

2009 COMPREHENSIVE STORMWATER PLAN

CITY OF LANGLEY

**Mayor
Paul Samuelson**

City Council

**Robert Gilman
James Recupero
Renee Neff
Russell Sparkman
Bob Waterman**

**Public Works Director
Challis Stringer**

**City Engineer
Ryan Goodman, P.E.**

**Prepared by
URS Corporation**

and

Katy Isaksen & Associates

DRAFT

February 17, 2009

CITY OF LANGLEY
COMPREHENSIVE STORMWATER MANAGEMENT PLAN
ENGINEER'S CERTIFICATION

The technical material and data contained in this report was prepared by URS Corporation under the supervision of the below-listed individual. Those responsible staff members who are registered professional engineers are licensed in the State of Washington.



EXPIRES: 08/21/

Darla J. Guerrero, P.E.
Senior Engineer, URS Corp.

Date

**CITY OF LANGLEY
COMPREHENSIVE STORMWATER
MANAGEMENT PLAN UPDATE**

TABLE OF CONTENTS

		<u>Page</u>
1.0	INTRODUCTION.....	1-1
1.1	AUTHORIZATION AND SCOPE OF WORK	1-1
1.2	OBJECTIVE	1-1
1.3	BACKGROUND AND SYSTEM HISTORY	1-2
1.3.1	Background.....	1-2
1.3.2	History.....	1-3
1.4	AGENCY COORDINATION	1-3
1.5	REPORT OVERVIEW	1-3
2.0	GENERAL PLANNING DATA	2-1
2.1	INTRODUCTION	2-1
2.2	LOCATION	2-1
2.3	PLANNING AREA	2-1
2.4	EXISTING SERVICE AREA.....	2-1
2.5	OTHER UTILITIES/RELATED PLANNING DOCUMENTS.....	2-2
2.6	SOILS	2-2
2.7	TOPOGRAPHY	2-2
2.8	CLIMATE.....	2-3
2.9	EXISTING AND FUTURE LAND USE	2-3
2.9.1	Existing Land Use.....	2-3
2.9.2	Future Land Use.....	2-4
2.10	DEMOGRAPHICS	2-4
2.10.1	Existing Population.....	2-4
2.10.2	Projected Population	2-5
2.11	WELLHEAD PROTECTION AREA.....	2-5
2.12	AREAS OF HIGH INFILTRATION POTENTIAL.....	2-6
2.12.1	Background on Infiltration System Use.....	2-6
2.12.2	Infiltration Potential Zones	2-7
2.13	ENVIRONMENTALLY SENSITIVE AREAS	2-7
2.13.1	Wetlands	2-7
2.13.2	Steep Slopes	2-8
2.13.3	Streams.....	2-8
2.13.4	Flood Hazard Area.....	2-9
3.0	EXISTING CONDITIONS	3-1
3.1	INTRODUCTION	3-1
3.2	MINIMUM DESIGN REQUIREMENTS	3-1
3.3	GENERAL DESIGN CRITERIA.....	3-1

TABLE OF CONTENTS
(Continued)

	<u>Page</u>
3.4	EXISTING DRAINAGE SYSTEM OVERVIEW 3-1
3.5	STREAM CONDITIONS 3-3
3.5.1	Saratoga Creek 3-3
3.5.2	Noble Creek 3-4
3.5.3	Brookhaven Creek 3-5
3.5.4	Edgecliff Drive Wetlands 3-6
3.6	WATER QUALITY CONDITIONS 3-6
3.7	EXISTING DRAINAGE PROBLEM AREAS 3-7
4.0	STORMWATER FLOW ANALYSIS 4-1
4.1	REGULATORY SETTING 4-1
4.2	HYDROLOGIC AND HYDRAULIC MODELING 4-4
4.2.1	Precipitation 4-4
4.2.2	Basin Areas 4-4
4.2.3	Runoff Curve Numbers 4-5
4.2.4	Time of Concentration 4-6
4.2.5	Estimated Flow Rates 4-7
4.3	PROBLEM AREAS 4-9
4.4	SUMMARY OF RESULTS 4-14
5.0	PROGRAMMATIC RECOMMENDATIONS 5-1
5.1	STATE AND FEDERAL POLICIES OVERVIEW 5-1
5.2	FEDERAL STORMWATER NPDES PROGRAM 5-1
5.3	DOE BASIC STORMWATER PROGRAM 5-2
5.4	GROWTH MANAGEMENT ACT COORDINATION 5-4
5.5	DRAINAGE STANDARD REVISIONS 5-4
5.6	PUBLIC EDUCATION AND OUTREACH 5-5
5.7	LOW IMPACT DEVELOPMENT OPPORTUNITIES 5-6
5.7.1	LID Limitations 5-6
5.7.2	Site Suitability Criteria 5-6
5.7.3	LID Strategies/Practices 5-9
5.8	OPERATIONS AND MAINTENANCE 5-10
5.9	RECOMMENDED SYSTEM MAINTENANCE 5-11
5.9.1	Catch Basins 5-11
5.9.2	Roadside Ditches 5-11
5.9.3	Detention Ponds 5-12
5.9.4	Infiltration Basins 5-12
5.9.5	Rain Gardens 5-13
5.10	RECORD KEEPING 5-13
5.11	SUMMARY OF MANAGEMENT RECOMMENDATIONS 5-13
5.12	RECOMMENDATIONS FOR WATER QUALITY IMPROVEMENTS 5-14

TABLE OF CONTENTS
(Continued)

	<u>Page</u>
6.0 ALTERNATIVE SOLUTIONS AND RECOMMENDED PROGRAM.....	6-1
6.1 PROPOSED SOLUTIONS TO EXISTING DRAINAGE PROBLEMS	6-1
6.2 PRIORITIZATION OF RECOMMENDED IMPROVEMENTS.....	6-5
6.3 IMPLEMENTATION SCHEDULE.....	6-7
7.0 CAPITAL IMPROVEMENT PROGRAM AND FUNDING OPTIONS.....	7-1
7.1 SUMMARY FINANCIAL HISTORY	7-1
7.2 CURRENT RATE STRUCTURE AND ACCOUNTS.....	7-2
7.3 OUTSTANDING DEBT	7-3
7.4 STORMWATER FUNDING PRIORITIES	7-4
7.5 CAPITAL IMPROVEMENT FUNDING	7-4
7.5.1 Capital Funding Sources	7-4
7.5.2 Capital Improvement Funding Plan	7-5
7.5.3 Six-Year Capital Improvement Funding.....	7-5
7.6 SUMMARY STORMWATER OPERATING OUTLOOK.....	7-7
7.6.1 Detailed Six-Year Financial Plan.....	7-9
8.0 REFERENCES.....	8-1

TABLE OF CONTENTS (Continued)

Page

TABLES

Table 2-1	City of Langley Acreage by Type of Land Use (within UGA) ¹	2-4
Table 2-2	City of Langley Population Projections ¹	2-5
Table 3-1	Storm Drain Inventory	3-2
Table 3-2	Detention/Retention and Infiltration Facilities	3-3
Table 4-1	24-hour Design Storm Precipitation	4-4
Table 4-2	Basin Areas	4-5
Table 4-3	Basin Runoff Curve Numbers	4-6
Table 4-4	Time of Concentration	4-6
Table 4-5	Peak Flow Rates: Existing Conditions	4-8
Table 4-6	Peak Flow Rates: Fully-developed Conditions	4-8
Table 5-1	Basin Soils Type and Area	5-9
Table 6-1	Proposed Drainage Improvements	6-5
Table 6-2	Recommended Improvements – 6-Year Plan	6-11
Table 6-3	Recommended Improvements – 20-Year Plan	6-12
Table 6-4	Recommended Improvements – Maintenance and Monitoring	6-12
Table 7-1	Summary History of Street/Storm Fund 101	7-1
Table 7-2	Storm Rate Schedule	7-3
Table 7-3	Comparison of Single Family Monthly Rates	7-3
Table 7-4	Stormwater Capital Improvement Projects	7-6
Table 7-5	Six-Year Priority Projects Funding Plan	7-7
Table 7-6	Summary Stormwater Outlook	7-8
Table 7-7	Recommended Stormwater Monthly Rates	7-8
Table 7-8	Key Assumptions in Rate Model	7-9
Table 7-9	Storm Outlook Detail – Six-Year Plan	7-10
Table 7-10	Storm Outlook – Detail Page 2	7-11
Table 7-11	Storm Outlook Detail – Capital Funding Scenarios	7-12

FIGURES

Figure 1.1	Site Vicinity Map
Figure 2.1	Drainage Basins
Figure 2.2	Existing Zoning
Figure 2.3	Future Land Use
Figure 2.4	Wellhead Protection
Figure 2.5	Limited Infiltration Areas
Figure 2.6	Critical Areas
Figure 3.1	Existing Storm Drainage System and Problem Areas
Figure 5.1	Soils Map

TABLE OF CONTENTS
(Continued)

Page

APPENDICES

A	SEPA Checklist
B	Hydraulic Model Results
C	Existing Drainage Land Development Standards and Proposed Revisions
D	Cost Estimates
E	Plan Comments and Approvals

ABBREVIATIONS AND ACRONYMS

Ac	acre
BMP	Best Management Practice
City	City of Langley
cf	cubic feet
cfs	cubic feet per second
CIP	Capital Improvement Program
CMP	Corrugated Metal Pipe
County	Island County
CSMP	Comprehensive Stormwater Management Plan
DB	Drainage Basin
DOE	Washington State Department of Ecology
DOE Manual	2005 Stormwater Management Manual for Puget Sound
DOH	Washington State Department of Health
EPA	Environmental Protection Agency
GMA	Growth Management Act
IACC	Infrastructure Assistance Coordinating Council
JPA	Joint Planning Area
LID	Low Impact Development
LID Manual	Low Impact Development Technical Guidance Manual for Puget Sound
LIDAR	Light Detection and Ranging
M&O	Maintenance and Operation
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service (formerly SCS)
PGIS	Pollution Generating Impervious Surfaces
PWTF	Public Works Trust Fund
PSP	Puget Sound Partnership
RCP	Reinforced Concrete Pipe
SCS	Soil Conservation Service
SEPA	State Environmental Policy Act
SRF	State Revolving Fund
TIB	Transportation Improvement Board
UGA	Urban Growth Area
ULID	Utility Local Improvement District
USGS	United States Geological Survey
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish & Wildlife
WICD	Whidbey Island Conservation District
yr	year

1.0 INTRODUCTION

1.1 AUTHORIZATION AND SCOPE OF WORK

In 1994, a Comprehensive Stormwater Management Plan was prepared for the City of Langley, located on Whidbey Island in Island County, Washington (see Figure 1.1: Site Vicinity Map). Since that time, new areas have been annexed, capital projects have been constructed, a major upgrade to the harbor area is planned, and four significant documents have been adopted: the Low Impact Development (LID) Technical Guidance Manual for Puget Sound (LID Manual), the Washington State Department of Ecology Stormwater Management Manual for Western Washington (DOE Manual), the Wellhead Protection Plan, and a substantial revision to the City of Langley Comprehensive Plan. Another relevant document that has recently been updated for the City is the 2006 Sewer Comprehensive Plan.

In September 2007, the City Council of Langley authorized the development of a Stormwater Comprehensive Plan update to meet the rules and regulations of the Washington State Department of Ecology (DOE) regarding general stormwater drainage facilities. The minimum state requirements are listed in the Washington Administrative Code (WAC) 173-240.

The purpose of this project is to update the Comprehensive Stormwater Management Plan (CSMP) to incorporate these changes. It is expected that these changes will affect the capital improvement plan (CIP) and maintenance and operations (M&O) programs; thus an element of this update is to revisit the stormwater utility rate structure for fitness with the CIP and M&O.

The CSMP update will revisit the existing and future conditions of the drainage basins within the City, identify and recommend approaches to resolve stormwater problems and utilize opportunities, prioritize these projects for a CIP, and evaluate the stormwater utility rate structure and revenue with current and future City development. This work will be accomplished by the production of the plan in several sections as described in the following tasks.

1.2 OBJECTIVE

The general objective of this report is to prepare a plan that will serve as a guide for the continued development of an adequate stormwater system for the City of Langley and to manage surface water runoff to protect people and property and meet water quality and resource protection goals. In general the goals and objectives of this study are to:

- Review the existing CSMP and regulations, and to discuss with the City the goals and objectives for the updated CSMP.
- Revise the drainage basin delineation to reflect the study area.
- Review sensitive areas, wetlands and steep slopes for the potential affect on or by future development and stormwater impacts.

- Update planning data per the recent updates to the Sewer Comprehensive Plan and City Comprehensive Plan, including:
 - Land use and zoning, and
 - Climatic and topographic information.
- Conduct a public meeting to identify the public's concerns with respect to the current stormwater facility.
- Complete site visits to evaluate known geotechnical and wetland related issues for incorporation into the existing conditions and stormwater inventory.
- Complete hydrologic and hydraulic modeling to analyze the existing and future drainage systems. Analyze the system under current and future conditions for the 10-, 25- and 100-year 24-hour storm events. The areas modeled included the Joint Planning Area (JPA), so the densities reflect the worst case scenario.
- Identify problems and recommend improvements for control and mitigation of surface water quantity and quality issues.
- Identify areas appropriate for implementation of LID practices in accordance with the LID Manual.
- Compile a list of stormwater-related problems, opportunities, and recommended alternatives. Develop a program of prioritized capital improvements for the construction of facilities included in the comprehensive plan.
- Evaluate potential environmental impacts created by the list of capital improvements and draft a checklist in accordance with State Environmental Policy Act (SEPA) requirements. This evaluation is included in Appendix A.
- Evaluate the current revenue and rate structure and assess future funding needs for the stormwater utility regarding the updated CIP and M&O Program.

1.3 BACKGROUND AND SYSTEM HISTORY

1.3.1 Background

Population growth has occurred irregularly within the City, with the influx of new residents concentrating toward the center of the City. The 2007 Comprehensive Plan includes two planning areas outside the City, the Urban Growth Area (UGA) and the Joint Planning Area (JPA). The UGA is the boundary within which the City plans for utilities (including storm drainage) and other urban services. The JPA is a shared planning area with Island County. The JPA is unlikely to be included in the UGA within the next 20 years, so this study focuses on the UGA for planning purposes. This plan includes storm drainage improvements reflective of fully

developed land use conditions for both the UGA and JPA; for this reason, the plan provides conservative recommendations.

1.3.2 History

The original stormwater drainage facilities include pipe and ditch conveyance, detention and infiltration systems, and natural stream and wetland drainage systems. The stormwater conveyance system is mainly limited to the central portion of the City. Due to the topography within the central area, most of the stormwater runoff converges at the storm drains on Anthes Avenue and Park Avenue. Most of the City's stormwater system challenges are related to the lack of adequate conveyance capacity along streets and maintenance of the conveyance system. Drainage problem areas were identified through field investigation, correspondence with City staff and citizens through a public meeting, and through hydrologic modeling.

The City has experienced some growth since the previous Stormwater Comprehensive Plan which is discussed further in Section 2 (General Planning Data). Projects completed since 1994 are summarized in Sections 4 and 5.

1.4 AGENCY COORDINATION

In preparation of this plan it was necessary to contact the Island County Engineering Department to obtain current topographic information.

1.5 REPORT OVERVIEW

This plan provides recommendations for structural and non-structural improvements to existing storm drainage facilities. These facilities include pipe and ditch conveyance, detention and infiltration systems and natural stream and wetland drainage systems. Management of stormwater runoff has become a requirement for local jurisdictions with federal and state regulations concerning protection of water quality and sensitive areas. Besides structural improvements this report includes non-structural management recommendations including, public education, policies and ordinances governing future development, operation and maintenance and record keeping. The structural and non-structural solutions developed in this report are consistent with federal and state regulations. The individual sections are summarized below:

Section 1 - Introduction

A statement of the purpose and authority for the project, statement of goals and objectives, report overview and agency coordination.

