance activities conducted by the Permittee? (*Required* by February 15, 2010, S5.C.5.f)				
83	Established and implemented policies and procedures to reduce pollutants in discharges from all lands owned or maintained by the Permittee and subject to this Permit, including but not limited to: parks, open space, road right-of-way, maintenance yards, and stormwater treatment and flow control facilities? (*Required* by February 15, 2010, S5.C.5.g)				
84	Initiated or implemented an operations and maintenance (O&M) program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations? (Required by February 15, 2010, S5.C.5.h.)				
84b.	Number of trainings provided:				
84c.	Number of staff trained:				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, if applicable
85	Initiated or implemented a Stormwater Pollution Prevention Plan (SWPPP) for all heavy equipment maintenance or storage yards, and material storage facilities owned or operated by the Permittee in areas subject to this Permit that are not required to have coverage under the Industrial Stormwater General Permit? (*Required* by February 15, 2010, S5.C.5.i)				
86	Is there an approved Total Maximum Daily Load (TMDL) applicable to stormwater discharges from a MS4s owned or operated by the Permittee?				
87	Complied with the specific requirements identified in Appendix 2? (S7.A)				
88	**Attached** status report of TMDL implementation? (S7.A)				
89	Where monitoring was required in Appendix 2, did you conduct the monitoring according to a Quality Assurance Project Plan? (S7.A)				
90	Took appropriate action to correct or minimize the threat to human health or the environment or otherwise stop or correct the condition of any instances of non-compliance with any of the terms and conditions of this Permit, including discharges from the Permittee's MS4 which may cause a threat to human heath or the environment? (G20 and S4.F)				
90b.	[**Attached** a summary of the status of implementation of any actions taken pursuant to S4.F and any information from an assessment and evaluation procedures collected during the reporting period. (S4.F.2.d)])				

Question		Y/N/ NA	#	Comments (50 word limit)	Name of Attachment & Page #, **if applicable**
91	Notified Ecology of the failure to comply with the permit terms and conditions within 30 days of becoming aware of the non-compliance? (G20 and S4.F)				
92	Notified Ecology immediately in cases where the Permittee becomes aware of a discharge from the Permittees MS4 which may cause or contribute to an eminent threat to human health or the environment? (G20 and S4.F)				

REMINDER: Save your work as you go. Did you answer each question, provide necessary background information in the # and/or Comments field, and note the filename and page number of all required documentation in the Attachment field? Proceed to the **Info Collection (Section VII-A)** tab next.

ATTACHMENT E

SWMP Implementation Plans

SWMP Implementation Plans

To fill gaps in the City of Lynnwood SWMP with respect to NPDES Phase II Permit requirements, several actions and program modifications are needed. Implementation plans for several categories of needs are presented below, organized according to the issues that the NPDES permit focuses on. Each of these implementation plans will be developed further as part of the City's Stormwater Management Comprehensive Plan update and/or as the City carries out the SWMP.

SWMP Implementation Plan for Public Education and Outreach

Table E-1. Summary of public education and outreach needs, Ecology deliverables, and due dates.

Requirement/Need	Ecology Deliverable	Due Date
Develop and implement an education and outreach program.	None.	February 15, 2009
Measure the understanding and adoption of targeted behaviors among targeted audiences.	None.	February 15, 2009
Track education and outreach activities.	Number of activities implemented. [a]	February 15, 2009

[a] This deliverable is required in the next annual report, which must be submitted to Ecology on or before March 31, 2009.

References

Ecology. 2007. Western Washington Phase II Municipal Stormwater Permit. Washington State Department of Ecology, Olympia, Washington. January 17, 2007.

Ecology. 2008. Resources, Training, and Guidance for Municipal Stormwater Permits. Accessed from agency Web site on May 5, 2008: <http://www.ecy.wa.gov/programs/wq/stormwater/municipal/resources_training_guidance.html>.

EPA. 2008. Stormwater Outreach Materials and Reference Documents. Accessed from agency Web site on May 5, 2008: <http://cfpub.epa.gov/npdes/stormwatermonth.cfm>.

Federal Way, City of. 2008. Stormwater Management Publications. Accessed from agency Web site on May 5, 2008: <http://www.cityoffederalway.com/Page.aspx?page=392>.

Jull, P.M. 2003. Evaluating Education and Outreach Programs: Workshop Materials Developed for the Washington State Department of Ecology Coordinated Prevention Grant Recipients. Applied Research Northwest. May 2003. Accessed from agency Web site on March 18, 2008: http://www.ecy.wa.gov/PROGRAMS/WQ/stormwater/municipal/public_outreach_resources.html.

Kitsap County. 2008. Kitsap County Outreach and Education Materials. Accessed from agency Web site on May 5, 2008: http://www.kitsapgov.com/sswm/pub_docs.htm.

Thurston County. 2008. Thurston County Storm and Surface Water Utility. Accessed from agency Web site on May 5, 2008:
http://www.co.thurston.wa.us/stormwater/General_stormwater_home.htm.

Actions

Ordinance and Requirements

None.

Stormwater Management Comprehensive Plan Revisions

The strengthened stormwater management program (SWMP) will include an expanded public education and outreach program, which will be described in the Stormwater Management Comprehensive Plan. The public education and outreach program will target each of the following groups identified in the NPDES Phase II Permit:

- General public
- General public, businesses, including home-based and mobile businesses
- Homeowners, landscapers, and property managers
- Engineers, contractors, developers, review staff and land use planners.

The public education and outreach program will also focus on several commercial business groups identified by City staff based on the potential for stormwater pollution:

- Automotive businesses
- Restaurants
- Bakeries
- Car washes
- Coffee stands
- Taverns
- Concrete pouring.

Target behaviors will be identified based on current stormwater issues within the City and other requirements such as IDDE and TMDL compliance. Methods will be developed to measure understanding and adoption of these target behaviors based on available literature on measuring performance of education programs and coordination with other jurisdictions in western Washington that are seeking to measure the same types of actions.

Record Keeping

A simple record keeping system will be developed to track education and outreach activities including date, location, target audience, quantities of material distributed, and information related to measurement of understanding and adoption of target behaviors. This system will be formatted to promote easy incorporation into the City's annual NPDES permit reporting to Ecology.

SWMP Implementation Plan for Public Involvement and Participation

Table E-2. Summary of public involvement and participation needs, Ecology deliverables, and due dates.

Requirement/Need	Ecology Deliverable	Due Date
Provide opportunities for the public to participate in the development, implementation, and update of the Permittee's entire SWMP.	None.	February 15, 2008
Develop and implement a process for public involvement and consideration of public comments on the SWMP.	None.	February 15, 2008
Make the SWMP documentation, annual report, and annual report attachments available to the public.	Make the documentation available on the City of Lynnwood Web site or submit the documentation to Ecology for posting on the Ecology website [a]	February 15, 2008

[a] This deliverable is required in the next annual report, which will be submitted to Ecology on March 31, 2009.

References

Ecology. 2007. Western Washington Phase II Municipal Stormwater Permit. Washington Department of Ecology, Olympia, Washington. January 17, 2007.

Actions

Ordinance and Requirements

None.

Stormwater Management Comprehensive Plan Revisions

Public involvement and participation will be incorporated in the SWMP revision process. The revised Stormwater Management Comprehensive Plan will include a new section that describes a process for public involvement and participation. This section will also document opportunities that will be created for public involvement and participation.

When the updated Stormwater Management Comprehensive Plan is in complete draft form, and subsequently when it is finalized, it will be made available to the public on the City Web site along with all SWMP annual reports and documentation that accompanied the reports. While the Stormwater Management Comprehensive Plan is in the process of being updated, summary information on the scope of the update work will be posted on the City's Web site.

SWMP Implementation Plan for Illicit Discharge Detection and Elimination (IDDE)

Table E-3. Summary of illicit discharge detection and elimination (IDDE) needs, Ecology deliverables, and due dates.

Requirement/Need	Ecology Deliverable	Due Date
Develop a map of the stormwater system.	Electronic map (upon request)	February 15, 2011
Adopt an IDDE ordinance.	None.	August 15, 2009
Develop an enforcement strategy and implement ongoing program.	None.	August 19, 2011
Define procedures for locating priority areas (land use and previous complaints).	None.	August 19, 2011
Implemented field assessment.	None.	August 19, 2011
Develop prioritized list of water bodies for IDDE.	None.	February 15, 2010
Conduct field assessment on three high priority water bodies.	None.	February 15, 2011
Conduct field assessment on one site per year.	None.	After February 15, 2011
Develop discharge characterization procedure.	None.	August 19, 2011
Develop source tracing procedures.	None.	August 19, 2011
Develop source removal procedures.	None.	August 19, 2011
Provide public information on illicit discharge hazards.	Report on IDDE related public education efforts.	August 19, 2011
List and publicize a hotline for IDDE reporting.	Number of calls received. Number of follow up actions taken. [a]	February 15, 2009
Adopt procedures for IDDE program evaluation (number and type of spills, ID, inspections, feedback from public education efforts).	Number of tracked events (number of spills, number of illicit discharges identified, number of inspections), summary of calls received and follow up actions taken. [a]	August 19, 2011
Develop a training program.	None.	February 15, 2010
Provide staff with initial training.	Number of trainings provided, number of trained staff. [a]	August 15, 2009
Provide follow-up training.	Number of trainings provided, number of trained staff. [a]	August 15, 2009

[a] This deliverable is required in the next annual report, which will be submitted to Ecology on the following March 31st.

References

Ecology. 2007. Western Washington Phase II Municipal Stormwater Permit. Washington Department of Ecology, Olympia, Washington. January 17, 2007.

Center for Watershed Protection and Pitt, R. 2004. Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments. Accessed via Web site on March 20, 2008: <http://www.cwp.org/IDDE/IDDE.htm>.

Actions

Ordinance and Requirements

The City will develop and adopt a new ordinance that forbids illicit discharges into the City storm drainage system. The ordinance should address the following:

- Identify exempt discharges
- Include discharges from potable water sources, discharges from lawn watering, dechlorinated swimming pool discharges, street and sidewalk washwater, water used to control dust, routine external building wash water, and other non-stormwater discharges
- Address commercial animal handling areas and commercial composting facilities by requiring source control BMPs equivalent to those presented in Ecology's *Stormwater Management Manual for Western Washington*
- Specify other discharges of concern.

The ordinance will also outline an enforcement strategy that includes escalating enforcement procedures.

Stormwater Management Comprehensive Plan Revisions

The revised Stormwater Management Comprehensive Plan will include a new section on illicit discharge detection and elimination. The IDDE section will identify procedures for detection, field assessment, characterization, tracking, and addressing illicit discharges. Beyond the comprehensive plan, the City's SWMP should also include detailed procedures for locating priority areas based on land uses, previous complaints, material storage, and TMDL listing. This procedure will be developed based upon guidance from the U.S. Environmental Protection Agency, prepared by the Center for Watershed Protection (2004) and other guidance that Ecology may deem appropriate.

The SWMP should also include procedures for IDDE program evaluation and improvement, including tracking the number of illicit discharge "events," the number of calls received, and the type of follow up actions taken.

Storm Drain System Map

The SWMP will include a map of the existing stormwater system that identifies the following attributes for all storm sewer outfalls with a 24-inch nominal diameter or larger (or equivalent open channel conveyance):

- Tributary conveyance
- Associated drainage areas
- Land use

- Receiving waters
- Structural BMPs in the ground
- Private connections
- Closed contours (e.g., surface water depressions).

Though the deadline for development of the system map is 1 year after the deadline for site prioritization, the map would provide a very useful tool when prioritizing sites.

Prioritization and Field Assessment

As part of the IDDE component within the SWMP, the City will develop a prioritized list of water bodies for use in prioritizing IDDE field assessment activities. This prioritization will key into TMDL requirements and concerns, as well as information on potential for illicit discharges related to land use and anecdotal information obtained by City staff. The City will need to conduct field assessments in drainage areas tributary to three high priority water bodies using documented field assessment procedures. The needs for IDDE actions in one high priority water body will be assessed each subsequent year.

Public Education and Reporting

The City will need to integrate IDDE information into its SWMP public education and outreach program, and establish a hotline for reporting illicit discharges.

Training

As part of the SWMP, the City will need to develop an IDDE training program. The program should include a list of training requirements for staff, a training schedule, and a method for tracking staff training.

Record Keeping

The City will need to develop a system for tracking IDDE related material, including the number of illicit discharge "events," the number of calls received, and the type of follow up actions taken. Records of staff training will also need to be maintained.

SWMP Implementation Plan for Controlling Runoff from New Development, Redevelopment, and Construction

Table E-4. Summary of controlling runoff from new development, redevelopment, and construction needs, Ecology deliverables, and due dates.