Section 2 - Drainage Area Characteristics

The physical features, climate, soils, sensitive areas, land use, ground water and infiltration characteristics.

Section 3 - Existing Conditions

The existing stormwater collection system, stream conditions, and drainage problem areas.

Section 4 - Stormwater Flow Analysis

The computer models used to predict runoff and evaluate system capacities are described and results are presented. Existing and future surface water quantity problems are identified.

Section 5 - Management Recommendations

Requirements of federal and state agencies are reviewed, and non-structural recommendations including drainage standard revisions, public education, operation and maintenance and record keeping are presented.

Section 6 - Alternative Solutions and Recommended Program

An evaluation of water quantity and quality improvement alternatives is made with identification of the recommended plan. Ranking of the recommended capital improvements are presented, including estimated costs and schedule of construction.

Section 7 - Capital Improvement Program and Funding Options

Financing mechanisms are reviewed for implementation of the proposed improvements.

2.0 GENERAL PLANNING DATA

2.1 INTRODUCTION

This section includes discussions of land use (existing and future) and demographics (existing and projected population). In addition, the section includes descriptions of existing water supply wells in the system vicinity, drainage basins in the planning area, critical areas, and other pertinent physical geographic data. Also included is information on service area policies and compliance or consistency with related planning documents.

2.2 LOCATION

The City of Langley is situated on the eastern shore of Whidbey Island near the southern end of the island facing Saratoga passage, which is the channel between Whidbey and Camano Islands. The City is about 5 miles (northeast) from the Clinton ferry landing and about 2.5 miles north of State Highway 525, the main road through Whidbey Island. Langley is the only incorporated city in the southern portion of Whidbey Island.

2.3 PLANNING AREA

The planning study area includes both the city and the area within the City's UGA. The drainage basins within the study area are shown on Figure 2.1. The boundaries of some of these basins extend outside of the City and UGA limits. For evaluation and preparation of this plan, a complete tributary area of each basin was evaluated in the hydrologic and hydraulic analyses.

As noted in Section 1, proposed stormwater system improvements are developed for the area within the City Limits and UGA. Stormwater flows are considered for the JPA for purposes of analyzing the potential impact on the existing storm drainage system and proposed system improvements.

As described in the 2007 City of Langley Comprehensive Plan (2007 Comprehensive Plan), the UGA represents the community's policy plan for growth for the 20 year period from 2007 through 2027. One purpose of the UGA is to limit urbanization to areas that are adequately supported by transportation and utility infrastructure and also to preserve agricultural and natural resource lands.

2.4 EXISTING SERVICE AREA

The City limits encompass approximately 644 acres and the unincorporated area of the UGA covers approximately 452 acres. The existing storm drainage system serves a substantial portion of the population and essentially all of the businesses, the fairgrounds and the middle school. Currently, none of the UGA outside the City is served by the existing stormwater system. The existing stormwater service area, shown on Figure 3.1, is generally bounded by Saratoga Passage

(on the north), DeBruyn Avenue (on the west), Sixth Street (on the south), and Noble Creek (on the east).

2.5 OTHER UTILITIES/RELATED PLANNING DOCUMENTS

The City has current relationships with Whidbey Telephone, AT&T/Comcast, Puget Sound Energy, Verizon, Nextel, Voicestream, Sprint, and Island Disposal, for telephone, cable television, power utilities, cellular services, and solid waste, respectively. The City does not currently have any relationship with other water, stormwater or sewer utilities.

2.6 SOILS

Soils within Island County originated largely from glacial drift. This was deposited in moraines left by glaciers that once moved over the Puget Sound area from the north. The drift consists of sand, gravel, and clay which vary by texture, permeability, and consistency. There are two main types of soils in the Langley area, Keystone loamy sand and Norma silt loam. The soils within the planning area are further discussed in Sections 2.12 and 5.7 and are presented on Figure 5.1.

The Norma silt loam soils occur in depression areas or basins that receive considerable seepage and runoff from surrounding uplands. These soils drain poorly in part due to a gravelly till layer that exists at a depth of about three feet. This material is moderately compact or weakly cemented and restricts the penetration of water. The water table of these soils is high and during the winter rainy season is usually at, or near, the surface. This type of soil is generally not appropriate for infiltration systems (see Figure 2.5).

The other type of soil present in the drainage area is Keystone loamy sand. This is a glacial upland soil with 0-15% slopes. This soil developed from sandy drift and is relatively free of gravel. Because of the soil's open porous texture, water is absorbed readily and drains very rapidly. As a result, surface runoff is very slow from this soil and it is generally good for infiltration systems.

2.7 TOPOGRAPHY

The City of Langley is situated in a bowl-shaped depression on the eastern shore of south Whidbey Island and is part of a relatively small drainage basin comprised of 613 acres. The business district is located at the base of the bowl and parallel to the 50-foot high bluff that overlooks Saratoga passage. The bluff is protected in places by a seawall; where it is not, the bluff is more vulnerable to erosion. Several narrow drainage basins lie on the east end of Langley, which also slope toward Saratoga Passage. The topography ranges from sea level along Wharf Street to approximately 280 feet above sea level at the City's southern boundary.

Due to topographical restraints, there is some land in the community that cannot be developed. For example, steep slopes (in excess of 15%) can be unstable in nature. These areas are, therefore, either costly to develop, or not suitable for development. Topography within the

planning area is presented on Figure 2.1: Drainage Basins. The contours shown on this figure are based on a LIDAR survey provided by the County. Light Detection and Ranging (LIDAR) is a remote sensing system used to collect topographic data.

2.8 CLIMATE

The south end of Whidbey Island has cool, dry summers and mild, cloudy and rainy winters. Severe winter storms are generally prevented from moving into the area by the Olympic Mountains. The combination of rainy winters, mild temperatures, and long growing seasons is conducive to lush vegetation. The result is evergreen forests with thick undergrowth. There is a prevailing wind from the north in Saratoga Passage on most afternoons in the summer (2006 Sewer Comprehensive Plan).

The mean maximum and minimum temperatures in January are 45°F and 33°F, respectively. The mean maximum and minimum temperatures in July are 72°F and 52°F, respectively. The average length of the growing season is 180 days. The mean annual precipitation (approximately 30-year average) is about 35 inches per year (2006 Sewer Comprehensive Plan).

2.9 EXISTING AND FUTURE LAND USE

2.9.1 Existing Land Use

The land use information used in this plan is summarized from the 2007 Comprehensive Plan (Land Use Section). This plan was prepared to conform to countywide planning policies and the GMA requirements. The GMA mandates that population growth be concentrated inside urban growth areas.

The City of Langley's existing zoning is shown on Figure 2.2. Land use within the UGA is generally characterized by a concentration of development in the downtown and immediately surrounding area and lower density development in the outlying areas. The exceptions in the outlying areas are near the shorelines, both immediately west and farther east of Langley. These areas are more densely populated which is typical of waterfront areas on Whidbey Island.

Table 2-1 shows the breakdown of acreage for each land use within the City Limits and UGA. The table was referenced from the 2007 Comprehensive Plan.

The existing land use status inventory (2007 Comprehensive Plan, Land Use Section) indicates that there is a relatively small balance of land available for new commercial land uses. Development within Langley over the last 30 years has virtually exhausted the inventory of land reserved for high density housing, and there is an abundance of land for single-family use, both within the existing city limits and the UGA. These uses may need to be monitored in the future to determine if the commercial-zoned lands are adequate to serve local needs, and if the land uses can achieve overarching housing goals or maintain a desired balance between lower and higher density housing. Some of these potential land use changes could affect existing drainage systems or networks.

**Table 2-1
City of Langley Acreage by Type of Land Use (within UGA)¹**

Principal Land Use	Acres (inside the City only)	Percent of Total Area Inside City	Acres (in unincorporated UGA)	Percent of Total Area in Unincorporated UGA
Agriculture	36	6.1%	43	9.6%
Commercial	16	2.7%	5	1.1%
Residential	237	40.3%	194	43.9%
Hotel/B&B	5	0.9%	11	2.5%
Institutional	123	20.9%	0	-
Religious	6	1.1%	0	-
Parking	1	0.1%	0	-
Vacant	103	17.6%	190	42.8%
Active Application	61	10.4%	0	-
TOTALS:	588^{2,3}	100%	443	100%

¹Source: 2007 Comprehensive Plan.

²Source: 2007 Land Use Inventory, City of Langley.

³This total is less than the 644-acre total for land inside the current City limits because the area within the right-of-way and private streets is not included in the land-use inventory.

2.9.2 Future Land Use

Future land use, as derived from the 2007 Comprehensive Plan, is shown on Figure 2.3. Approximately 17.6% of the acreage in the Langley UGA is currently vacant or undeveloped (2007 Comprehensive Plan). These land use designations will be dictated by revisions to future Comprehensive Plans and land development trends. The available land area could accommodate additional development subject to on and off-site improvements. The City should require developers to be financially responsible for both on and off-site improvements. These improvements could include street improvements, utilities, and parks. The City also includes lands designated as central areas, which are privately owned lands that are permanently set aside as open space as well as publicly owned open space. An integrated system of open spaces, in addition to improving quality of life, acts as buffers and connections between various land uses.

The rural areas outside the UGA are intended to remain rural through the foreseeable future; however, it is anticipated that some rural areas, particularly those adjacent to urban land uses, may be included in the UGA in the future.

2.10 DEMOGRAPHICS

2.10.1 Existing Population

The most recent population estimate for Langley, as noted in the 2007 Comprehensive Plan, is approximately 1,060. This is an increase from the 2000 census population of 959. The population in Langley currently is about 1.4% of the total population in Island County.

2.10.2 Projected Population

Population projections to 2020 for the City of Langley were derived from the State Office of Financial Management. Three projections, based on high, low and past trends were evaluated and are presented in Table 2-2. Although it is difficult to predict at this time, some of the projected growth may occur through future annexations in addition to infill growth.

**Table 2-2
City of Langley Population Projections¹**

Alternative ²	Actual		Projected		% Increase (20 yrs.)
	1990	2000	2010	2020	
Alternative 1 – Based on 2002 State Low Range Projections	845	959	1020	1141	12%
Alternative 2 – Based on past trends 2002 State Intermediate Range Projections	845	959	1127	1319	32%
Alternative 3 – Based on 2002 State High Range Projections	845	959	1180	1451	52%

¹Source: 2007 Comprehensive Plan and State Office of Financial Management Projections (2002).

²Alternative 1 (Low) rate = 0.6%/yr; Alternative 2 (Past Trends) = 1.6%/yr; Alternative 3 (High) = 2.6%/yr.

2.11 WELLHEAD PROTECTION AREA

The location of the Langley's wellhead protection area is discussed since this study considers the use of infiltration systems to recharge ground water and these systems must not allow contamination of the groundwater. A wellhead protection area is the surface and subsurface area surrounding a well that supplies a public water system through which contaminants are likely to pass and eventually reach the water source. The Department of Health (DOH) prepared an initial delineation of the wellhead protection area for Langley's wells using the Calculated Fixed Radius method in January 1993. This method determines a 1-, 5-, and 10-year time of travel zone for contaminants. The Calculated Fixed Radius method is a simple ground water model which may not accurately predict the actual zone of contribution to the City's wells. The method is based on the well pumping rate, soil porosity and well screen interval. Figure 2.4 shows the three wellhead protection zones delineated by the DOH.

The DOH provided the delineation for the City to use as a basis for initiating its wellhead protection program. The Wellhead Protection Plan is a required component of Water System Plans for all ground water based public water systems according to the State Board of Health's Drinking Water Regulations (May 1994). The wellhead protection plan outlines management strategies for wellhead protection including: zoning ordinances, design standards, source prohibitions, public education, ground water monitoring, household hazardous waste collection, and purchase of property.

Specific concerns regarding groundwater quality include the following:

- **Stormwater Runoff.** Increased urbanization has resulted in increased stormwater runoff in the City of Langley. Stormwater is a potential chronic source of groundwater contamination, particularly nitrates, metals, and petroleum products.
- **Zoning/Density.** Increased growth in the area could affect groundwater quality.
- **Septic Tanks/Drainfields.** Increased growth in the area could affect groundwater quality. Septic tank leaks could potentially contaminate groundwater.

Protection of ground water recharge characteristics by limiting impervious surface construction is one method of wellhead protection. Besides ensuring replenishment of the aquifers, protection of the recharge characteristics may help prevent sea water intrusion. The use of infiltration systems within the wellhead protection area, as with all areas of the City, must have water quality treatment elements as specified in the DOE Manual design guidelines.

Specific wellhead protection strategies and response actions include the following:

- **Land use restrictions.** To help ensure ground water recharge, the City has adopted regulations on the extent of impervious surfaces allowed on development sites.
- **Contingencies for groundwater supply.** Development of alternative water supply sources, and verification of existing sources.
- **Public involvement.** Consistent and persistent messages should be conveyed regarding the value of the groundwater resource and the rationale behind management strategies.
- **Monitoring.** Physical and water quality monitoring of the City of Langley aquifer and area streams should be conducted to help aid in evaluating the interaction between streams and the aquifer, as well as obtaining aquifer water level and water quality data.

2.12 AREAS OF HIGH INFILTRATION POTENTIAL

2.12.1 Background on Infiltration System Use

The DOE Manual and the City's adoption of the LID Manual both encourage installation of infiltration systems where feasible. Of the various Best Management Practices (BMPs) described in the manuals, infiltration is listed as the preferred method for managing stormwater.

The reason for their preference for the use of infiltration systems is that they mitigate some of the problems caused by conventional stormwater conveyance systems such as; potentially increased runoff volumes to downstream areas; lower base flows in receiving streams, lowering of water tables, and increased discharges of urban pollutants. Infiltration systems divert stormwater into the ground rather than discharging it to surface water bodies thereby imitating, to some degree, natural hydrologic conditions (1994 Comprehensive Stormwater Management Plan, Section 2.8).

2.12.2 Infiltration Potential Zones

The study area was divided into two infiltration potential categories: high and low. The locations of areas of low infiltration potential within the study area are highlighted in red in Figure 2.5. The areas that are not highlighted in red are areas of high infiltration potential. The major factor affecting ground water recharge is the soil's ability to infiltrate rainfall (soil permeability). Other factors that affect infiltration potential include soil moisture-holding capacity, relative position of soil to surface water features, depth of soil and rooting zone, and relative position of the water table. The primary source of information of these parameters was the Soil Conservation Service soil survey report for Island County (September 4, 2008).

Soil types in the high category include the Keystone series and generally have high permeability. These soils typically do not have seasonal water tables within the upper three feet of the soil profile. Soil types in the low category include the Whidbey series which generally have low permeability of 0.05- to 0.15-inches per hour. Although not ideal soils, they are considered suitable for infiltration. Soils types in the very low permeability are the Norma series which have a very low rate of 0- to 0.05-inches per hour. These soils typically have poor drainage with water tables near the surface during most of the year and are not suitable for infiltration systems.

2.13 ENVIRONMENTALLY SENSITIVE AREAS

The City has adopted a Critical Areas Ordinance (No. 861) to protect environmentally sensitive areas. The areas protected include wetlands, frequently flooded areas, fish and wildlife habitats, geologic hazard areas, and aquifer recharge areas. Several planning goals to protect environmentally sensitive areas from encroachment or development are noted in the 2007 Comprehensive Plan. The City has three creeks within its boundary—Saratoga Creek, Brookhaven Creek and Noble Creek. A map of the known locations of critical areas, prepared by the City's planning department, is presented as Figure 2.6.

2.13.1 Wetlands

The protection of wetland areas is especially important in the management of stormwater runoff. During flooding, streams overflow their banks and spread out across the flood plain. Wetland soils act like a ground water reservoir storing surplus water as ground water during wet periods and discharging this stored water into streams later to augment base flow. Wetlands also filter pollutants by a combination of physical, chemical and biological processes. Therefore, wetlands act as natural stormwater detention and water quality treatment facilities. Loss of wetlands in a

watershed would be equivalent to a loss in runoff storage and could increase flows downstream. Protection of the City's wetland areas will contribute to stormwater management by reducing the need for new stormwater facilities.

The City's wetland mapping includes areas identified through site-specific analysis conducted by private property owners and a wetlands inventory conducted through funding from the Department of Ecology (1991). According to the City's Critical Areas Ordinance, wetlands are classified as Category I, II, III, or IV using the Washington State Department of Ecology's *Wetland Rating System for Western Washington* (2004). The city code establishes a 250-foot buffer for Category I wetlands, a 150-foot buffer for Category II wetlands, a 110-foot buffer for Category III wetlands, and a 50-foot buffer for Category IV wetlands.

2.13.2 Steep Slopes

The steep slope protected areas include slopes greater than 15%, areas that are potentially unstable due to stream bank erosion, and historically unstable slopes due to ground water seepage. Protection of steep slopes includes establishment of a 50-foot buffer from the top or toe of the slope. Protection of steep slopes along stream channels is an important method of preventing erosion and deposition of sediment into these natural drainage ways. This Plan identifies the existing bank erosion areas of the bluff along Saratoga Passage and recommends diversion of drainage away from these areas to prevent further erosion.

2.13.3 Streams

According to the City's Critical Areas Ordinance, streams are categorized into five "types" based on such factors as size, gradient, and fish use. The City's Critical Areas Ordinance also addresses the protection of streams. It established a 250-foot buffer for Type 1 and 2 streams, 100-foot buffer for Type 3 streams and 50-foot buffer for Type 4 and 5 streams. Buffers are measured from the ordinary high water mark as identified in the field or surveyed or from the edge of the stream. The buffer may be modified in certain circumstances by the City's planning official up to a maximum of 25% of the required width and subject to approval of a buffer enhancement plan.

Noble Creek is classified as a Type 4 stream. Brookhaven Creek is a Type 4 stream from the south edge of the pavement on 3rd Street north to Saratoga Passage. From the south edge of the pavement on 3rd Street south to the creek's source, Brookhaven Creek is classified as a Type 3 stream. Saratoga Creek is classified as a Type 3 stream.

The Critical Areas Ordinance addresses the control of stormwater runoff in areas adjacent to wetlands and streams in an effort to minimize impacts to them. The ordinance requires any surface water directed into wetlands and streams must be infiltrated or treated, detained and dispersed into the buffer in an effort to prevent channelized flow.

2.13.4 Flood Hazard Area

The 100-year floodplain, identified as the 'base flood' by the 1984 FEMA Flood Insurance Rate Map. The flood hazard area is mainly along the shoreline.

3.0 EXISTING CONDITIONS

3.1 INTRODUCTION

This section describes the existing drainage system, the conditions of the three creeks that flow through the City and existing drainage problem areas identified by field investigation and City staff.

3.2 MINIMUM DESIGN REQUIREMENTS

The design criteria are established by the DOE Manual. These guidelines, in conjunction with the City's minimum requirements, establish the design criteria and construction standards to be used for upgrades and additions to the City of Langley's storm drainage system.

3.3 GENERAL DESIGN CRITERIA

Stormwater facilities are to be designed in accordance with good engineering practices to suit the actual conditions at the project location by a professional engineer approved by the City and licensed in the State of Washington.

In accordance with the Langley Municipal Code (Section 15.01.440.B), stormwater conveyance systems must be designed with sufficient capacity to carry the 25-year, 24-hour peak flows from the tributary area under fully developed conditions. For this evaluation and planning process, both the 25- and 100-year storms were evaluated to help determine if an added level of protection or conveyance would be needed.

3.4 EXISTING DRAINAGE SYSTEM OVERVIEW

The City of Langley has a stormwater conveyance system that is limited to the central portion of the City. Figure 3.1 shows the City's existing drainage system. Due to the bowl-shaped nature of the central area, most of the stormwater runoff converges at the storm drains along Anthes and Park Avenue. In the past, this concentration of flow through the downtown commercial area has contributed to drainage problems within the downtown area. Many of these previous problems have been addressed through projects identified and constructed in the 1994 CSMP.

The existing system consists of open ditches, storm drains along some major arterials, and mainly privately owned detention and infiltration systems. In addition, the natural drainage system includes three small creeks that flow through the City and wetland areas shown on Figure 3-1. The name of the creek to the west of the City is Saratoga Creek, the creek that flows through the center of town is Brookhaven Creek, and the creek east of Camano Avenue is Noble Creek. None of the three creeks have native fish populations, though local fishing clubs have planted Brookhaven Creek in the past with Coho salmon.

The City was divided into ten drainage basins, as shown in Figure 2.1, in order to develop a computer simulation of runoff flow rates for this CSMP update. These basins are part of four main basins which drain to Saratoga Creek, Brookhaven Creek/Anthes Avenue, and Noble Creek. In addition, there are four basins (DB-7, DB-8, DB-9 and DB-10) located east of Noble Creek. The City's surface water discharges to the Puget Sound through four outfall locations in addition to Noble and Saratoga Creeks. All stormwater runoff within the central part of town are routed to the Anthes Avenue storm drain system (which receives flows from Brookhaven Creek: DB-3 East and DB-3B) and the Park Avenue storm drain system (basins DB-3A and DB-3 West, shown on Figure 3.1). Anthes Avenue drainage is discharged to Saratoga Passage through an 18-inch concrete outfall. There is a small portion of First and Second Street west of Park Avenue that drains to a 12-inch ADS outfall located on Park Avenue (basin DB-3A). The other major outfall is a 12-inch HDPE drain located on Camano Avenue. Flow to this outfall is collected from Camano Avenue and a small section of East Sixth Street (basin DB-5). A portion of Edgecliff Drive is collected and discharged to Saratoga Passage through a 24-inch outfall near the east end of Edgecliff Drive (basins DB-9, DB-9A, and DB-10).

Much of the City's storm drainage system was installed in the 1960's. The catch basins installed during this period have small grate inlets and sediment trap sumps in comparison to today's standard Type I catch basins. There are several open ditch sections that are in need of maintenance. Areas requiring maintenance are identified in Sections 4 and 6.

An inventory of the storm drains and detention/infiltration facilities within the City are presented in Tables 3-1 and 3-2. The detention and infiltration facilities are privately owned except for the Cedars infiltration ponds which are owned and maintained by the City.

**Table 3-1
Storm Drain Inventory**

Pipe Size (inches)	Approximate Length (feet)
48	100
42	90
36	40
24	380
18	1,350
15	1,610
12	11,550
10	740
8	4,450
6	1,720
4	250

**Table 3-2
Detention/Retention and Infiltration Facilities**

Facility	Capacity
Northview Pond	25,600 cf
Cedars Infiltration Ponds	29,689 sf
Saratoga Terrace Infiltration Trenches	1,842 cf
Creekside Terrace Retention Pond	2,000 cf
Fourth Street Condos Detention Pipe	Unknown
Glenhaven Condos Detention Pipe	605 cf
Martin Short Plot Infiltration Pond (north of Sixth Street)	400 sf
Second Street - Langley Village Detention Pipe	2,700 cf
Harrison House Detention Pipe	115 cf

3.5 STREAM CONDITIONS

A field evaluation of the condition of the three creeks was made by URS on December 3, 2007 to determine if there were erosion or sedimentation problems being caused by stormwater runoff. A wetland and geotechnical field evaluation of the creeks and adjacent wetlands was completed by URS on October 19, 2007. The conditions of the three small creeks that flow through the City north into Saratoga Passage are described in the following section.

3.5.1 Saratoga Creek

Saratoga Creek drains a tributary area of approximately 800 acres. The majority of the basin area is undeveloped forest land, most of which is outside of the City limits (subbasins DB-1 and DB-2 on Figure 3-1). The creek flows through forested wetlands located east of Coles Road and south of Brooks Hill Road. These wetlands provide storage for runoff from the basin and regulate flow to Saratoga Creek. Land use within the creek's basin area also includes agricultural pasture, and low-density residential areas. The City's Critical Areas Ordinance protects a stream buffer area of 100 feet on each side of the Type 3 stream. This ordinance also restricts any development of the wetland areas. The soil along much of the creek is Norma silt loam which has formed in depression areas on Whidbey Island and has low percolation rates. The upland areas of the basin consist of Keystone loamy sand soils with high permeability.

Saratoga Creek flows north under Saratoga Road through a 24-inch diameter culvert. Downstream of the road, the stream is in a very steep gorge and the culvert creates a fish blockage since there is a 4-1/2 foot drop from the culvert outlet to the channel bed. The banks contain western red cedar, with an understory of sword fern and salmonberry. Upstream of the road, the gorge is not as deep or narrow and red alder is the dominant tree species. There is potential for very small wetlands to occur immediately adjacent to Saratoga Creek downstream of Saratoga Road. A wetland with skunk cabbage was observed adjacent to the creek upstream of Saratoga Road. The banks of Saratoga Creek upstream of the road contain Himalayan blackberry on the banks and the English ivy infestation is extensive through the riparian area. A

fish passage barrier near the mouth of the stream prevents access for salmon, restricting salmonid presence to resident coastal cutthroat trout.

Brooks Hill Road crossing Saratoga Creek flows through three 12-inch culverts and most of the flow is through the culvert located furthest to the west. Saratoga Creek at this location is shallow and the riparian area is dominated by red alder. There is a very large wetland complex upstream of road. The wetland contains a large ponded area with water parsley, lady fern, reed canarygrass, creeping buttercup, skunk cabbage, and salmonberry. Downstream, the creek is channelized through mostly residential property.

At the mouth of the creek there is a 24-inch RCP culvert that discharges onto the beach. Since this basin is mainly undeveloped there are no man-made drainage conveyance systems other than these culverts.

3.5.2 Noble Creek

Noble Creek drains a tributary area of approximately 511 acres (basin DB-6 in Figure 2.1). The majority of the basin area is undeveloped forest land and most of the basin is outside of the City limits. The land use within the creek's basin area also includes low-density residential, multifamily, commercial, and part of the County Fairgrounds. The soils along the creek are classified as Keystone loamy sand. This creek has lower flows than either Saratoga or Brookhaven Creek.

The Noble Creek channel has a mild slope of about 2 to 3% until it reaches the steep bluffs above Saratoga Passage. The creek channel is generally about 2 to 3 feet wide with a sand and gravel channel bed. There is a significant amount of sediment deposition along sections of the channel bed. Similar to Saratoga Creek, this stream descends toward Puget Sound through a steeply-sided ravine with dense vegetation. There is no evidence of significant erosion of this ravine due to the presence of dense bank vegetation. There is one area near the mouth of the creek on the east bank where the steep slope is not vegetated and there is evidence of sloughing. Apparently some vegetation was cut in the past along the east bank near the mouth of the creek. Removal of vegetation along the creek's banks is no longer allowed due to the stream buffer protection required by the Critical Areas Ordinance.

Although there is a multifamily residential development (The Saratoga Terrace Apartments) south of Edgecliff Drive near the creek, a vegetative buffer has kept the stream corridor mainly in its natural state. In addition, runoff from this residential area is minimal since the apartments have an infiltration trench drainage system. The 2007 Comprehensive Plan proposed a pedestrian trail along Noble Creek between Edgecliff Drive and Sandy Point Road, this project has been completed.

Noble Creek flows through a 24-inch CMP culvert where it crosses Sandy Point Road and a 12-inch CMP culvert where it crosses Edgecliff Drive. Downstream of Edgecliff Drive, the riparian area contains big leaf maple, salmonberry, and English ivy with a very small wetland fringe immediately adjacent to the stream. Upstream, the riparian area contains red alder, salmonberry, English holly, and a very large western red cedar. No wetlands are immediately adjacent to the

culvert; however the upstream banks of Noble Creek appear to contain a small wetland area near the footbridge. The wetland is dominated by creeping buttercup and common Horsetail and may be inundated early in the growing season.

Based on a review of the *Critical Areas Assessment Report: Wetland Buffer Mitigation Plan, Noble Creek Property Parcel B* (Cantrell & Associates 2005), the wetland complex surrounding this reach of Noble Creek is rated as a Category III. Category III wetlands require a 110-foot buffer according to Langley Municipal Code 16.20.065.

The Langley City Code classified Noble Creek as a Type 4 stream, which has a 50-foot buffer.

3.5.3 Brookhaven Creek

Brookhaven Creek flows through the center of Langley along the Brookhaven Housing Project. The last 1/4-mile section of the creek flows through an 18-inch storm drain along Second Street and Anthes Avenue. The Brookhaven Creek Basin includes an area of approximately 270 acres. About two thirds of the basin is undeveloped forest land and pasture and the remainder includes residential, multifamily residential, commercial, and school land use (basins DB-3 East and DB-3B in Figure 3.1). The creek headwaters are within City property where the City's water supply wells are located. The creek is spring fed. The basin soils include Norma silt loam and Norma loam in the lower areas and Keystone loamy sand in the higher basin areas.

Much of the stormwater runoff within the City flows into Brookhaven Creek. The stream is designated as Type 4 from Third Street north to Saratoga Passage and Type 3 south of Third Street, with associated 50-foot and 100-foot buffers respectively. The Brookhaven Creek channel has a moderate slope of about 4 to 6%.

The furthest downstream section of the creek, where it flows within an open channel prior to entering the 18-inch storm drain was replanted as part of a restoration project associated with the adjacent Langley Village Development. The restoration of the approximately 120-foot creek section included planting the channel banks with various types of vegetation.

Just north of where the stream crosses Fourth Street, there have been several trees recently cut along the stream bank and vegetation replanted. The plantings are now overgrown with weeds and the creek flow is being inhibited by the overgrowth. This area needs to have periodical maintenance to insure that the creek will not become stagnant and begin ponding.

The section of the creek just south of Fourth Street was rerouted during the construction of the Glenhaven Condos in about 1991 (see Figure 3-1). The rerouting of the creek provided some benefit by shortening the length of the creek section that was culverted. There were several rock steps along the creek before it enters the culvert crossing Fourth Street.

South of the Glenhaven property, the creek flows through some private residences where a couple of small ponds and dams have been created. South of these ponds the creek flows by the Creekside Terrace Condos. This section of the creek was left mainly in its natural state with an adequate buffer. Vegetation along the stream bank consists of fir and alder trees, shrubs, and

grass, which provide a significant amount of cover. This is a steeper section of the creek with slopes of 5 to 6% where it may be beneficial to add some grade control structures, such as log or rock weirs. The installation of a series of weirs and plunge pools at intervals along this section would serve two purposes. First, they would provide grade control by dissipating erosive stream flows. Secondly, they would resemble the step-pool channel type that would typically be found in 5 to 6% gradient stream channels.

Another 12-inch culvert is located where the creek crosses Sixth Street. Further upstream, part of the creek's flow is diverted through an approximately 300 foot long 12-inch storm drain across the middle school property. If an overall stream rehabilitation project is undertaken in the future, diverting flow back to a natural channel should be considered at this location. An up and downstream analysis would need to be conducted to minimize impacts of flooding to property owners as well as potential impacts to critical areas.

Further upstream, the headwaters of Brookhaven Creek are located east of the Northview subdivision. There are several small creek channels that wind throughout an area that may be considered a wetland. The City's wells are located just south of this area.

Throughout the creek there is silt and sand deposition evident in the culverts and channel beds. Construction of various developments along the creek has been blamed by residents for the channel's condition. There has been concern raised about operation of the Northview detention pond located near the creek headwaters. The Northview pond's condition and recommended improvements are discussed in Sections 3.7 and 6.1.