Requirement/Need	Ecology Deliverable	Due Date
Ordinance		
Develop and adopt new ordinance or ordinance revisions.	None	August 15, 2009
Adopt a site planning process and BMP selection and design criteria.	None	August 15, 2009
Develop an approval process for new development that includes inspections.	None	August 15, 2009
Develop provisions for LID technologies.	None	August 15, 2009
Develop enforcement sanctions if the "Erosivity Waiver" is used (see NPDES Phase II Permit, Appendix 1, Minimum Requirement #2).	None	August 15, 2009
Permits and Inspections		
Develop and implement a permitting process for all sites greater than 1 acre	None	August 15, 2009
Review all stormwater site plans for new development and redevelopment.	Number of site plans reviewed. [a]	August 15, 2009
Inspect construction sites prior to construction if they exhibit high sediment transport potential.	Number of sites inspected prior to construction. [a]	August 15, 2009
Inspect all sites during construction to ensure adequate erosion and sediment control BMPs.	Number of sites inspected during construction. [a]	August 15, 2009
Inspect all sites after construction and verify maintenance plan.	Number of known sites. 1 Number of sites inspected after construction. [a]	August 15, 2009
Maintain inspection records.		
Develop and implement an enforcement strategy for non-compliance	Number of enforcement actions taken. [a]	August 15, 2009
Adopt or reject the erosivity waiver in NPDES Phase II Permit Appendix 1, Minimum Requirement #2.	Number of waivers allowed. [a]	August 15, 2009
Long-term O&M of Stormwater Facilities		
Adopt provisions that identify the party responsible for performing maintenance, require inspection of facilities, and establish enforcement procedures if private parties will have responsibility.	None	August 15, 2009
Establish maintenance standards equivalent to those presented in Ecology's SMMWW.	Documentation of any maintenance delays. [a]	August 15, 2009
Conduct annual inspections of stormwater treatment and flow control facilities permitted by the City (unless reduced frequency can be documented).	Documentation for reduced inspection frequency. [a]	August 15, 2009
Inspect all new flow control and water quality treatment facilities	Number of facilities inspected. [a]	August 15, 2009
Develop a record keeping procedure.		August 15, 2009
Make NOI letters available.		
Develop a training program and maintain training records.	Number of trainings provided.1 Number of staff trained.	August 15, 2009

[a] This deliverable is required in the next annual report, which will be submitted to Ecology on or before the following March 31st.

References

Ecology. 2007. Western Washington Phase II Municipal Stormwater Permit. Washington Department of Ecology, Olympia, Washington. January 17, 2007.

Ecology. 2005. Stormwater Management Manual for Western Washington. Publication number 05-01-029 through 05-10-033. Washington Department of Ecology, Olympia, Washington. February 2005.

Actions

Ordinance and Requirements

The City will revise the existing drainage code or develop new drainage code to meet the requirements of the NPDES Phase II Permit. The new or revised code will address six primary requirements. Each of these requirements is listed below along with a brief discussion.

- **Meet the minimum requirements, technical thresholds, and definitions in Appendix 1 of the Permit.** This will be accomplished through adoption of the Ecology *Stormwater Management Manual for Western Washington* or an equivalent set of requirements (i.e., tailoring the Ecology manual based on specific characteristics within the City of Lynnwood, including geologic, hydrologic, and geographic characteristics or other).

- **Require a site planning process and BMP selection criteria as protective as set forth in the Ecology Stormwater Management Manual for Western Washington.** This will be accomplished through a combination of adoption of the *Stormwater Management Manual for Western Washington* or an equivalent set of requirements (i.e., tailoring the Ecology manual based on specific characteristics within the City of Lynnwood, including geologic, hydrologic, and geographic characteristics), and training City permit review staff to impose those requirements diligently on all affected projects.

- **Establish the legal authority to inspect private facilities.** The current code indicates that inspection of drainage facilities will be scheduled after drainage plan review. The revised code will expand on this provision to require new developments to submit as-built stormwater facility design plans to enable post-construction inspections by the city into perpetuity.

- **Include provisions for non-structural preventative actions and source reduction approaches (e.g., LID).** The revised code will include provisions to allow non-structural preventative actions and pollutant source reduction approaches. These provisions will account for specific characteristics within the City of Lynnwood, including geologic, hydrologic, and geographic characteristics, as well as access and maintenance.

- **Develop escalating enforcement sanctions for fraudulent use of the erosivity waiver.** If the City adopts the erosivity waiver in Appendix 1, Minimum Requirement 2 of the NPDES Phase II Permit, the City will develop escalating enforcement procedures. If the City chooses not to adopt the erosivity waiver, then no enforcement sanctions will be developed.

- **Establish provisions to verify adequate long-term maintenance.** The current City code allows for the City to assume the operation and maintenance responsibility for stormwater facilities under certain conditions. The new or revised code will identify the party who is responsible for operation and maintenance (O&M) of the facility and require inspection of flow control and water quality treatment facilities on an annual basis unless a reduced frequency of inspections can be justified based on O&M records. The new or revised code will also require inspection of new flow control and water quality treatment facilities in accordance with the requirements in the *Stormwater Management Manual for Western Washington*.

The City will evaluate several options for establishing the necessary requirements for new development, redevelopment, and construction. These options include complete adoption of Ecology's *Stormwater Management Manual for Western Washington* and adoption of a set of requirements based upon the manual and as protective as the manual but more specific to the stormwater management needs of the City of Lynnwood. During this evaluation the City will examine several aspects of the manual.

Permitting and Inspection

- The City currently has a detailed storm drainage permitting process, which includes plan review and site inspections for new development, redevelopment, and construction. The City will revise the permit review process to include requirements of the NPDES Phase II Permit and the revised SWMP. These revisions will include the following items:

- The process will require drainage review to the *Stormwater Management Manual for Western Washingto*n standards for all sites greater than 1 acre.

- Drainage plan review will be required for all permitted projects.

- Inspections will be required prior to construction to review potential pollution problems, during construction to verify erosion control measures are in place, and after construction to verify that the drainage system was constructed correctly in accordance with the permitted plans, and to verify that a maintenance plan has been developed.

- The City will develop a process for tracking information related to permitting, plan review, inspections, and enforcement, and which can provide the information required by the annual report to Ecology.

One objective of the permit and inspection process will be to achieve a 95 percent inspection rate for sites that require inspection—preconstruction, during construction, and post construction.

Stormwater Management Comprehensive Plan Revisions

The revised Stormwater Management Comprehensive Plan will include a section on controlling runoff from new development, redevelopment, and construction. This section will identify applicable City of Lynnwood Municipal Code sections and associated stormwater requirements. It will also describe the permitting process, internal recordkeeping procedure and responsibilities, identify training needs, and specify a location for documentation of City staff training.

Record Keeping

As part of the SWMP revisions, the City will develop a new record keeping system or revise the existing system to track, at minimum, the following information required by the NPDES Phase II Permit:

- Number of site plans reviewed
- Number of sites inspected prior to construction
- Number of sites inspected during construction
- Number of sites that qualify for inspection after construction
- Number of sites inspected after construction
- Number of enforcement actions taken
- Number of waivers allowed
- Number of O&M inspections conducted
- Number of structural BMPs inspected (during O&M inspections)
- Number of enforcement actions taken.