3.5.4 Edgecliff Drive Wetlands

There is an existing wetland on the south side of Edgecliff Drive which basins DB-7, DB-8, DB-9 and DB-9A drain toward. It is vegetated with creeping buttercup, soft rush, stinging nettle, and lady fern. Based on a review of the *Critical Areas Assessment Report: Wetland Delineation, Sandy Point Road Property* (Cantrell & Associates 2006), the wetland on this site is rated as a Category III. Category III wetlands require a 110-foot buffer according to Langley Municipal Code 16.20.065. Development upstream would need to consider and avoid possible impacts to the wetland.

There currently is no existing storm drainage system in this area, from the east side of Noble Creek to Furman Avenue. Areas of ponding and poor drainage are found along this section of Edgecliff drive. There is a ditch along the south side of Edgecliff Drive east of Furman Avenue which drains toward the 24-inch outfall pipe near the east end of Edgecliff Drive. This existing ditch is overgrown and in need of maintenance.

3.6 WATER QUALITY CONDITIONS

The water quality of Saratoga Passage, the area's groundwater, and the City's creeks is important to the quality of life in Langley. Water quality standards are established in Chapter 173-200 WAC, Water Quality Standards for Ground Waters of the State of Washington; Chapter 173-

201A Water Quality Standards for Surface Waters of the State of Washington; and Chapter 173-204, Sediment Management Standards. The water quality criteria are maximum contaminant concentrations based on human health criteria. As discussed in Section 2.11, Island County was designated as a sole source aquifer since it is the sole source for drinking water and is vulnerable to contamination.

Water flowing to streams from urban areas often contains a wide variety of pollutants. Highest pollutant concentrations generally occur in runoff from impervious surfaces, especially roads and parking lots. Pollutants occurring in urban stormwater (and their potential source) can be divided into the following categories:

- Sediments (construction sites, street dirt).
- Nutrients (excess fertilizer application, animal feces).
- Toxic chemicals (herbicide and pesticide application, industry).
- Oxygen demanding substances (dumped leaves and grass clippings, sediments).
- Oil and grease (automobile operation, illegal dumping).
- Trace metals such as lead, zinc and cadmium (automobiles, construction materials, industry).

No water quality samples were taken in any of the City's three creeks during the preparation of this update. Through observation, various conclusions were made about the water quality conditions of the creeks. During winter base flow conditions the water appeared clear in all three creeks. As discussed previously, there was a substantial amount of sediment located in channel bed of Brookhaven Creek and also in sections of Noble Creek. Sedimentation appears to be the major water quality problem affecting Brookhaven Creek. Most of the sediment appears to come from runoff of residential areas rather than from stream bank erosion. Various contaminants and trace metals have the potential adhere to sediment particles originating from developed areas.

3.7 EXISTING DRAINAGE PROBLEM AREAS

Existing physical system drainage problems were identified through various sources, including: City staff; residents, through a public meeting held on April 3, 2008; and field investigations completed on October 19 and December 3, 2007. Problem area locations are identified on Figure 3-1 using the numbers listed below. A total of 20 existing problem areas are described. Proposed solutions to these drainage problems are discussed in Section 6.1.

1. **Second Street – Park Avenue to Melson Alley.** There is no conveyance channel along the steep section of Second Street between Park Avenue and Melson Alley. As a result, during storm events there have been erosion and flooding along the south shoulder of the street. The volume of flow that concentrates along the south side of Second Street during

storm events is less than the amount that flows down Third Street. But erosion and flooding result from the combination of a steep slope and lack of a conveyance system. In addition, flow from an alley that enters Second Street from the south has eroded a gully in the dirt parking lot just west of Anthes Avenue.

2. **Sixth Street East of Anthes Avenue to Brookhaven Creek.** There is no stormwater conveyance system present along Sixth Street west of Brookhaven Creek. Residents of the Creekside Terrace Condos have complained about runoff from Sixth Street entering their driveway. Surface water runoff flows from the west down Sixth Street and onto their driveway, causing problems mainly in the winter when it occasionally freezes, making the driveway slippery. Upstream drainage flows east and is not intercepted by a ditch or catch basin and ponding of water occurs between the catch basin and creek.
3. **Parking Area at the Bottom of Wharf Street.** At the bottom of Wharf Street, there is a 6-inch storm drain that appears to have broken. Water seeps up through the pavement above the storm drain and is causing deterioration of the pavement. When Wharf Street was recently repaved, the road was sloped so that flow is collected on the west side of the road and conveyed to a new catch basin installed at the bottom of the road. Currently runoff from the road is conveyed through this broken 6-inch line to a 6-inch outfall. The 6-inch drain needs to be replaced in order to prevent further deterioration of the pavement at the bottom of Wharf Street.
4. **Northview Subdivision Drainage and Detention Pond.** There are two apparent problems with the operation of the storm drainage system serving the Northview Subdivision. Approximately half of the subdivision area that was designed to drain to the detention pond is being conveyed directly towards Brookhaven Creek. A ditch, shown on the pond's design drawings, within a designated utility easement was intended to convey flow into the pond but was never constructed. Instead a 15-inch CMP storm drain conveys the flow towards Brookhaven Creek. Secondly, the detention pond is not working properly due to the outfall pipe being restricted and/or plugged. The pond retains runoff, keeping the water surface at the emergency overflow elevation of 133.0 feet, which has turned the detention pond into a year-round pond.

Since the water continually flows out through the overflow, there is no water storage available and the runoff is not released at the proper flow rate. In large storm events, the runoff essentially runs through the pond and out the overflow, therefore, the pond is not providing flow detention. This has the potential to cause erosion downstream. This short residence time may increase the sediment and pollutants flowing directly into the downstream system, Brookhaven Creek. Detention ponds should be designed to control release rates so that the flows after land development are not larger than before land development.

The flow control manhole and outfall pipe will need to be fitted with an overflow riser and orifice. The orifice will need to be sized to release inflow at the pre-developed peak flow rates. This will allow the detention pond to function as it was intended, controlling

runoff and the amount of sediment being released downstream. Additional information on the existing condition of the outlet structure is needed to design the repair.

5. **Melson Alley (4th to 6th).** Currently the drainage from Fourth Street is conveyed in an existing ditch along the south side of Fourth Street. The ditch is shallow and ends at the alley just east of Park Avenue. Runoff from the alley flows north to its intersection with Fourth Street where it is causing flooding and erosion.
6. **Intersection of Anthes Avenue and First Street.** The existing catch basin grates clog easily from debris such as leaves and garbage, which gather along the edge of the street. As a result, during large storm events there has been some flooding at the low spot along the street.
7. **Edgecliff Drive West of Furman Avenue.** There is no drainage conveyance system on Edgecliff Drive west of Furman Avenue. Just west of the intersection with Decker Avenue, ponding occurs on the south side of Edgecliff Drive during storms and extends at times half way across the road.
8. **Furman Avenue.** There is no drainage along Furman Avenue which causes surface water drainage to flow onto Edgecliff Drive causing ponding at the intersection of Furman and Edgecliff.
9. **Decker Avenue.** Similar to Furman Avenue, there is no drainage along Decker Avenue which causes surface water drainage to flow onto Edgecliff Drive, which causes ponding at the intersection of Decker and Edgecliff.
10. **Second Street to Cascade Avenue to the Extension of Third Street.** The existing storm drain in Second Street currently ends about halfway up the street towards Cascade Avenue. The existing drainage on Second Street needs to be extended to Cascade Avenue, then to the south on Cascade to the extension of Third Avenue.
11. **Sixth Street from Anthes Avenue to Park Avenue.** The alley west of Anthes on Sixth Street has a sub-standard drainage system and ponding occurs.
12. **First Street and DeBruyn Avenue.** There is no street drainage on First Street from DeBruyn Avenue to Park Avenue.
13. **Second Street and DeBruyn Avenue.** There is no street drainage on Second Street from DeBruyn Avenue to Park Avenue.
14. **Saratoga Creek Crossing at Saratoga Road.** The pipe capacity of the existing drainage pipe needs to be evaluated because the roadway pavement has longitudinal cracking and some erosion along the sides of the creek has been observed.
15. **Saratoga Creek Crossing at Brooks Hill Road.** After large storms the surface water upstream of the road crossing has been observed to be close to overtopping the road. The

existing pipes need to be evaluated to determine if there is adequate capacity for conveyance.

16. **Sixth Street west of Park Avenue.** Ponding at the driveway to property south of Sixth Street and after heavy storms ponding in the street occurs and is causing damage to the asphalt pavement.
17. **County Outfall System.** The existing ditch along the south side of Edgecliff Drive drains towards the east and discharges into a 24-inch outfall, which was installed by Island County. The ditch is currently overgrown which may be causing conveyance issues.
18. **Edgecliff Drive East of Furman Avenue to City Limits.** There is an area about 700 feet east of Furman Avenue on Edgecliff Drive where ponding occurs on the south side of the road. This area is a low point and adjacent to a wetland area. The property on the north side of Edgecliff Drive opposite this wet area has experienced bluff erosion problems. The ponding water may be seeping under the road causing saturated soil on the north side which may undermine the stability of the bluff. The drainage to the east of the wetlands also has drainage problems with standing water, ponding at driveways. There is no evident drainage system.
19. **Brookhaven Creek from Fourth to Third Streets.** The existing creek was recently reconstructed with log weirs and plantings along the side of the channel. Currently the creek bed and sides are overgrown with weeds and the cobbles and plantings are lost within the weeds. The overgrowth is causing the creek flow to slow and pond in places. The water is becoming stagnant.
20. **Water Quality Treatment at Existing Outfalls.** There is presently no water quality treatment of stormwater flows at existing outfalls. This is a concern in the central, more heavily developed areas of the City.
21. **Camano Avenue Outfall.** The existing 12-inch outfall pipe needs to be evaluated to determine if adequate conveyance capacity exists.

4.0 STORMWATER FLOW ANALYSIS

4.1 REGULATORY SETTING

The City of Langley Municipal Code (LMC), Title 15: Buildings and Construction includes mandatory requirements for drainage in Section 15.01.440 and the LID Manual Chapter 7. If discrepancies between the two documents are found, the LID Manual should be used. The following design criteria apply to drainage facilities.

- **Runoff Control.** Methods for predicting runoff from a given drainage basin that is acceptable to the City is the Western Washington Hydrology Model (WWHM) and others, which include King County Runoff Time Series (KCRTS) and MGS Flood. The LID Manual shows how to incorporate various LID techniques within the models so that their benefit in reducing surface runoff can be estimated.
- **Stormwater Quantity Conveyance** (Section 15.01.440. B).
 - Conveyance systems connected to the present piping system shall be designed to convey a 25-year, 24-hour storm as computed using the Soil Conservation Service (SCS) method or the Santa Barbara Urban Hydrograph (SBUH) method. In basins smaller than 25-acres the Rational Method is acceptable.
 - Stormwater runoff that is discharged directly or indirectly to a stream shall be regulated as follows:
 1. The peak rate of runoff from individual development sites shall be limited to 50 percent of the existing condition 2-year, 24-hour storm while maintaining the existing condition peak runoff rate for the 10-year, 24-hour, and 100-year, 24-hour design storm.
 2. In cases where discharge is directly to Puget Sound and the downstream conveyance system has adequate capacity to carry the 25-year, 24-hour peak flow, the requirement to limit peak rates to pre-development values may be waived based on the City Engineer's approval.
 3. In cases where discharge is indirectly to Puget Sound, but the downstream conveyance system has limited capacity, post-development peak runoff rates shall be limited to the magnitudes of the pre-development 10-year, 24-hour and 100-year, 24-hour peak runoff rates.
- **Water Quality Facilities** (Section 15.01.440. C). Water quality facilities shall be designed for the 6-month, 24-hour storm event which is approximately equal to 64 percent of the 2-year, 24-hour storm.

- **On-site Detention and Infiltration** (Section 15.01.445).
 - All reasonable and appropriate LID measures shall be incorporated into site design before conventional on-site detention and infiltration methods are considered.
 - Open retention/detention facilities and infiltration facilities shall not be located in public road right-of-way. The City Engineer is authorized to require all persons, associations, and/or corporations constructing new or maintaining retention/detention facilities to secure a liability insurance policy for the duration of the operation of the facility.
 - An emergency overflow system is required for all retention/detention facilities.
 - Detention basin design must account for antecedent moisture conditions which may contribute to a partially full basin at the beginning of the design storm. In other words, a minimum of one foot of freeboard above the maximum design water surface is required.
 - Existing wetlands may function as both a control feature in the natural surface drainage system and as areas of groundwater recharge. Any reduction of such features shall be replaced with equivalent drainage controls.
 - Infiltration is preferred, where practical because it reduces the demand for conveyance capacity and hence, reduces potential flooding. Figure 2.7 of the 2007 Comprehensive Plan and Section 5 of this document discuss areas where infiltration should be considered. The LID Manual and the DOE Manual provide general guidelines for analyzing the feasibility of the infiltration systems, which should be recognized as minimum standards. The basic design shall follow the DOE Manual. Infiltration may be restricted or disallowed, as determined by the City Engineer, in those areas designated and defined in LMC as Sensitive Areas.

- **Storm Sewer System – Minimum Requirements** (Section 15.01.455).
 - Mainline Storm Sewers:
 1. Minimum diameter of storm drain shall be 12-inches except that a maximum length of 60 lineal feet of eight-inch diameter pipe may be used between inlet and catch basin.
 2. Minimum slope of storm drain pipe shall be 0.005 feet per foot.
 3. Minimum velocity at design flow shall be three feet per second.
 4. Maximum depth of liquid in a culvert shall be $d/D = 0.8$.

5. Maintain line and grade between all catch basins/manholes.
 6. Install catch basins/manholes at all changes of line and grade, at all pipe intersections, and at both ends of all storm drain pipe, except driveway culverts and at maximum spacing of 300 feet.
 7. Extend mainline storm sewers to boundary of project to serve adjacent upstream properties.
 8. Design location of pipe shall be south and west of street centerline under street curb, except as required to match existing utilities.
 9. Maximum depth of cover over the top of a pipe into catch basins shall be four feet except where approved by the City Engineer. Where the depth to pipe invert is five feet or more, a manhole shall be installed at grade breaks and pipe intersections.
 10. Provide six-inch tees to serve each adjacent land parcel or future lot. Extend service lines to property line where under future paving, curbs or sidewalks.
 11. Note pipe size, length, slope, and invert elevations in profile on each run between catch basins.
 12. Drainage facilities must be designed to convey the surface water entering a drainage area at the naturally occurring location.
- In areas where ditches are allowed, they shall be constructed with maximum depth of three feet, minimum side slope of one and one-half to one vertical, with driveway culverts of twelve-inch minimum diameter.
 - Footing and Downspout Drains:
 1. Installation of a drywell for infiltration of drainage is the preferred alternative over discharge to the storm drain.
 2. Minimum diameter shall be six inches to the property line.
 3. Minimum slope shall be one percent.
 4. Provide three foot minimum depth at property line, or deeper if required by lot topography.
 5. Provide individual drain for each house or lot.
 6. All drain lines shall enter a mainline at a tee or catch basin.

7. Under no circumstances shall storm drain be connected to the sanitary sewer system.
8. In no event shall footing drains and downspout drains be allowed to be tied together within 10 feet of a structure.

4.2 HYDROLOGIC AND HYDRAULIC MODELING

Hydrologic and hydraulic analyses included modeling the drainage system to evaluate the existing conveyance capacity of stormwater network elements and to identify problem areas under existing and fully developed conditions. The model input parameters are discussed in this section and detailed model input information and results are presented in Appendix B.

Surface water runoff from each basin was evaluated using SCS inputs into an SBUH model. Model input parameters were developed for existing and fully developed conditions within each basin. These parameters are listed as follows and described in further detail in the sections to follow.

- Precipitation.
- Basin Area.
- Runoff Curve Number.
- Time of Concentration.

4.2.1 Precipitation

Total precipitation was obtained from the maps published by the National Oceanic and Atmospheric Administration (NOAA) which are presented in the DOE Manual. The precipitation values for the design storm events are presented in Table 4-1.

**Table 4-1
24-hour Design Storm Precipitation**

Recurrence Interval	Precipitation (inches)
2	1.20
10	1.75
25	2.15
100	2.60

4.2.2 Basin Areas

Basins within the study area were delineated from Island County LIDAR topography. The Langley study area was divided into ten drainage basins (DB), shown in Figure 2.1. The basin boundaries were adjusted to reflect man-made modifications to the natural drainage system. Since the topographic mapping available for this study was available with 5 foot contours, the basin boundaries are approximate. The basin areas are presented in Table 4-2.

**Table 4-2
Basin Areas**

Outfall Locations	Basin Designation	Basin Area (acres)
Saratoga Creek Basins	DB-1	335
	DB-2	465
Brookhaven Creek Basins	DB-3A	55
	DB-3B	66
	DB-3 West	112
	DB-3 East	92
Wharf Street	DB-4	10
Camano Outfall	DB-5	27
Noble Creek Basin	DB-6	511
Runoff to Saratoga Passage	DB-7	266
	DB-8	39
	DB-9	116
	DB-10	14

Note: * DB-3, shown on Figure 2.1, was divided into subbasins (West and East).

4.2.3 Runoff Curve Numbers

Each basin was characterized by its pervious and impervious area, shape, size, hydrologic soil type and land use. Based on this data and the SCS Runoff Curve Number (RCN) values presented in Table 4.3, average basin curve numbers were developed. To use the SCS curve number table the Hydrologic Soil Group (HSG) was identified. The HSG designations for the soils located in the study area are listed below:

- Keystone soil series - HSG A (low runoff potential).
- Whidbey soil series - HSG C (moderate runoff potential).
- Norma soil series - HSG D (high runoff potential).

RCN values for existing and fully developed conditions are presented in Tables 4-3.

**Table 4-3
Basin Runoff Curve Numbers**

Basin ID	RCN Value Existing		RCN Value Fully Developed	
	Pervious	Impervious	Pervious	Impervious
DB-1	54.8	100	63.1	98.3
DB-2	40.4	100	50.9	98.3
DB-3 West	46.1	98.3	46.3	98.1
DB-3 East	53.6	98	53	98
DB-3A	43.2	98	38.4	98
DB-3B	60.7	98	60.7	98
DB-4	*	98	*	98
DB-5	**	**	41.4	98
DB-6	38.5	98.2	46.3	98.1
DB-7	41.5	98	57.3	98.2
DB-8	41.8	98	46.3	98
DB-9	35.4	98.7	42.7	98.5
DB-10	*	98	*	98

Notes: * Basins are considered small and were not modeled.
 ** Existing systems are at or near capacity, calculated fully developed only.

4.2.4 Time of Concentration

Another important parameter when using the SCS method is the Time of Concentration (T_c), defined as the time for runoff to travel from the hydraulically most distant point of the basin to its outlet. The time of concentration depends on the overland flow velocity which is determined by slope, conveyance type and roughness. Time of concentration influences both the shape and the peak of the runoff hydrograph. Urbanization typically decreases time of concentration values as drainage networks with straight, smooth channels increase the velocity of runoff traveling through the system.

**Table 4-4
Time of Concentration**

Basin ID	T_c Existing	T_c Fully Developed
DB-1	140.73	140.73
DB-2	137.73	137.73
DB-3 West	126.36	77.21
DB-3 East	78.8	42.94
DB-3A	63.93	42.32
DB-3B	9.79	9.79
DB-4	*	*
DB-5	**	81.75
DB-6	140.20	86.46
DB-7	179.57	97.67
DB-8	63.68	35.45

**Table 4-4 (Continued)
Time of Concentration**

Basin ID	T_c Existing	T_c Fully Developed
DB-9	116.57	79.47
DB- 10	*	*

Note: * Basin is considered small, therefore a minimum pipe size of 12 inches, per Section 4.1 was assumed.
 ** Existing systems are at or near capacity, calculated fully developed only.

4.2.5 Estimated Flow Rates

The model input data were entered into the SBUH program to generate runoff hydrographs for each basin. Results of the hydrologic analysis were evaluated against the estimated capacities of major drainage system elements to identify potential inadequacies of the existing system as well as identify possible stormwater challenges under fully developed conditions. Descriptions of stormwater problem areas evaluated under existing and developed conditions are included in Section 4.3.

The existing peak flows for the 10-, 25-, and 100-year storm events for each basin within the City’s watershed were estimated and are presented in Table 4.5.

The fully developed peak flows for the 10-, 25-, and 100-year storm events for each basin are presented in Table 4.6. As described in Section 2.3, future land use data was obtained from the proposed comprehensive land use plan, shown on Figure 2.3.

Simulation of future fully developed unmitigated conditions resulted in increases to peak flows in basins DB-1, DB-2, DB-3, DB-6, DB-7, DB-8, and DB-9. Flow control measures will be needed for built-out conditions. Future conditions were not simulated for basins DB-4 and DB-10 since these basins are relatively small and there will be little or no new development in the basins compared with the other areas.

In general, the 25-year storm event is the design storm used to determine the adequacy of the existing conveyance system. Where a Hydraulic Permit Approval (HPA) is required by the WDFW, the 100-year storm is the required design storm. Areas of high traffic flow, areas with critical infrastructure, and other areas determined by the City may prefer the use of the 100-year design storm to provide an additional level of protection against stormwater flooding and erosion as identified in Section 3.3.

**Table 4-5
Peak Flow Rates: Existing Conditions**

Drainage Basin	Total Pervious Area (acres)	Total Impervious Area (acres)	Total Drainage Basin Area (acres)	Average Impervious RCN Value	Average Pervious RCN Value	10-year Peak Runoff (cfs)	25-year Peak Runoff (cfs)	100-year Peak Runoff (cfs)
DB-1	321	14	335	100	54.8	2.27	2.79	3.37
DB-2	442	23	465	100	40.4	3.77	4.63	5.60
DB-3 West	96.7	15.3	112	98.3	46.1	2.40	3.01	3.70
DB-3 East	77.1	14.9	92	98	53.6	2.89	3.63	4.47
DB-3A	36.0	19	55	98	43.2	4.04	5.07	6.23
DB-3B	29.1	36.9	66	98	60.7	14.51	18.14	22.2
DB-4	*	*	*	*	*	*	*	*
DB-5	**	**	**	**	**	**	**	**
DB-6	405.0	106	511	98.2	38.5	15.62	19.67	24.21
DB-7	225.6	40.4	266	98	48	5.14	6.50	8.02
DB-8	29.5	9.6	39.1	98	41.8	2.04	2.56	3.15
DB-9	92.2	23.8	116	98.7	35.4	4.00	4.98	6.09
DB-10	*	*	*	*	*	*	*	*

Note: * Basin is considered small, therefore a minimum pipe size of 12 inches, per Section 4.1 was assumed.

** Existing systems are at or near capacity, calculated fully developed only (see Table 4-6).

**Table 4-6
Peak Flow Rates: Fully-developed Conditions**

Drainage Basin	Total Pervious Area (acres)	Total Impervious Area (acres)	Total Drainage Basin Area (acres)	Average Imp. RCN Value	Average Perv. RCN Value	10-year Peak Runoff (cfs)	25-year Peak Runoff (cfs)	100-year Peak Runoff (cfs)
DB-1	235.6	99.4	335	98.3	63.1	14.73	18.52	22.81
DB-2	331.6	133.5	465	98.3	50.9	20.01	25.15	30.90
DB-3 West	76.9	35.1	112	98.1	46.3	6.91	8.68	10.66
DB-3 East	68.6	23.4	92	98	53.0	5.90	7.40	9.09
DB-3A	34.0	21.0	55	98	38.4	5.33	6.69	8.20
DB-3B	29.1	36.9	66	98	60.7	14.51	18.14	22.2
DB-4	*	*	*	*	*	*	*	*
DB-5	16.5	10.4	26.9	98	41.4	1.98	2.50	3.07
DB-6	352.1	158.9	511	98.1	46.3	29.70	37.34	45.88
DB-7	185.0	81.0	266	98.2	61.8	14.37	18.05	22.17
DB-8	27.4	11.7	39.1	98	46.3	3.45	4.32	5.29
DB-9	81.0	35.0	116	98.5	42.7	6.98	8.71	10.65
DB-10	*	*	*	*	*	*	*	*

Note: * Basin is small; therefore a minimum pipe size of 12 inches, per Section 4.1 was used.

4.3 PROBLEM AREAS

Basin DB-1 and DB-2 (Saratoga Creek Basin)

Basins DB-1 and DB-2 include the area tributary to Saratoga Creek (see Figure 2.1). DB-2 includes the 465 acres mostly located south of Brooks Hill Road. This basin is heavily forested and includes about 23 acres of wetlands. Poorly draining Norma series soils are located along the creek and coincide to some extent with the wetland areas. Because the basin is mainly undeveloped there is no drainage conveyance system except for three culverts crossing Brooks Hill Road. Flow from this basin is conveyed to the lower section of Saratoga Creek through three 12-inch culverts. The 12-inch CMP culvert located farthest to the east at the road crossing has a headwater depth of about 2 feet and a capacity of about 3.05 cfs. This culvert appears to receive the majority of the flow, although all three culverts appear to be identical, except for the pipe lengths. It is estimated that each culvert would carry 3.05 cfs, for a total capacity of 9.15 cfs.

Conclusion: There have been no reported problems with flow through these three culverts except that during heavy storms, the water level of the wetlands approaches the edge of the roadway (per discussion with the City Engineer). The three culverts do not appear to have the combined capacity to convey the fully developed 10-, 25-, or 100-year storm. Removing and replacing one 12-inch culvert with a 24-inch CMP is estimated to provide a total flow capacity of 25.5 cfs at the road crossing. This would be adequate to convey the 25-year storm and is not expected to disturb the existing channel. It is recommended that these culverts are monitored during and immediately following storm events for overflow, sedimentation build-up, debris around inlets, and outlets and erosion.

The lower tributary area to Saratoga Creek is referred to as basin DB-1. This 335-acre area has low density residential development and a forested buffer area along Saratoga Creek. The basin has an area of poorly draining Norma loam soil along the creek. Again, this basin has no drainage conveyance system except for the culvert crossing at Saratoga Road. The 24-inch CMP culvert has an available head of approximately 3 feet and the outlet drops about 4.5-feet with a capacity of 36.13 cfs.

Conclusion: There have been no reported problems with flow through this culvert although the pavement above has cracking and needs repair. This culvert is estimated to have adequate capacity to convey the 10-year storm estimated at 34.52 cfs. However, this pipe does not appear to have adequate capacity for the 25-year storm and is recommended to be upsized to a 30-inch CMP with an estimated capacity of 62.9 cfs. This size culvert would convey the estimated 25- and 100-year storms of 43.4 and 53.3 cfs, respectively.

Basin DB-3A

Basin DB-3A drains to the Park Avenue storm drain system, which outfalls into Saratoga Passage through a 12-inch ADS pipe. The basin is about 55 acres in size and includes residential and agricultural land uses. The soil type is mostly Keystone, highly permeable soil.

The basin's topography results in runoff originating from the south that flows towards DeBruyn Avenue where flow then is conveyed to Second and First Street. This has resulted in standing water along the shoulder of the DeBruyn Avenue at the intersections with both streets. To control this problem a storm drain conveyance system of ditches and pipes need to be installed on the two streets to route the runoff towards the Park Avenue storm drain outfall system.

Conclusion: The existing 12-inch outfall pipe was estimated to have a capacity of 8.7 cfs, which will adequately convey the future 25-year, 24-hour storm event of 6.7 cfs.

The First and Second Street ditch and culverts between DeBruyn Avenue and Park Avenue are areas where stormwater conveyance systems need to be installed. The proposed storm drain pipes should be of 12-inch minimum diameter.

Basin DB-3 (DB-3 East and DB-3 West) and 3B; Brookhaven Creek Basin

Basin DB-3 East consists of 92 acres and Basin DB-3 West consists of 112 acres, both of which consist of mostly agricultural and residential land uses. A small area of the upper basin is forested. The soil type within DB-3 East and DB-3 West is mostly Keystone, highly permeable soil, with a small area of Norma loam soil.

Basin DB-3B is the lower tributary area to Brookhaven Creek and is about 66-acres in size. This basin includes the downtown core area and consists of mainly commercial development with sections of residential land use. The basin's land uses include commercial and multi- and single-family residential. The soil type is mainly poorly draining Norma loam.

The area east of Anderson Road (DB-3 East) drains to Brookhaven Creek which flows north into the downtown drainage system (DB-3B), see Figure 3-1. Brookhaven Creek (DB-3 East) is conveyed through a 12-inch CMP culvert at the Sixth Street crossing with an estimated capacity of 6.4 cfs. Based on an estimated pipe slope, the capacity was evaluated to be slightly undersized for the existing condition flow rate of 7.4 cfs from DB-3 East, east of Anderson Road. The actual slope and headwater capacity may allow additional flow; this should be field verified and monitored during storms prior to considering a culvert replacement.

Flow from the area west of Anderson Road (DB-3 West) combines with that of DB-3B at Sixth Street and Park Avenue. DB-3 West enters a 6-inch storm drain that currently drains a portion of Sixth Street and runoff from the pasture to the north (this 6-inch diameter pipe is less than the minimum required pipe size and is undersized for the anticipated 25-year flow rates of 8.7 cfs, which would require at least a 12-inch concrete pipe). Flow from this point is conveyed from the alley into the Anthes Street drainage system, which ranges in size from 10 to 12 inches in diameter through the downtown area before it combines with DB-3B and DB-3 East into an 18-inch storm drain.

The upper three sections of the 18-inch storm drain, with slopes ranging from 0.7 to 1.9 percent, have estimated flow capacities ranging from 8.8 to 14.5 cfs. This 18-inch diameter storm drain has limited capacity available for increased flow.

Pipe sizes less than 10 inches in diameter are undersized per the City's 12-inch minimum standard. A pipe size of 12 to 18 inches is needed to convey the anticipated 25-year flow rate, depending on the slope.

Simulation of future fully developed for basins DB-3 West, DB-3B and DB-3 East shows significantly increased flows that could reach maximum capacities through the downtown conveyance system. The 18-inch storm drain on Anthes Avenue has little capacity available for increased flows. With the recent upgrades at Anthes through town, the only ponding that occurs is when the catch basins become plugged from litter and leaves at the intersection of Anthes and Second Street.

As basins DB-3 East and West are developed, the application of LID measures to control flows and preserve the capacity of the existing system is recommended. Alternately, a regional detention/retention facility may be worth considering for the purpose of improving water quality and providing flow control. A possible location for a regional detention facility is in the DB-3 East basin is just east of Brookhaven Creek on the School District property where a 12-inch culvert currently conveys the creek across the school property.

Within DB-3 East is the Northview residential area. The existing detention pond within this area has been altered by a landowner and does not have an orifice/riser in the flow control manhole. It currently acts as a year round basin and allows flow to pass through undetained. The existing conditions of this pond outfall structure need to be field verified and some adjustments to the outlet structure are recommended in order for the pond to provide flow control, as it was designed.