The record keeping system will also track and maintain documentation for variances from the maintenance requirements of the permit:

- Documentation of the cause of maintenance delays
- Documentation to justify reduced inspection frequency.

Records of notice of intent for coverage under the Construction Stormwater General Permit and the Industrial Stormwater General Permit will be maintained and made available to the public.

Training

As part of the strengthened SWMP, the City will need to develop a training program for staff with responsibility for implementing the program. Staff that review permits and plans or conduct inspections and enforcement will be included in the training plan.

SWMP Implementation Plan for Pollution Prevention and Operation and Maintenance for Municipal Operations

Table E-5. Summary of pollution prevention and operation and maintenance needs, Ecology deliverables, and due dates.

Requirement/Need	Ecology Deliverable	Due Date
Develop maintenance standards equivalent to the SMMWW (Ecology 2005) or adopt the SMMWW.	Documentation of maintenance delays, if any.	February 15, 2010
Conduct annual inspections of treatment and flow control facilities.	Number of facilities known. Number of facilities inspected. Documentation for reduced inspection frequency.	February 15, 2010
Conduct spot checks after major storms (24hr-10yr)	Number of facilities inspected.	February 15, 2010
Inspect all catch basins and inlets once during permit term.	Number of catch basins. Number of catch basins inspected. Number of catch basins cleaned.	February 15, 2012
Establish an inspection program.	None.	
Establish and implement practices to reduce roadway impacts (e.g., sweeping).	None.	
Establish and implement policies and procedures to reduce pollutant discharge from all City properties.	None.	
Develop and implement a training program for construction and O&M staff.	Number of trainings provided and number of staff trained.	
Develop and implement a SWPPP for all heavy equipment maintenance and storage facilities.	None.	
Maintain records of inspections and maintenance.	None.	
Conduct annual inspections of treatment and flow control facilities permitted by the City (unless reduced frequency can be justified through documentation).	Documentation of maintenance delays, if any.	February 15, 2010

[a] This deliverable is required in the next annual report, which will be submitted to Ecology on the following March 31st.

References:

Ecology. 2007. Western Washington Phase II Municipal Stormwater Permit. Washington Department of Ecology, Olympia, Washington. January 17, 2007.

Ecology. 2005. Stormwater Management Manual for Western Washington. Publication number 05-01-029 through 05-10-033. Washington Department of Ecology, Olympia, Washington. February 2005.

Actions

Ordinance and Requirements

Maintenance standards that are as stringent as those in Volume 5 of the *Stormwater Management Manual for Western Washington* will be established.

Stormwater Management Comprehensive Plan Revisions

The revised Stormwater Management Comprehensive Plan will include a revised section for pollution prevention and operation and maintenance (O&M) for municipal operations. This section will identify O&M requirements that are at least as stringent as those in the *Stormwater Management Manual for Western Washington* (Ecology 2005). This may be accomplished through adoption of Volume 5 of the *Stormwater Management Manual for Western Washington*. The Stormwater Management Comprehensive Plan will establish an inspection program (document existing practices and identify new requirements), specify an inspection frequency, and identify the required maintenance time window for facilities in need of maintenance as determined through inspection. A goal of the inspection program will be to inspect 95 percent of all facilities. The inspection program will meet the following requirements for municipal facilities:

- Flow control and water quality treatment facilities will be inspected annually.
- Inspection frequencies may be reduced if justified through inspection and maintenance records.
- Spot checks of stormwater flow control and treatment facilities will be performed after storms equivalent to or greater than the 24-hour, 10-year recurrence interval storm.
- All catch basins and drain inlets will be inspected at least once before February 15, 2012.

The Stormwater Management Comprehensive Plan will also establish a pollution prevention program that identifies practices to reduce stormwater impacts from streets, parking lots, roads, and other City-owned infrastructure. The pollution prevention component of the SWMP will evaluate the feasibility and practicality and make recommendations about the following activities:

- Pipe cleaning
- Cleaning of culverts
- Ditch maintenance
- Street cleaning
- Road repair and resurfacing
- Snow and ice control
- Utility installation
- Pavement striping maintenance
- Maintaining roadside areas
- Dust control.

The Stormwater Management Comprehensive Plan will also establish policies and procedures to reduce pollutants in runoff from City owned or operated lands. These policies and procedures will address the following activities:

- Application of fertilizer, pesticides, and herbicides including the development of nutrient management and integrated pest management plans
- Sediment and erosion control
- Landscape maintenance and vegetation disposal
- Trash management
- Building exterior cleaning and maintenance.

The Stormwater Management Comprehensive Plan will outline a training program for City staff and describe the requirements for a Stormwater Pollution Prevention Plan for heavy equipment maintenance or storage yards, and material storage facilities that are not subject to the Industrial Stormwater General Permit.

Training

As part of the SWMP revisions, the City will identify staff whose construction, operations, or maintenance job functions may impact stormwater and develop a training program for these employees. This training program will meet the requirements of the NPDES Phase II Permit and will include documentation of staff training.

Record Keeping

As part of the SWMP revisions, the City will develop a new record keeping system or revise the existing system to track information required by the NPDES Phase II Permit:

- Documentation of maintenance delays
- Number of facilities known
- Number of facilities inspected
- Documentation for reduced inspection frequency
- Number of spot checks performed after major storms
- Number of catch basins
- Number of catch basins inspected
- Number of catch basins cleaned
- Number of staff trained
- Documentation of trainings provided.

ATTACHMENT F

Status of Drainage Problems Identified in the 1998 Comprehensive Flood and Drainage Management Plan

Table F-1. Status of Drainage Problems Identified in the 1998 Comprehensive Drainage Plan.

ID	Project Location	Problem	Cause	1998 Status	Incorporate in 2008 Plan (Yes/No)[a]
F-1	180th Street from 48th Ave N to Highway 99	Flooding	Debris clogged ditch on N side of 180th St Sw	Corrected	No
F-2	Scriber Creek crossing 180th St SW between 54th Pl W and Highway 99	Flooding	Undersized culverts	Corrected	No
F-2	Scriber Creek crossing 180th St SW between 54th Pl W and Highway 99	Flooding	Lack of North Scriber Creek Detention Facility	Under construction	No
F-3	188th St SW east of Highway 99 at Scriber Creek crossing	Flooding	Insufficient culvert capacity during very high flows	Uncorrected, solution recommended	**Yes**
F-4	190th St SW in Brookwood at Scriber Creek crossing	Flooding	Insufficient culvert capacity	Corrected	**Yes**
F-5	191th St SW in Brookwood at Scriber Creek crossing	Flooding	Insufficient culvert capacity	Uncorrected, solution recommended	**Yes**
F-6	60th Ave W before crossing Highway 99, Scriber Lake High School	Flooding	Insufficient culvert capacity	Uncorrected, solution recommended	No
F-6	60th Ave W before crossing Highway 99, Scriber Lake High School	Flooding	Undersized drainage pipes on private property	Responsibility of property owners	No
F-7	North side of Scriber Creek crossing at 196th St Sw	Flooding	Insufficient culvert capacity	Uncorrected, solution recommended	**Yes**
F-7	North side of Scriber Creek crossing at 196th St Sw	Flooding	Adverse grade of sections of the creek	Uncorrected, solution recommended	**Yes**
F-7	North side of Scriber Creek crossing at 196th St Sw	Flooding	Heavy siltation	Uncorrected, solution recommended	**Yes**
F-7	North side of Scriber Creek crossing at 196th St Sw	Flooding	Extremely poor hydraulic conditions in the 42-inch culvert	Uncorrected, solution recommended	**Yes**
F-8	Scriber Creek crossing at 200th St SW and 50th Ave W, downstream from Scriber Lake	Flooding	Insufficient culvert capacity	Corrected	**Yes**
F-9	Scriber Creek crossing at 44th Ave W, east of I-5	Flooding	Sediment deposition in culvert, Insufficient culvert capacity	Uncorrected, solution recommended	No
F-10	Elks lodge (65th Ave W, if extended and 204th St SW) south through Whispering Cedars Apt. Complex, Then south across 208th St SW	Flooding	Inadequate maintenance	Corrected	No
F-11	The west side of Olympic View Dr, just upstream of 178th St SW	Flooding	Plugged driveway culvert in ditch	Corrected	No
F-12	Meadowdale Pond (173rd St SW and Meadowdale Dr)	Flooding	Surface runoff into a inflitration system can exceed the infiltration rate of the pond	Uncorrected, solution recommended	No
F-13	System on Private Property 168th St SW and West of 63rd Ave	Flooding	An obstruction in the system withn the private property	Uncorrected, solution recommended	No
F-14	Northeast corner of Olympic View Dr and 176th St SW	Flooding	Debris plugging the inlets to catch basins	Corrected	No
F-14	Northeast corner of Olympic View Dr and 176th St SW	Flooding	The colecter pipe located downstream had inadequate capacity	Corrected	No
F-15	52nd Ave W along frontage of Cedar Valley Elementary and along Cedar Vally rd to Sprauge Ponds	Flooding	Local runoff and not caused by Scriber Creek	Corrected	No
F-16	64th Ave W and 200th, The Harris Ford property	Flooding	Inadequate storm drain system capacity	Uncorrected, solution recommended	No
F-17	Private home at 60th Ave W and 188th St Sw	Flooding	Inadequate storm drain system capacity	Corrected	No
F-18	The south lane of 188th St SW at approximately 6116	Flooding	inadequate storm drains	Corrected	No
F-19	The property on the NE corner at highway 99 and 208th St SW	Flooding	Drainage set too low	Responsibility of property owners	No
F-19	The property on the NE corner at highway 99 and 208th St SW	Flooding	Nearby car wash installation may have blocked drainage	Corrected	No
F-20	Several homes at 18204 Olympic View Dr and 18407 Blue Ridge Dr	Flooding	Property below street grade with no maintained drainage outlet	Uncorrected, Snoho.Cnty. Jurisdiction	No
F-21	Property on the SE corner of 180th St SW and 65th Pl SW	Flooding	Unknown	Corrected	No
F-22	52nd Ave W near 170th Place SW, behind Dominion Apartments	Flooding	Inadequate maintenance of drainage system	Corrected	No
F-23	SE corner of 180th St SW and Olympic View Drive	Flooding	Eastern storm drain is above grade and blocks drainage; ill-defined drainage patterns	Uncorrected, solution recommended	No
F-24	NW corner of 179th St and 26th Ave W	Flooding	An isolated low spot caused by roadway fill embankments - corrected with catch basin and pipe system, yet causing downsystem flooding	Uncorrected, solution recommended	No
F-25	Home on west side of creek south of Hall Lake Rd	Ponding water	Private development's drainage system north of site	Corrected	No
F-26	Pond east of Hall Lake	Flooding	Inadequate peak flow control from pond for entering drainage system	Corrected	No
F-27	See Table 6-3 for location of undersized pipes	Potential Flooding	Undersized pipes	Uncorrected, solution recommended; many locations are responsibility of private property owners	No
F-28	Perrinville Creek downstream of developments	Sedimentation	Lack of sediment control within developments	Uncorrected, solution recommended	No
F-28	Perrinville Ck downstream of the Snohomish County Park	Erosion and bank undercutting	High flow velocities	Uncorrected, solution recommended	No
F-28	Talbot Rd and Perrinville Creek	Flooding	Undersized culvert at Talbot Rd	Uncorrected, solution recommended	No
F-28	Along Olympic View Dr. east of 76th Ave	Potential Flooding	Undersized CMP system	Uncorrected, solution recommended	No
F-29	Maple Rd and Ash Way	Flooding causing road closure	Capacity restriction of conveyance system	Uncorrected, solution recommended with additional analysis needed	No

Notes:

a. According to City staff all projects listed as "No" are either resolved or not in need of further study.

Table F-1 (continued). Status of Drainage Problems Identified in the 1998 Comprehensive Drainage Plan.

ID	Project Location	Problem	Cause	1998 Status	Still Unresolved -- Incorporate in 2008 Plan (Yes/No)
F-30	6628 212st SW (67th Ave W and 212th St SW)	Flooding	Unknown	Uncorrected, solution recommended	No
F-31	20429 53rd Ave W, N of 206th St SW	Ponding	Undersized system in poor condition (likely cause)	Uncorrected, solution recommended with additional analysis needed; partial responsibiity of private property owners	No
F-32	W side of Olympic View Drive, N of Blue Ridge Dr.	Flooding	Unmaintained drainage ditch	Uncorrected, solution recommended (location within Snohomish County)	No
F-33	Unname stream N of 202nd St SW btw 66th Pl W and SR-99	Flooding	Unmaintained stream and undersized drainage system	Uncorrected, solution recommended; partial responsibiity of private property owners	No
F-34	W side of 56th Ave W, S of 181st Pl SW	Flooding	Inadequate maintenance of drainage channel	Uncorrected, solution recommended	No
F-35	5614 173rd Pl SW and the Chang Shortplat	Flooding	Vegetation growth within easement	Uncorrected, solution recommended	No
F-36	3104 176th St SW	Seepage problems	High water table resurfacing in lower elevations	Responsibility of property owners; solution recommended	No
F-37	Lynwood High School	Flooding	Lack of drainage system from private property to city system; lack of adequate maintenance of private and public drainage systems	Uncorrected, solution recommended; partial responsibiity of private property owners	No
F-38	Scriber Creek at SR-99 and 170th St SW	Flooding	Unknown	Uncorrected, solution recommended; partial responsibiity of private property owners	No
F-39	Scriber Creek N of 176th St SW and 52nd Ave W	Flooding	Clogged trash rack	Responsibility of property owners; solution recommended	No
F-40	Scriber Creek at 18601 Hwy 99	Flooding	Blockages and undersized culverts	Private property owners have made improvements; uncertain if further work is required	No
F-41	193rd St SW	Flooding	Inadequate maintenance of private drainage	Responsibility of property owners; solution recommended	No
F-42	Lund's Gulch oufalls	Erosion	Unknown	Uncorrected, solution recommended	No

ATTACHMENT G

2008 Drainage Problems

Table G-1. Status of Current Drainage Problems Identified During the Workshop on February 6, 2008 [a].