Conclusions: The existing 18-inch outfall pipe has enough capacity for existing conditions. (Upsizing of the existing 6- and 10-inch storm drain pipes is recommended per the City's minimum requirement of 12-inches.) The 18-inch storm drain is near capacity and it is recommended that the City observe this pipe under storm flow conditions to evaluate the need for replacement. The catch basins within the DB-3B require routine inspection and cleaning to keep clear of debris that may cause inlets to clog. The Northview detention pond needs to have an orifice/riser installed to better detain flows and reroute the 15-inch outfall into the detention pond as it was originally designed.

Basin DB-4

Basin DB-4 consists of 10 acres that drain to an existing 6-inch outfall pipe at the bottom of Wharf Street. Currently runoff from the road is conveyed through a broken 6-inch line leading to the 6-inch outfall. The 6-inch drain needs to be replaced in order to prevent further deterioration of the pavement.

Conclusion: Due to the small size of the drainage basin, this area was not modeled. Replacement of this pipeline and outfall with the minimum size pipe of 12-inches as required in Section 4.1 is expected to be adequate to properly convey storm flows.

Basin DB-5

Basin DB-5 consists of 26.9 acres that drain to the Camano Avenue 12-inch concrete storm drain that was constructed in 1992. Runoff from the basin discharges to Saratoga Passage through a 12-inch HDPE outfall located at the north end of Camano Avenue. The tributary area includes part of the fairgrounds, middle school, street runoff, and adjacent properties. The peak 10-year storm flow was estimated as 2.0 cfs, the 25-year storm flow was estimated at 2.5 cfs, and the peak 100-year storm flow was estimated at 3.1 cfs. The 12-inch storm drain on Camano Avenue was estimated to have an available capacity of 5.0 cfs if installed at a minimum slope of 2-percent.

Conclusion: The existing culvert appears to be of adequate size to convey storm flows.

Basin DB-6 (Noble Creek Basin)

Basin DB-6 drains towards Noble Creek and includes 511 acres of mostly undeveloped second growth forest, as well as areas of single- and multi-family residential and commercial land uses in the lower basin. The discharge of this basin is the Noble Creek channel that cuts through the steep bluff above Saratoga Passage. The soils within the basin are all identified as the Keystone series except near Noble Creek where the soils are Norma loam soils. The creek crosses Sandy Point Road through a 24-inch CMP culvert and Edgecliff Drive through a 12-inch CMP culvert. The capacity of the 12-inch CMP Edgecliff Drive culvert is estimated to be about 4.73 cfs. There have been no historical reports of problems with overflows at this culvert location even though basin modeling shows it to be significantly undersized (as compared to flow rates of 24.2 cfs, existing and 37.3 cfs, fully developed). The high permeability soils surrounding the creek and the assumed ability of the wetland to store and infiltrate runoff, capacity issues may be why capacity issues are not as severe as indicated by modeling.

Conclusion: The 12-inch diameter pipe appears to be undersized and is recommended for upsizing to an 18-inch minimum diameter concrete pipe. It is recommended that the City observe this pipe under storm flow conditions to confirm the need for replacement.

Basin DB-7

Basin DB-7 is approximately 266 acres in size. Much of the upper portion of the basin is undeveloped forest and the lower portion is low-density residential development. The basin's soil type is identified as the Keystone series. This basin has no drainage conveyance system. Due to the rural nature of the area, topography and highly permeable soils, the lack of a drainage conveyance system has not appeared to result in many drainage problems. The only problem identified is ponding along the south side of Edgecliff Drive by the intersection with Furman and Decker Avenues. There are no detention systems in the basin; however, the Cedars Subdivision has a series of infiltration basins. Most of basin DB-7 is included as an area with high infiltration potential (See Figure 2.5). The area just south of Edgecliff Drive has wetland characteristics (and is highly valued by the neighborhood community).

Conclusion: Surface water conveyance system upgrades along Edgecliff Drive are needed to control ponding. This conveyance system could be routed to Noble Creek. Upgrades may include installing ditches along Furman and Decker Avenues to drain to Edgecliff Drive, installing new ditches and driveway culverts along Edgecliff Drive crossing Furman and Decker Avenues. It is expected that the Noble Creek outfall would require upgrading if DB-7 (and DB-8, see below) flows are routed in that direction. Monitoring of the existing culvert may be incorporated into the maintenance program to be sure the conveyance capacity remains adequate.

Basin DB-8

Basin DB-8 is comprised of about 39 acres. Much of the basin is undeveloped forest and has low-density residential development. The basin's soil type is identified as the Keystone series. Presently, much of the stormwater in the basin infiltrates. This basin has no drainage conveyance system. Future development in this area would require road improvements and constructed conveyance systems. The existing streets, Furman and Decker Avenues, need to have a storm drain conveyance system installed to drain runoff to Edgecliff Drive.

Conclusion: The area's topography would allow for ditches or an underground storm drain system along Furman and Decker Avenue to drain to Edgecliff Drive and then drain along Edgecliff Drive towards Noble Creek to the west.

The estimated 25-year peak flow under fully developed conditions is 4.3 cfs. Proposed storm drainage pipes should be 12-inch minimum diameter concrete. Proposed driveway culverts should be at least 15-inch diameter CMP. Proposed storm drainage ditches should have a minimum longitudinal slope of 0.5 percent, bottom width of two feet, maximum side slopes of two horizontal to one vertical, and minimum depth of two feet.

Much of the basin currently infiltrates and there are opportunities to implement LID practices within this basin through new development or the installation of a stormwater drainage/management system.

Basin DB-9

Basin DB-9 consists of about 116 acres. The upper portion of basin DB-9 is mainly undeveloped second growth forest. The lower basin DB-9A includes mainly low-density residential land use. The basin includes two wetland areas along the south side of Edgecliff Drive. The soils of the basin are Keystone sandy loam except for two areas of Norma loam soil also located just south of Edgecliff Drive. There is no drainage conveyance system in this basin except for a ditch along the south side of Edgecliff Drive that drains east to a 24-inch CMP outfall (County outfall) just beyond the City limits. The existing 24-inch culvert was estimated to have a capacity of 17.3 cfs, which is adequate to convey the expected 25-year flow of 8.7 cfs.

As with basin DB-7, due to the topography, sandy upper basin soils, and lack of development, there is no concentrated channel of runoff from this basin. The ditch along Edgecliff drive is

congested with vegetation and debris, which has resulted in standing water and ponding problems

Conclusion: The ditch along Edgecliff drive should be maintained on a regular (annual) basis to ensure adequate conveyance of storm flows.

Basin DB-10

Basin DB-10 is about 14 acres in size and is located outside of the City limits. This basin does not have an existing drainage system and is zoned for medium-density residential land use. The soils within the basin are Keystone sandy loam. Due to the topography, sandy upper basin soils, and lack of development, there is no concentrated channel of runoff from this basin.

Conclusion: LID measures are considered appropriate for this basin. Because this is a small basin, conveyance pipes should be of 12-inch minimum diameter per the City standards.

4.4 SUMMARY OF RESULTS

A summary of inadequate sections of the drainage system identified by the hydrologic modeling is listed below:

- **DB-1:** Model results indicate that the 24-inch culvert crossing Saratoga Road is undersized and will require monitoring as the upstream basin becomes developed. A 30-inch diameter CMP is estimated to be adequate to convey both the 25- and 100-year storms. The pavement above the existing culvert is cracking and is in need of repair.
- **DB-2:** Model results indicate that the three 12-inch culverts crossing Brooks Hill Road are undersized. One option for repair is to upsize one 12-inch culvert to a 24-inch CMP, which is estimated to convey the 25-year storm.
- **DB-3A:** The First and Second Street ditch and culverts between DeBruyn Avenue and Park Avenue are areas where stormwater conveyance systems need to be installed.
- **DB-3B:** Routine (at least annual) inspection and cleaning of catch basins within this basin, particularly at the intersection of Anthes and Second Street is needed.
- **DB-3 West:** The 18-inch storm drain on Anthes Avenue was estimated to have just enough capacity for the 25-year peak flow. It is proposed that this pipe be monitored during large storm events, and that LID requirements continue to be enforced on new development in basin DB-3 West. In addition, the 6-, and 8-inch diameter storm drains in the alley west of Anthes Avenue do not meet the City's minimum size and may need upsizing in the future and/or if problems arise.

- **DB-3 East:**
 - The 12-inch culvert conveying Brookhaven Creek across Sixth Street is slightly undersized and should be monitored during storm events to evaluate whether replacement is needed.
 - The Northview detention flow control outlet structure needs to be modified with an orifice/riser or similar measure. The pond should be cleaned out during outlet modifications.
- **DB-4:** The 6-inch outfall pipe at Wharf Street is undersized and should be replaced with a 12-inch diameter pipe.
- **DB-5:** The existing 12-inch storm drain system and outfall at Camano Avenue are estimated to have adequate capacity.
- **DB-6:** Monitor the existing 12-inch pipe during storm events as model results indicate the outfall pipe at Edgecliff Drive is undersized and needs to be upsized.
- **DB-7, 8, and 9:** All three basins drain to the ditch and wetlands on the south side of Edgecliff Drive. Furman and Decker Avenues are recommended to be upgraded with the installation of ditches, 12-inch diameter concrete storm drains, and/or 15-inch diameter CMP driveway culverts that drain to new ditches along the south side of Edgecliff Drive. A thickened edge along the north side of Edgecliff Drive would route surface water collected on the road to the drainage system. Additional right of way or drainage easements may be needed depending on the locations and sizes of the ditches. The new ditches will require routine (at least annual) inspection and maintenance to ensure conveyance of storm flows.
- **DB-10:** No drainage problems are known. New construction will require 12-inch minimum pipe size for conveyance of flow towards the 24-inch outfall pipe.

5.0 PROGRAMMATIC RECOMMENDATIONS

The purpose of this section is to give an overview of State and Federal stormwater regulations and recommend how to implement the management measures required by these regulations to improve water quality and runoff control. Management or non-structural solutions to water quality and water quantity problems discussed in this section include policies, development standard revisions, maintenance practice, and public education.

5.1 STATE AND FEDERAL POLICIES OVERVIEW

The traditional flood control aspects of stormwater management have been drastically modified by new planning directions from the State and Federal level. The passage of the 1987 Amendments to the Federal Clean Water Act has triggered additional requirements on local agencies. In Washington State, the Legislature created the Puget Sound Water Quality Authority which has impacted urban communities through the requirement that each community develop an integrated program to manage the quality of urban stormwater to meet the State goals.

5.2 FEDERAL STORMWATER NPDES PROGRAM

The 1987 Water Quality Act amended the Federal Clean Water Act to require the United States Environmental Protection Agency (EPA) to impose stormwater discharge permits under the NPDES program. In Washington, the program is administered by the Department of Ecology (DOE). The program is being implemented in phases. Phase I of the program covers cities and counties with populations of 100,000 or more served by MS4s. Federal law defines an MS4 as any system of conveyance designed and operated to collect and convey stormwater runoff (including road drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, and storm drains), owned or operated by a public agency having jurisdiction over the disposal of stormwater runoff and discharging to waters of the United States. Phase II, effective in Western Washington on February 16, 2007, covers cities and counties with populations greater than 10,000. The NPDES Phase II Municipal Stormwater Permit for Western Washington that regulates stormwater and wastewater discharges to waters of the state. Owners of publicly-owned stormwater systems are required to obtain NPDES permits for their stormwater discharges.

The population currently served by the City's MS4 is approximately 1,060 (see Section 2.10); therefore, the City's stormwater system is not regulated under NPDES Phase I or Phase II requirements.

Specific industries and businesses may be required to obtain operating stormwater NPDES permits. These are regulated by the DOE under the Industrial General Stormwater Permit or a site specific NPDES permit. The industrial stormwater NPDES permit program applies to various industries that discharge directly to surface waters or to municipal storm sewers. Cities,

regardless of size, are required to obtain industrial stormwater NPDES permits for certain municipal facilities such as landfills, vehicle maintenance shops and sewage treatment plants.

Construction sites that disturb one or more acres and discharge to a surface water must apply for Ecology's construction stormwater permit. NPDES General Permit for Construction Activities relies heavily upon the DOE Manual and use of specific Best Management Practices (BMP's) for temporary erosion and sediment control. A site-specific Construction Stormwater Pollution Prevention Plan is generally required for the acquisition of this permit.

In summary, the federal NPDES program, administered by DOE, will:

- Regulate and permit industrial and commercial activities as well as direct specific operational and maintenance implementing activities to protect water quality.
- Regulate and permit construction activities on-sites one or more acres in area.

The inclusion of construction sites in the industrial stormwater NPDES program creates an important area of overlap with the DOE's Basic Stormwater Program described in the following section. These construction sites will be regulated by both the City's stormwater standards and the NPDES permit.

Since the Ecology manual will be the reference for both regulations, there should be minimal conflict between the state and local programs.

5.3 DOE BASIC STORMWATER PROGRAM

The DOE's stormwater unit is enforcing the requirements of the stormwater section of the Puget Sound Water Quality Management Plan (December 2000) which includes basic stormwater programs for all jurisdictions in the Puget Sound Region. The program's goal is to protect shellfish beds, fish habitat, and other resources, to prevent the contamination of sediments from urban runoff, and to achieve standards for water quality by reducing pollutant discharges from stormwater throughout Puget Sound.

The Puget Sound Water Quality Management Plan calls for all jurisdictions in Puget Sound to develop and implement a comprehensive stormwater management program which includes:

1. Ordinances for all new development and redevelopment which require the use of BMPs to control stormwater flows, provide treatment, and prevent erosion and sedimentation. The adoption of the DOE Manual or an approved manual with substantially equivalent technical standards is required. All new development shall seek to achieve no net detrimental change in the natural surface runoff and infiltration.
2. Stormwater Site plans are required to insure that stormwater control measures are adequate and consistent with local requirements.

3. Regular inspection of construction sites, maintenance of temporary BMPs, adoption of ordinances to ensure clear authority to inspect construction sites, and to enforcement of violations. Local inspectors shall be provided with training on erosion and sediment control practices.
4. Regular maintenance of permanent facilities is required to ensure performance. Provisions need to be developed, such as agreements or maintenance contracts, to ensure that facilities on private property are maintained. Professionals who maintain stormwater facilities shall be provided training.
5. Develop and implement a program to control sources of pollutants from new development and redevelopment using BMPs from the DOE Manual. These source controls include pollution from roadways and landscaping activities. Road side vegetation shall be managed by integrated pest management practices.
6. Ordinances that prohibit dumping and illicit discharges. Carry out activities to detect, eliminate and prevent illicit discharges, and respond to spills and water quality violations.
7. Identify and rank existing problems that degrade water quality, aquatic species and habitat, and natural hydrologic processes through watershed or basin planning. Conduct hydrologic analysis and map stormwater drainages, outfalls, and impervious surfaces by watershed. Develop plans, schedules, and identify funding to fix the problems.
8. Educate and involve citizens, businesses, elected officials, site designers, developers, builders, and other members of the community to build awareness and understanding of stormwater and water quality issues. Provide practical alternatives to actions that degrade water quality and biological resources.
9. Ordinances that allow and encourage LID practices. These practices infiltrate stormwater on-site rather than collecting, conveying, and discharging stormwater off-site. Goals of LID practices are to enhance overall habitat functions, reduce runoff, recharge aquifers, maintain historic in-stream flows and reduce maintenance costs.
10. Implement watershed or basin planning processes, such as planning under Chapter 400-12 WAC or Chapter 90.82 RCW. The idea is to coordinate efforts, pool resources, ensure consistent methodology and standards, maintain and restore watershed health, and protect and enhance natural hydrology and processes – including natural surface runoff, infiltration and evapotranspiration. Identify and rank existing stormwater problems, develop a plan and schedule to fix the problems, and set goals for limiting effective impervious surfaces and preserve open spaces and forests through watershed or basin planning. Basin plans should use continuous runoff modeling to simulate existing and potential impacts of land use and should address water quality, aquatic habitat, ground water recharge, and water re-use. Stormwater management measures shall meet the minimum requirements of the DOE

Manual. Recommendations from watershed or basin plans and specific requirements from Total Maximum Daily Load (TMDL) Water Cleanup Plan processes shall be incorporated into stormwater programs, land use comprehensive plans and site development ordinances.