	1998 Comp Plan Reference	Project Location	Problem	Cause	Current Status/Comment	Problem Identified in 1998 Plan (Yes / No)	Structural Solution Identified in 1998 Plan (Yes / No / NA)	1998 Cost Esimate Developed (Yes/No)	1998 Solution/Analysis Needs to Be Updated (Yes / No / NA)	Programed in Capital Facilities Program (Yes / No)	Develop New/Revised Solution in 2008 Plan (Yes / No / NA)
2	F-29[b]	Maple Road and Ash Way	Flooding	Sinking of roadway by 3-4ft in past 15years	Uncorrected, proposed CFP will not solve problem CFP - Drainage Improvements: Maple Rd at Ash Way - $100K	Yes	Yes	No	Yes	Yes	Yes
	F-3	188th St SW east of Highway 99 at Scriber Creek crossing	Flooding	Insufficient culvert capacity during very high flows	Further analysis recommended.	Yes	Yes	Yes	Yes	No	Yes
	F-4	190th St SW in Brookwood at Scriber Creek crossing	Flooding	Insufficient culvert capacity	42" culvert converted to 6' x 4' box culvert. Further analysis recommended.	Yes	Yes	Yes	Yes	No	Yes
	F-5	191th St SW in Brookwood at Scriber Creek crossing	Flooding	Insufficient culvert capacity	Replaced with 48" Further analysis recommended.	Yes	Yes	Yes	Yes	No	Yes
	F-7	North side of Scriber Creek crossing at "Old" 196th St Sw	Flooding	Insufficient culvert capacity	Recommendations made in 1998 plan.	Yes	Yes	Yes	Yes	No	Yes
	F-7	North side of Scriber Creek crossing at "Old" 196th St Sw	Flooding	Adverse grade of sections of the creek	Recommendations made in 1998 plan.	Yes	Yes	Yes	Yes	No	Yes
	F-7	North side of Scriber Creek crossing at "Old" 196th St Sw	Flooding	Heavy siltation	Recommendations made in 1998 plan.	Yes	Yes	Yes	Yes	No	Yes
	F-7	North side of Scriber Creek crossing at "Old" 196th St Sw	Flooding	Extremely poor hydraulic conditions in the 42-inch culvert	Recommendations made in 1998 plan.	Yes	Yes	Yes	Yes	No	Yes
17	F-7 [b]	Scriber Creek Crossing at 196th	Backwater and flooding	Reverse grade pipe creates	Confirm whether this is the same problem identified in 1998 comp plan	Yes	No	No	Yes	No	Yes
16	F-8[b]	Scriber Creek crossing at 200th St SW and 50th Ave W, downstream from Scriber Lake	Flooding	Sediment clogged inlet and insufficient culvert capacity.	New 12' x 3' culvert installed. Still flooding upstream.	Yes	No	No	Yes	No	Yes
19	F-9[b]	44th Ave W and Scriber Creek	Flooding	Road settlement and creek sedimentation	CFP Project- Scriber Creek Culverts and 44th Ave W - Phase 2, $4.5M	Yes -- 1998 cites undersized culvert	Yes	Yes	No	Yes	No
5		188th and 50th (Buzz Inn - private)	Flooding of open channel	Bird cage not maintained		No	NA	NA	NA	No	No
3		UMC - pipe in front	Belly in the pipe; minimal flooding	Pipe in poor condition?		No	NA	NA	NA	No	No
4		60th and Dale Way	Flooding?	Private system is undersized		No	NA	NA	NA	No	No
7	F-16[b]	Gold Park - 200th and 64th	Flooding	Lack of slope for drainage	Confirm whether this is the same problem identified in 1998 comp plan	Yes	Yes	Yes	No	No	No
8		Golf Course and Trails	Flooding	Unknown; potential disconnect of MHs		No	NA	NA	NA	No	No
9		Maple and 41st Ave	Flooding (recently)			No	NA	NA	NA	No	No
10		Maple and 36th Ave	Flooding	Clogged debris racks, upstream development		No	NA	NA	NA	No	No
11		184th St	Flooding	Roots in pipe		No	NA	NA	NA	No	No
12		N of Golde Park (private)	Flooding	Roots in pipe		No	NA	NA	NA	No	No
13	F-30[b]	212th and 68th (private)	Flooding in ROW	Private system is undersized?	Uncorrected; attempting to purchase property? CFP - Storm Realignment: 212th St SW and 68th Ave W - $50K Confirm whether this is the same problem identified in 1998 comp plan	Yes	Yes	No	No	Yes	No
14	F-30[b]	216th and 66th	Flooding	Unknown - Lynnwood blamed	Confirm whether this is the same problem identified in 1998 comp plan	Yes	Yes	No	NA	Yes	No
15		178th and 55th (Private) - "Davidson short plats"	Flooding	Inadequate maintenance		No	NA	NA	NA	No	No
18		Systemwide	Infiltration into storm drains	Pipes in poor condition?		No	NA		NA	No	No
20		212th St SW and 63rd Ave W Utilities Reconstruction	Flooding	Low spots in the pipes resulting from ground subsidence	CFP Project - Utilities Reconstruction: 212th St SW and 63rd Ave W - Raise pipes - $100k	No	NA	NA	NA	Yes	No

Note:
a. Add projects from 1998 Drainage Problems List if they are still unresolved.
b. Problem was identified during the workshop and matches with a problem described in 1998 comp plan.

ATTACHMENT H

Staffing and Financial Need

Table H-1. City of Lynnwood activities with potential stormwater impacts--listed by department.

Activity with Potential Stormwater Impacts[1]	Does the Activity Have any Documented Standard Operating Procedures? (Yes/No)[2]	Do Procedures Include Stormwater Pollution Prevention Measures? (Yes/No)[2]	Does Training Includes Stormwater Pollution Prevention? (Yes/No)[2]	Comments
Executive Department				
None				
Administrative Services Department				
None				
Community Development Department				
None				
Parks, Recreation, and Cultural Arts Department				
Pesticide application	Yes	Yes	Yes	Licensed Washington State Pesticide Operators
Fertilizer application	No	No	No	
Storage of fertilizer, pesticides, and gasoline	Yes and No	No	Yes and No	Yes for Pesticide and Gasoline
Landscaping (mowing, pruning, planting)	No	No	No	
Landscaping waste/compost storage and disposal	No	No	No	
Excavation	No	No	No	
Public Works Department				
Catch basin maintenance	No			
Maintenance of water quality and flow control facilities	No			
Maintenance of pollution control facilities	No			The frequency depends on the facility.
Vactruck decant	No			Emptied at the City's decant facilities.
Street sweeping	No			Street sweeper active daily.
Street sweeping waste management	No			
Paving and pavement repair	No			
Excavation	No			
Concrete placement	No			
Manufacturing (machining, grinding, welding, soldering, cutting)	No			
Tool washing	No			
Vehicle maintenance	No			Occurs indoors. All chemicals are recycled.
Vehicle washing	No			Vehicles are washed either at a professional facility, or in the parking lots where sewer diversion valves are used to send wastes into sanitary sewer.
Utility line Installation	No			
Sewer line maintenance and repair	No			
Sewer line cleaning	No			
Water line maintenance and repair	No			
Water line flushing	No			All water undergoes dechlorination prior to discharge.
Fire Department				
Training with Aqueous Fire Fighting Foam	Yes	Yes	Yes	Meadowdale Pond (DOE Approved) SOP 200.37
Floor Cleaning	No	Yes	No	In Bays w/grease interceptor to Storm Drains
Vehicle washing	No	Yes	No	In Bays w/grease interceptor to Storm Drains
Fire Hose Cleaning	No	No	No	Debris rinse down to Storm Drains
Pressure Cleaning Sidewalks	No	No	No	Water run off to storm drains
Cert Fire Extinguisher Training	No	Yes	No	Used Dry Chem. & Burned fuel residue rinsed to drain
Police Department				
Vehicle washing	No	No	No	Most vehicle washing that occurs by the police department is done at a commercial facility. On rare occasions it is conducted in the parking area in front of the jail.
Building Maintenance Department				
Chemical storage for pool / spa	No	No	No	Calcium hypochlorite, sodium bicarbonate, calcium chloride, truox, soda ash, and diatomaceous earth (DE) stored inside recreation center.
Cleaning the pulsar feeders	No	No	No	Pulsar feeders feed chlorine into pool / spa. Includes calcium hypochlorite cleaning outside with muriatic acid.
Community Affairs Department				
None				
Economic Development Department				
None				
Municipal Court Department				
None				
Human Resources Department				
None				

Notes:

1. These activities were identified by City staff. The procedures used to complete these activities have the potential to affect stormwater quality. Further evaluation is recommended to determine whether written standard operating procedures, pollution prevention measures, or training are needed.

2. Standard operating procedures, pollution prevention measures, and training are not necessarily required for these activities; however, further evaluation is recommended to identify any needs.

APPENDIX H

Additional Stormwater Management Program Staffing Resource Needs

Additional Stormwater Management Program Staffing Resource Needs

This appendix presents an estimate of the additional full time equivalent (FTE) staff needed in the Public Works Department for compliance with stormwater management program and operation and maintenance activities between 2009 and 2012. The basis for the activities included in this assessment is provided in the main body of this report and in Appendices B, C, D, and G. The staffing needs presented in Tables H-1 and H-2 were calculated by performing a comprehensive review of the NPDES Phase II permit, comparing Lynnwood's stormwater program to other regional jurisdictions, discussing specific activities with City staff, and applying professional judgment. These projected needs are based on the following assumptions:

- The existing 1.625 FTEs dedicated to the City's stormwater management program (1 FTE administration and management, 0.5 FTE O&M management, and 0.125 utility management) continue to perform their current duties and also take on all of the NPDES Phase II permit compliance activities presented in this report

- The City will perform the programmatic work necessary to comply with NPDES Phase II permit requirements (e.g., staff training, code revisions, document development, establishing an IDDE program) internally, without hiring consultants to perform that work.

If the City chooses to maintain existing staffing levels and use consultants to complete some of the stormwater program expansion work, the net cost to the Surface Water Utility would be similar. The estimated staffing needs also account for some stormwater management program staff time spent planning for annexation of portions of the Municipal Urban Growth Area and time spent adjusting the stormwater program to account for the expanded jurisdiction. However, the staffing projections presented in this appendix do not account for long term stormwater management program or operations and maintenance staff needs that would likely develop after annexation.

The stormwater program staffing increases projected in Table H-1 are relative to existing program staffing as of January 2009.

Table H-1. Additional stormwater program management staff hours needed for the City of Lynnwood to comply with NPDES Phase II permit requirements and address other program needs [1,2]