11. Create local funding capacity, such as a utility, to ensure adequate, ongoing funding for program activities and to provide funding to contribute to regional stormwater projects.
12. Monitor program implementation and environmental conditions and trends over time to measure the effectiveness of program activities. Monitoring results should be shared with local and state agencies and citizens periodically.
13. Develop an implementation schedule with specific target dates and funding sources to help plan program activities.

The intent of the DOE and the initiative started by the Puget Sound Water Quality Management Plan is to have the local agencies modernize their stormwater detention design criteria, add state-of-the-art techniques for managing erosion, sediment, and pollution control as standards for all projects, and generally standardize the technical approach in all local jurisdictions by providing the DOE Manual as a model and the minimum performance standard.

Revisions to the City's development drainage standards are consistent with the DOE Manual's minimum requirements and are presented in Appendix C. The DOE Manual will be the design guideline for future development in the City.

5.4 GROWTH MANAGEMENT ACT COORDINATION

This stormwater plan is being updated in coordination with the City's Comprehensive Land Use Plan. Many of the land use and policy decisions in the Plan affect the SCMP, and vice versa. For instance, land use decisions will drive stormwater management capital facilities needs in a given area, and critical areas designations and policies may restrict siting of stormwater facilities. Conversely, stormwater management decisions could limit land use options where implementation of the SCMP identifies areas of poor drainage or other conditions that cannot be cost-effectively solved by stormwater system improvements.

5.5 DRAINAGE STANDARD REVISIONS

The City's Drainage Land Development Standards and proposed revisions to these standards are presented in Appendix C. One of the DOE Basic Stormwater Program requirements is that the minimum design standards for all new development and redevelopment included in the DOE Manual be adopted by ordinance. These minimum requirements have been incorporated into the City's Development Standards and are presented in Section 15 of the Langley Municipal Code.

In the fall of 2005, the City of Langley became the first local government in the region to adopt the Puget Sound Action Team's Low Impact Development Manual for Puget Sound as part of its development code. Builders and developers now must integrate LID into their site designs. Conventional stormwater management measures can only be used if LID measures are not practical.

The City incorporated the LID manual by reference, rather than making item-by-item changes to the code. This approach gives developers maximum flexibility in selecting LID application for their particular site conditions (Puget Sound Action Team, 2006).

The minimum drainage criteria included in the current development standards are summarized in Section 4.1 of this document.

5.6 PUBLIC EDUCATION AND OUTREACH

One required element of the DOE Basic Stormwater Program is implementing stormwater education programs. The goal of public education is to prevent inappropriate use and disposal by the public of substances that can pollute surface runoff. Preventing the deposition of pollutants on land and their eventual transport by stormwater to receiving waters can be the most cost-effective method of limiting the amount of pollutants in stormwater. The first step in public education is to raise public awareness by describing the basic water quality problems caused by citizens through their daily activities that can deposit pollutants. Next, it is necessary to explain how pesticides, oil, antifreeze, and many household chemicals and by-products deposited within the City find their way to receiving waters. Finally, the public must be shown how the materials they dispose of improperly affect the water quality of streams and Puget Sound.

With support and involvement of the public, protection of surface water in the City's watershed can become an important part of community life. Programs such as erecting signs at stream crossings and developing school and adopt-a-stream programs are methods of increasing the public awareness of the impact of activities such as wetland filling, disposal of waste engine oil in catch basins, and use of fertilizers and pesticides. Whidbey Island Conservation District (WICD) is a good source of information for residents.

The following measures are recommended for consideration to enhance public involvement:

- Distribution of **“Living Responsibly in a Green Community”** to all residents.
- **Streamside Signs.** Place and maintain signs along streams, stream buffers, wetlands and wetland buffers, and at watershed boundaries.
- Work with the **Adopt-A-Stream Program** to encourage citizen activists to “adopt” local streams.
- **School Curriculum.** Establish Educational Programs for protecting water resources by working with local schools.

- **Recycle Oil.** Work with nearby service stations to increase the number of stations offering oil recycling services.
- **Mark storm drains** to discourage dumping of motor oil or other wastes into the storm drains. The County or other watershed groups may participate and share costs in this type of program.
- **Brochure Distribution.** Provide informational brochures on protection of water resources at City Hall (DOE has brochures available).
- **The Puget Sound Water Quality Authority** has an Island County liaison that is available to give educational presentations on water quality to public groups.

5.7 LOW IMPACT DEVELOPMENT OPPORTUNITIES

Low Impact Development (LID) is a stormwater management and land development strategy applied at the parcel and subdivision scale that emphasizes conservation and use of on-site natural features integrated with engineered, small-scale hydrologic controls to mimic predevelopment hydrologic functions. Implementation of LID practices benefits streams, lakes, and Puget Sound by moderating the impacts of stormwater runoff generated by the built environment. These techniques may be accessory or alternative to traditional, structural stormwater management solutions.

According to the LID Manual, technical approaches to LID can be applied in a variety of settings including: large lots in rural areas; low, medium, and high-density development within urban growth boundaries; redevelopment of highly urbanized areas; and commercial and industrial development. LID applications can be designed for use on glacial outwash and alluvium soils, as well as soils with low infiltration rates, such as dense silt loams or till mantled areas.

5.7.1 LID Limitations

The LID Manual provides the following limitations for LID practices:

- High water table.
- Impermeable or saturated soils.
- Steep slopes.
- Site locations within a wellhead protection zone.

5.7.2 Site Suitability Criteria

Wellhead Protection Zone

Figure 2.4 shows that the planning area is situated in Zone 2 and Zone 3 of the wellhead protection zone for Langley. The lower part of Zone 2 is a high pressure zone and the upper part is a low pressure zone. Locations of wells are shown on Figure 2.4 and are to be field verified.

LID practices within suitable areas or water quality facilities shall be set back from wells as required in the following section.

Setback Criteria

The DOE Manual provides the following set back criteria as guidance to design LID applications:

- Stormwater facilities should be set back at least 100 feet from drinking water wells, septic tanks or drain fields, and springs used for public drinking water supplies.
- From building foundations, a downslope of a minimum of 20 feet and an upslope minimum of 100 feet must be maintained, since there may be adverse effects caused by seepage zones.
- From a Native Growth Protection Easement where no native vegetation shall be disturbed or removed, a distance of minimum 20 feet must be maintained.

Ground Water Protection Areas

According to the DOE Manual, a site is not suitable for infiltration if the infiltration facility affects the ground water quality. The City should be consulted for applicable pollutant removal requirements upstream of the infiltration facility since the planning area is within the wellhead protection zone.

The DOE Manual also recommends sufficient pollutant removal (including oil removal) upstream of the infiltration facility in high vehicle traffic areas, such as commercial or industrial sites, to ensure that the ground water quality standards are not violated and that the infiltration facility is not adversely affected.

General Soil Suitability for Treatment

The DOE Manual recommends that the soil texture and design infiltration rates should be considered along with the physical and chemical characteristics specified below to determine if the soil is adequate for removing the target pollutants.

- Depth of soil used for infiltration treatment must be a minimum of 18 inches.
- Organic content of the soil can increase the absorptive capacity of the soil for some pollutants. Therefore, soil is to be evaluated for organic content to determine whether the organic content of the soil is sufficient for controlling pollutants.
- Waste fill materials should not be used as infiltration soil media.

- Soil Infiltration Rate - For infiltration facilities used for treatment purposes, the short-term soil infiltration rate should be 2.4 in/hr and long-term infiltration rates can be considered up to 2.0 in/hr. Designs should consider a minimum safety factor of 2.0.

Langley Soils

Site soils are presented on Figure 5.1. According to the *Soil Survey of City of Langley, Washington*, (USDA SCS, 1958) the three main soils within Langley are mapped as Keystone Loamy Sand, Whidbey Gravelly Sandy Loam, and Norma Silt Loam. Other soils identified in the area are Tanwax Peat, Riffle Peat, Coastal Beach and rough broken land.

Keystone Loamy Sand: Keystone soil is a glacial upland soil developed from sandy drift and is relatively free of gravel. Because of the open porous texture of the soil, water is absorbed readily and drains very rapidly and these soils belong to Hydrologic Soil Group (HSG A). As per the DOE Manual, Volume III, soils that belong to HSG A have low runoff potential and high infiltration rates. They have a high rate of water transmission of greater than 0.3 in/hr. Therefore these soils are generally considered suitable for LID applications since they have high rates of infiltration.

Whidbey Gravelly Sandy Loam: Whidbey series consists of moderately well drained soils formed in glacial drift overlying dense glacial marine deposits. These soils belong to HSG C with low infiltration rates and have a water transmission of 0.05-0.15 in/hr. Since LID applications can be designed for use on glacial outwash, as well as soils with low infiltration rates, these soils are generally somewhat suitable for LID applications.

Norma Silt Loam: Norma series soils have high runoff potential and very low infiltration rates. They consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a hardpan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission of 0-0.05 in/hr. Areas with Norma silt loam soils are generally not recommended for LID applications.

Figure 2.5 shows the areas within Langley where soils have poor infiltration and therefore, these areas are not recommended for LID practices. Table 5-1 shows the existing drainage basins and the areas and types of soils in each basin. It is recommended that site soils undergo testing during the design of permanent LID applications to ensure that the BMP operates as intended.

Based on the LID Manual:

- LID emphasizes evaporation, storage and infiltration of stormwater in smaller scale facilities distributed throughout the site.
- On-sites with mixed soil types, the LID site plan should locate impervious areas over less permeable soils and preserve and utilize permeable soils for infiltration.

**Table 5-1
Basin Soils Type and Area**

	Basin ID	Total Area (acres)	HSG (Area in acres)		
			A Excellent LID Areas Keystone Loamy Sand	C Potential LID Areas Whidbey Gravelly Sandy Loam	D Non-LID Areas Norma Loam
Saratoga Creek Basins	DB-1	335	100	210	25
	DB-2	465	327	115	23
Brookhaven Creek Basins	DB-3	325	286	-	39
Wharf Street	DB-4	10	-	-	10
Camano Outfall	DB-5	27	27	-	-
Noble Creek Basin	DB-6	511	392	111	8
Runoff to Saratoga Passage	DB-7	265	116	146	3
	DB-8	39	35	4	-
	DB-9	116	108	-	8
	DB-10	14	14	-	-

5.7.3 LID Strategies/Practices

The LID Manual recommends the following strategies for LID practices:

- Always provide treatment of stormwater onsite.
- On difficult sites with low infiltration rates and higher densities, additional storage using conventional retention or detention pond facilities may be necessary.
- Preserve permeable, native soil and enhance disturbed soils to store and infiltrate storm flows.
- Locate buildings and roads away from critical areas and soils that provide effective infiltration.
- Minimize total impervious surface area and eliminate effective impervious surfaces.
- Bioretention facilities, vegetated roofs, permeable pavements, rain water harvesting etc., are some of the best management practices for storage, infiltration, and pollution control.
- Bioretention facilities should not be used as sediment control facilities and drainage should be directed away from bioretention facilities.

5.8 OPERATIONS AND MAINTENANCE

An operation and maintenance program is another element of the DOE Basic Stormwater Program required by all jurisdictions in the Puget Sound Region. The following program for maintenance of stormwater facilities is required:

- Each county and city shall develop and enforce, within local governments' authority, operation and maintenance programs and ordinance for new and existing public and private stormwater systems.
- Each county and city shall maintain records of new public and private storm drainage systems and appurtenances.

Stormwater maintenance is necessary not only to assure the reliability and dependability of stormwater infrastructure, including catch basins, open ditches, and pipe networks, but also to enhance water quality. The key to effective maintenance is both a regular schedule of inspections to determine maintenance needs and the clear assignment of responsibilities to either a private entity or the City.

The Land Development Standards section 15.01.450 which addresses maintenance of stormwater facilities is listed below.

1. Publicly Owned Stormwater Facilities Located in City Rights-Of-Way
 - Facilities are maintained by the City public works department. These facilities include catch basins, roadside ditches, storm drains, detention facilities, and infiltration facilities.
2. Existing Privately Owned Stormwater Facilities Located on Private Property
 - Facilities located on single lot private property shall be maintained by the property owner.
 - When a facility serves several properties, a homeowner association will provide an O&M agreement that the facilities will be inspected, with notice, by the City and paid for by the homeowners association. The facility shall be located in a tract or easement dedicated to that association.
 - Should private stormwater facilities not be maintained in accordance with City standards, then the City may choose to perform the necessary maintenance and charge the property owner/association, or the City may condemn the property as a health and safety nuisance and assume ownership.

3. Public facilities shall be inspected by the City annually and cleared of debris, sediment and vegetation when they affect the functioning and/or design capacity of the facility. All stormwater facilities shall be maintained in accordance with the DOE Manual.

Development of an operation and maintenance schedule for stormwater facilities requires preparing an inventory of facilities and establishing the level of service and frequency of maintenance for each type of facility. The responsible party (or parties) shall be identified.

The recommended general maintenance frequencies are presented below. This list should only be used as a general guide since some facilities, due to their location in the system, will require more maintenance than others. For instance, catch basins located in the downtown area on Anthes Street will require more frequent cleaning than those on streets that receive with less traffic and lower runoff volumes.

5.9 RECOMMENDED SYSTEM MAINTENANCE

Below some general maintenance recommendations for different types of facilities are presented. The DOE Manual provides more detailed information on the operation and maintenance requirements for each type of stormwater facility.

5.9.1 Catch Basins

Research has shown that roadside catch basins can remove from 5 to 15 percent of the pollutants present in stormwater. However, to be effective they must be cleaned regularly. Research has indicated that once catch basins are about 60 percent full of sediment, they cease removing sediments and sediment needs to be removed. The catch basins should be cleaned immediately if trash or debris is blocking more than 1/3 of the inlet/outlet height, is located in front of the catch basin opening, or blocking inlet capacity by more than 10%. Catch basins should be cleaned at a minimum of once a year in the fall prior to the heaviest rainfall period.

The basins should also be inspected regularly to check the structure's integrity. If holes larger than two square inches or cracks wider than 1/4 of an inch are found on the top slab, the slab needs to be replaced. If the basin's opening is blocked by vegetation by more than 10% or vegetation is found in the inlet/outlet to be taller than six inches and less than six inches apart then vegetation will need to be removed.

5.9.2 Roadside Ditches

The vegetation present in properly designed ditches can remove pollutants such as metals that are carried in particulate form in stormwater runoff. To minimize non-point pollution, maintenance of roadside ditches should be carried out in a manner that ensures the vegetation will be reestablished by the next wet season, thereby minimizing erosion within the ditch as well as making the ditch effective as a biofilter. Ditch cleaning to maintain hydraulic capacity should be

done during spring or summer months and should include immediate reseeding or sodding of drainage swales and channels.

Existing grass-lined ditches should be visually inspected after every heavy rainfall event and at a minimum once per year for potential capacity reduction, including sediment deposition, excessive vegetation growth, evidence of piping or scour holes, bank stability and clogged culverts. The visual inspections should occur in the early spring and mid-summer. Culvert openings should be cleared if obstructions occur.

5.9.3 Detention Ponds

Ponds should be visually inspected for sediment deposition in the summer and cleaned if sediment has accumulated to the point that 10% of the designed pond depth is filled or more importantly if the sediment storage allowed by the design of the pond is filled with sediment. Slopes should be inspected for erosion or sloughing and damaged areas repaired and stabilized using erosion control measures if damage is over two inches deep or if any erosion is observed on a compacted berm embankment. If trash and debris exceeds five cubic feet per 1,000 square feet, trash and debris needs to be cleared from site.