	2009				2010				2011				
Activities	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	Assumptions
Public Education and Outreach													
Develop audience specific educational materials		20	16	8									
Develop a method to measure public education program effectiveness			16										
Implement a method to measure public education program effectiveness				16									
Perform public education and outreach					16	24	24	24	24	24	16	24	
Measure the effectiveness of public education					8	8	8	8	8	8	8	8	
Modify public education and outreach program based on the results of measurement activity											24	8	
Total number of hours per quarter for this permit section		**20**	**32**	**24**	**24**	**32**	**32**	**32**	**32**	**32**	**48**	**40**	
Public Involvement and Participation													
Conduct public involvement for Surface Water Management Comprehensive Plan revision process and adopt the 2009 Stormwater Management Comprehensive Plan		30	30										
Develop a stormwater management program public involvement process.			16										
Review comments on the annual report.			8	8		4	4	4	4	4	4	4	
Implement the stormwater management program public involvement process.				16									
Conduct public involvement for the stormwater management program.					16	8	8	8	8	8	8	8	
Prepare the stormwater program annual report and supporting documentation, submit the documents to Ecology, and post the documents on the City website.					40				40				assumes modest level of extra effort to report on expanded stormwater program relative to effort expended in Feb/March 2009 report
Total number of hours per quarter for this permit section		**30**	**54**	**24**	**56**	**12**	**12**	**12**	**52**	**12**	**12**	**12**	
Illicit Discharge Detection and Elimination													
Develop and adopt new code to prohibit illicit discharge		80	120										
Develop and administer IDDE field investigation training		8	16										
Develop IDDE program and plan		120											
Refine stormwater system mapping		120	60										
Implement and administer IDDE program			20	40	20	20	20	20	20	20	20	20	
Develop and adopt a prioritized list of water bodies for the IDDE program			40	24	16								
Administer IDDE general awareness training					16								
Plan and execute field evaluation of 3 high priority water bodies						16	40	8					
Plan and execute field evaluation of 1 high priority water body per year											20		
Evaluate IDDE program effectiveness											40	24	
Total number of hours per quarter for this permit section		**328**	**256**	**64**	**52**	**36**	**60**	**28**	**20**	**20**	**80**	**44**	
Controlling Runoff from New Development, Redevelopment, and Construction Sites													
Develop new Code for adopting the Stormwater Management Manual for Western Washington, or an approved equivalent manual, as the City standard for stormwater management at development, redevelopment, and construction sites		120											
Adopt the Stormwater Management Manual for Western Washington, or an approved equivalent manual.			40										
Update the list of privately owned flow control and water quality stormwater facilities including a new facility map		80											
Develop and adopt a City specific addendum to the Stormwater Management Manual for Western Washington that includes specific LID guidelines			200	200	200	16							addendum development includes a focused review of the 2005 Stormwater Management Manual for Western Washington, or an approved equivalent manual, for specific applicability to Lynnwood, review of supplemental information developed since the 2005 manual was published (e.g., NPDES permit appendices, approved Phase I manuals), analysis of potential stormwater control benefit on small sites and projected future development in the City of Lynnwood, discussions with City staff on City-specific additions and modifications, and development of an addendum document. Does not include basin planning studies that may be required to develop effective basin specific requirements. Does not include simplified sizing tables for potential parcel-scale facilities.
Evaluate potential options for inspecting privately owned stormwater facilities and enforcing compliance with maintenance standards			200										
Develop a plan for inspecting privately owned flow control and water quality treatment stormwater facilities			16										
Inspect privately owned flow control and water quality treatment stormwater facilities				400	400	400	400	400	400	400	400	400	
Implement and administer the requirements of the Stormwater Management Manual for Western Washington, or an approved equivalent manual, and the requirements of the City specific addendum				40	20	12	120	20	20	20	20	20	
Total number of hours per quarter for this permit section		**200**	**456**	**640**	**620**	**428**	**520**	**420**	**420**	**420**	**420**	**420**	
Pollution Prevention and Operation and Maintenance for Municipal Operations													
Develop, adopt, and implement an O&M plan and system for tracking O&M activities		20	20	20	4								
Increase the level of O&M service to meet NPDES Phase II Permit requirements		8	8	8									
Develop and implement pollution prevention procedures and training material					40	40							
Perform O&M according to the O&M plan at a level of service that meets NPDES Phase II Permit requirements					16	4	4	4	16	4	4	4	assumes a review of previous years work is performed in the first quarter of each year
Revise pollution prevention procedures and administer pollution prevention training										24			
Total number of hours per quarter for this permit section		**28**	**28**	**28**	**60**	**44**	**4**	**4**	**16**	**28**	**4**	**4**	
Other Stormwater Program Management[3]													
Coordinate with Snohomish County for pending annexation		20	40	40	40	40							
Adjust program for annexation area increased work							40	40					
Prepare for issuance of a more challenging NPDES Phase II Permit in 2012												80	
Assist with Surface Water Utility Rate Study		16	16	16									
Total number of hours per quarter for this permit section		**36**	**56**	**56**	**40**	**40**	**40**	**40**	**0**	**0**	**0**	**80**	
Total number of hours per quarter for all permit activities		642	882	836	852	592	668	536	540	512	564	600	
Total number of FTE per quarter for all permit activities		1.5	2.1	2.0	2.0	1.4	1.6	1.3	1.3	1.2	1.4	1.4	
Total number of hours per year for all permit activities				**2360**				**2648**				**2216**	
Total number of FTE per year for all permit activities				**1.5**				**1.6**				**1.4**	

Assumptions.

1. Activities will be performed at a rate that meets the requirements of the NPDES Phase II Permit.
2. FTE estimates assume 20% of staff time in each quarter is used for vacation, holidays, sick days, training, other admin duties (i.e., FTE calculated as # weeks times 40 hours per week times 80%)
3. Estimate does not include additional staffing required for administering the stormwater management program for the expanded area after annexation. See Appendix B for staffing needs resulting from annexation.

Table H-2. Additional operations and maintenance staff hours needed for the City of Lynnwood to comply with NPDES Phase II permit requirements and address other program needs [1,2]

	2009				2010				2011			
Activities	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Illicit Discharge Detection and Elimination												
Develop and administer IDDE field investigation training			16	8								
Implement and administer IDDE program			20									
Administer IDDE general awareness training					8							
Plan and execute field evaluation of 3 high priority water bodies							40	20		16		
Total number of hours per quarter for this permit section		**0**	**36**	**8**	**8**	**0**	**40**	**20**	**0**	**16**	**0**	**0**
Controlling Runoff from New Development, Redevelopment, and Construction Sites												
Develop a plan for inspecting privately owned flow control and water quality treatment stormwater facilities			20									
Inspect privately owned flow control and water quality treatment stormwater facilities				16	16	16	16	16	16	16	16	16
Total number of hours per quarter for this permit section		**0**	**20**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**
Pollution Prevention and Operation and Maintenance for Municipal Operations												
Develop, adopt, and implement an O&M plan and system for tracking O&M activities		40	20	20	40							
Increase the level of O&M service to meet NPDES Phase II Permit requirements		200	400	600								
Develop and implement pollution prevention procedures and training material					40	40						
Perform O&M according to the O&M plan at a level of service that meets NPDES Phase II Permit requirements					800	800	800	800	800	800	800	800
Revise pollution prevention procedures and administer pollution prevention training									40			
Total number of hours per quarter for this permit section		**240**	**420**	**620**	**880**	**840**	**800**	**800**	**840**	**800**	**800**	**800**
Other Stormwater Program Management [3]												
Coordinate with Snohomish County for pending annexation		8	8	8	8							
Adjust program for annexation area increased work						8	8	8				
Total number of hours per quarter		**8**	**8**	**8**	**8**	**8**	**8**	**8**	**0**	**0**	**0**	**0**
Total number of hours per quarter for all permit activities		248	484	652	912	864	864	844	856	832	816	816
Total number of FTE per quarter for all permit activities		0.6	1.2	1.6	2.2	2.1	2.1	2.0	2.1	2.0	2.0	2.0
Total number of hours per year for all permit activities				**1384**				**3484**				**3320**
Total number of FTE per year for all permit activities				**0.9**				**2.1**				**2.0**

Assumptions.

1. Activities will be performed at a rate that meets the requirements of the NPDES Phase II Permit.

2. FTE estimates assume 20% of staff time in each quarter is used for vacation, holidays, sick days, training, other admin duties (i.e., FTE calculated as # weeks times 40 hours per week times 80%)

3. Estimate does not include additional staffing required for operation and maintenance of the stormwater system in the expanded annexation area. See Appendix B for staffing needs related to annexation.