At a minimum an annual routine maintenance of detention facilities includes inspection, comparison of existing conditions with design and as-constructed conditions, mowing, debris and litter removal, and sediment removal. For relatively stable watersheds, sediment removal is typically conducted at 5 to 10 year intervals and should occur during the summer or fall when the pond's surface is dry or the water level is low. Bare ground created by this activity should be treated with erosion control practices, including seeding, immediately following the maintenance activity.

5.9.4 Infiltration Basins

Maintenance of infiltration basins is important in order to assure the continued ability of the pond surface to infiltrate peak storm event runoff. A dense growth of turf will prevent soil erosion and basin scouring that could increase clogging of the basin surface. Also, the root penetration of a thick grass surface helps maintain the infiltration capacity of the basin floor. Mowing the grass once or twice a year is generally satisfactory.

If water accumulates in the basin for more than 24 hours after the end of a rainfall event or overflows more frequently than planned, debris/sediment should be removed, otherwise removal shall take place every six months or as needed to prevent clogging. Slopes should be repaired and stabilized using erosion control measures if eroded damage is over two inches deep or if any erosion is observed on a compacted berm embankment. If trash and debris exceeds five cubic feet per 1,000 square feet, trash and debris needs to be cleared from site.

After several years, a layer of silt may form on the pond surface, clogging the soil pores and inhibiting infiltration. To restore the ponds natural infiltration capacity the surface is either tilled or scarified (the silt layer is scraped off). Tilling or removal of sediment may be necessary every 5 to 10 years.

5.9.5 Rain Gardens

Rain gardens shall be inspected particularly in the fall before the wet season begins and again in the winter. If sediment is building up, determine the source and stabilize the area. Areas of exposed soil should be mulched and a healthy cover of plants should be maintained. A cover layer of decorative rock should be maintained to protect the ground surface where concentrated flows enter the rain garden. Fertilizers should not be used within rain gardens. Weeding to support preferred plant growth should be conducted as necessary (2007 Rain Garden Handbook for Western Washington Homeowners).

5.10 RECORD KEEPING

Another element of the DOE Basin Stormwater Program is that each city in the Puget Sound Region is required to maintain records of all public and private storm drainage systems. To adequately maintain all stormwater BMPs, records should also be kept on existing facilities whenever possible.

The following minimum standards for record keeping are recommended in the DOE Manual:

- A master maintenance schedule should be kept for all public and private facilities.
- As new facilities are constructed, they should be added to the master maintenance schedule.
- Records of stormwater facilities should include the following:
 - As-built plans, including site location, design criteria, and capacity of the BMP.
 - Information related to project exemptions granted by the local government.
 - Operation and maintenance requirements, including actions and frequencies.
 - Records of inspections and completed maintenance and repair.
 - Engineering reports and specifications, as appropriate.
 - Ownership and maintenance responsibility (private versus public)

5.11 SUMMARY OF MANAGEMENT RECOMMENDATIONS

The following are general policy recommendations which are intended to form the basis of the City's drainage management system.

1. **Revision of Land Development Standards.** By revising the drainage standards the City will promote development procedures and guidelines that minimize surface water quality degradation, maintain and protect the integrity and quantity of the groundwater resource,

and reduce the likelihood of damage to public and private property from flood, erosion, and sedimentation. The revisions to the standards are included in Appendix C.

2. **Drainage Ordinance.** The City should adopt the revised Land Development Standards by ordinance in order to assure implementation of the policies.
3. **Inspection and Maintenance of Stormwater Facilities.** To the extent practicable, the City should provide for inspection and maintenance of stormwater facilities in accordance with the DOE Manual. This will extend the life of the stormwater management system and BMP facilities and ensure that they are performing as designed, such as to prevent or remove pollution and/or reduce flooding.
4. **Record Keeping.** As part of the City's maintenance program, records should be kept of all new and existing public and private storm drainage systems.
5. **Public Education.** The City should take measures to increase public awareness of the City's water resources and the impact of various activities on these resources.
6. **Protection of Sensitive Areas.** The City, through adoption of Ordinance 861, has already taken measures to assure the protection of steep slopes, creeks, and wetlands which are necessary for the maintenance of the natural drainage patterns and flow rates. The proposed Land Development Standard revisions include runoff control and water quality requirements that provide additional protection of wetlands and streams.
7. **Preference for Infiltration BMPs.** Infiltration systems are the required method of water quality and runoff control, where the site conditions allow. This is based on the need to maintain ground water recharge, reduce downstream flows, and provide treatment of stormwater contaminants.

5.12 RECOMMENDATIONS FOR WATER QUALITY IMPROVEMENTS

There is not much space available for water quality treatment improvements within the developed areas of the town. For example, there is not sufficient right of way in the developed areas for biofiltration swales rather than ditches along roads. The main opportunity for water quality treatment in Langley is in new developing areas. Measures recommended to improve stormwater treatment are listed below.

- Continued water quality treatment of the 6-month 24- hour storm runoff for all areas of new development or redevelopment.
- Implementation of the maintenance and operation program presented in Section 5.9.
- Implementation of elements of the education program presented in Section 5.6.

- Preservation of wetlands which provide stormwater storage and treatment as required by the Environmentally Critical Areas Ordinance.
- Proposed improvements to the Northview Detention Pond.
- Proposed improvements to Brookhaven Creek described in Section 3.5.3.
- Use of open conveyance ditches rather than closed pipes for most proposed conveyance improvements. Open conveyance is preferred by the DOE Manual in order to provide some water quality treatment.
- Use of LID tools, like installation of rain gardens, pervious pavement and other methods described in the LID Manual.
- Use of Mechanical Treatment options such as Contech Stormfilters, CDS or equivalent (as approved by the City on a case by case basis).

6.0 ALTERNATIVE SOLUTIONS AND RECOMMENDED PROGRAM

This section presents the alternatives evaluated and the recommended stormwater facility improvements for the City. Also provided is a schedule for making the improvements and estimated costs of the improvements. Cost estimates are in 2008 dollars and include design costs, administration, total construction costs, and tax.

6.1 PROPOSED SOLUTIONS TO EXISTING DRAINAGE PROBLEMS

Proposed solutions to the existing drainage problem areas described in Sections 3 and 4 are described below. The improvement projects are numbered, summarized below, and shown on Figure 3-1. The numbered projects (1 through 20) are not prioritized; see Section 6.2 for project prioritization.

1. **Second Street – Park Avenue to Melson Alley.** The storm drain system in Second Street collects runoff from Melson Alley east to Anthes Avenue. The area west of the alley does not have an existing storm drainage system. Connection to the existing catch basin at the alley will alleviate ponding on Second Street. A 12-inch storm drain extending west from the alley is proposed in lieu of a ditch, since the existing shoulder is often used for parking.
2. **Sixth Street East of Anthes Avenue to Brookhaven Creek.** There currently is no conveyance system along this section of Sixth Street. It is proposed that a 12-inch storm drain be constructed on the south side of the street with laterals connecting the north side that would drain towards Brookhaven Creek and connect to the existing culvert. This would help prevent runoff from entering the Creekside Condo's driveway and ponding on Sixth. The addition of a thickened edge along the north side would also direct runoff to the proposed catch basins.
3. **Parking Area at the Bottom of Wharf Street.** The 6-inch storm drain that is broken and causing damage to the pavement will need to be replaced with a 12-inch drain. The City's standards call for a minimum storm drain size of 12-inches (see Section 4.1).
4. **Northview Subdivision Drainage and Detention Pond.** The detention pond's outfall structure needs to be improved by modifying the outlet structure with a riser with an orifice, in place of the existing 12-inch outlet. The orifice should be sized for the pre-developed 2-, and 10-year, 24-hour peak storm events with an overflow at the 100-year design level. The pond may need to be cleaned out by removing sediment that has accumulated at the bottom of the pond. The existing 15-inch outfall to the south will need to be re-routed to the east side of the existing residences and flow into the detention pond as originally designed.

5. **Melson Alley (4th to 6th).** Currently the drainage from Fourth Street is conveyed in an existing ditch along the south side of Fourth Street. The ditch is shallow and ends at the alley just east of Park Avenue. The proposed improvements are to install a 12-inch storm drain system on the south side of Fourth from the existing manhole at Anthes west to Park Avenue.
6. **Intersection of Anthes Avenue and First Street.** The existing catch basin and grates on Anthes Avenue clog easily. Since that is the low spot in the downtown area and the leaves and litter tend to frequently clog the grates, a maintenance routine should be put in place to keep runoff flowing through the system and eliminate ponding. An improvement including upgrading the existing catch basins to Type I structures is recommended to improve operation and minimize maintenance is recommended.
7. **Edgecliff Drive West of Furman Avenue.** There is no drainage conveyance system on Edgecliff Drive west of Furman Avenue. Just west of the intersection with Decker Avenue, ponding occurs on the south side of Edgecliff Drive during storms and extends at times half way across the road. As the residential area south of Edgecliff Drive develops and road improvements are made, a drainage system will be needed. It is feasible for drainage to be conveyed within grass-lined ditches to Noble Creek. The installation of a combination of ditches and 12- to 18-inch diameter driveway culverts draining towards Noble Creek and discharging to the creek either directly or by installing a manhole over the existing culvert is recommended. The quantity of flow through the ditches would be minimal with the implementation of infiltration systems (LID) for new development upstream. The north side of Edgecliff will need an asphalt thickened edge to direct flow to catch basin laterals that outfall into the ditch on the south side.
8. **Furman Avenue.** Furman Avenue does not have a storm drain system and currently sheet flows to Edgecliff Drive causing ponding at the intersection. Along with Decker Avenue a 12-inch storm drain system will be located on the west side with catch basins and laterals on the east directing flow to the storm drainage system along Edgecliff Drive.
9. **Decker Avenue.** Decker Avenue is similar to Furman Avenue as it has no existing storm drainage system and drains to Edgecliff Drive, causing ponding. Along with Furman Avenue a 12-inch storm drain system will be located on the west side with laterals on the east discharging to the Edgecliff Drive drainage system.
10. **Second Street to Cascade Avenue to the Extension of Third Street.** The existing storm drain in Second Street currently ends about halfway up the street to Cascade Avenue. The proposed 12-inch storm drain system will connect to the existing storm drain and extend east to Cascade Avenue. It will then continue on the west side of Cascade to the approximate extension of Third Street. The north and east sides of the streets will be collected with catch basin and laterals connected to the new storm drain.

11. **Sixth Street from Anthes Avenue to Park Avenue.** Currently flow from the ditch along the south side of Sixth Street outfalls into the storm drain system in Melson Alley. This 6-inch pipe is undersized and rerouting the flow with a proposed ditch and 12-inch storm drain system to the existing storm drain in Park Avenue would alleviate the capacity issue. The proposed system will include regrading of the existing ditch on the south side of Sixth Street to drain towards Park Avenue. The proposed 12-inch storm drain system will be extended south from the existing pipe at Fourth Street. The north and east sides of the streets will be collected with catch basins and laterals connecting to the new drainage system. The quantity of flow through the system could be controlled by implementation of infiltration systems through LID practices for new developments upstream.
12. **First Street and DeBruyn Avenue.** Currently there is no street drainage on First Street from DeBruyn to Park Avenue. A proposed 12-inch storm drain system will be constructed on the south side of First Street and outfall into the existing system in Park Avenue. The north side of the street will be collected and routed to the storm drain system by catch basins and laterals.
13. **Second Street and DeBruyn Avenue.** Currently there is no street drainage on Second Street from DeBruyn to Park Avenue. A proposed 12-inch storm drain system will be constructed on the south side of Second Street and outfall into the existing system in Park Avenue. The north side of the street will be collected and routed to the storm drain system by catch basins and laterals.
14. **Saratoga Creek Crossing at Saratoga Road.** Model results indicated that the existing 24-inch culvert is undersized and a 30-inch CMP is needed to convey future 25- and 100-year storm events. The existing pavement is cracking and will need pavement removal and repaving. Monitoring the culvert and pavement during and after storm events and semi-annually is proposed at this time. The monitoring should include keeping a record of pavement condition (including location and dimensions of cracks), water surface elevations, culvert sedimentation build-up, debris at the inlet and outlet, and noting erosion occurring around the culvert inlet and outlet.
15. **Saratoga Creek Crossing at Brooks Hill Road.** There are three existing 12-inch culverts crossing Brooks Hill Road. There have been times when the upstream water level has been observed to be close to the top of the roadway; however the road has not overtopped. The three 12-inch CMP culverts could be upsized to three 15-inch diameter concrete culverts; or to minimize disturbance during construction, one 12-inch culvert could be replaced with a 24-inch CMP. For the time being, monitoring the culverts during and after storm events and semi-annually is recommended. Monitoring should include keeping a record of water elevations, culvert sedimentation build-up, debris at the inlet and outlet, and noting erosion occurring around the culvert inlet and outlet.

16. **Sixth Street west of Park Avenue.** The existing asphalt driveway and South Piney Knoll Lane on the south side of Sixth Street needs repair and has areas of ponding. This will be corrected by regrading the ditch and installing the storm drain system for Project Number 11.
17. **County Outfall System.** The existing ditch along the south side of Edgecliff Drive drains towards the east of the wetlands area discharges into a 24-inch outfall, which was installed by Island County. This ditch is currently overgrown and in need of maintenance. Regrading and cleaning out the existing ditch will improve drainage to the outfall pipe. Existing driveway culverts that are smaller than 12-inches are recommended for upgrade to at least the minimum size. This will be included with the proposed improvements to Edgecliff Drive (Project No. 18). The outfall should be monitored through field observation during and after storm events and semi-annually. Monitoring should include keeping a record of water levels, culvert sedimentation build-up, debris at the inlet and outlet, and noting erosion occurring around the culvert inlet and outlet.
18. **Edgecliff Drive East of Furman Avenue to City Limits.** Ponding occurs at several points along Edgecliff Drive. Installation of proposed ditches and regrading existing ditches to allow runoff to be directed to the County outfall pipe is recommended. Driveway culverts, 12-inch minimum, will be installed at each driveway to allow flow to continue east. The drainage on the north side of Edgecliff will include the installation of an asphalt thickened edge. The thickened edge will direct flow to catch basins with laterals that will outfall into the ditch on the south side of the road. In order to help control surface water run-on from the upstream basin with future development, strict runoff control requirements are recommended.
19. **Brookhaven Creek from Fourth to Third Streets.** Brookhaven Creek recently underwent channel restoration which included several new plantings along the stream banks. The plantings are now all overgrown with weeds and tall grass, the flow is slowed by the weeds and causing ponding and stagnant water. The creek is on private property and needs to have regular maintenance by the property owners to keep the creek flowing as it should.
20. **Water Quality Treatment for Existing Outfalls.** Water quality systems, similar to the existing Contech CDS unit, are recommended for installation at four existing outfall pipes that collect runoff from Pollution Generating Impervious Surfaces (PGIS). It is recommended that the furthest downstream manhole/catch basin prior to outfalling into Saratoga Passage be removed and replaced with a water quality treatment system similar to the Contech CDS unit.

6.2 PRIORITIZATION OF RECOMMENDED IMPROVEMENTS

A summary of problem areas, recommended improvements, and estimated construction costs for each numbered project are presented in Table 6-1. The City prioritization of each project is also presented in this table. Support documentation for cost estimates is presented in Appendix D.

**Table 6-1
Proposed Drainage Improvements**

Project	Priority	Location	Proposed Improvement	Problem	Length / Quantity	Estimated Cost
1	8	Second Street – Park Avenue to Melson Alley	12-inch storm drain	No existing drainage system. Erosion and flooding along the south shoulder of the street during storms.	565	\$110,000.00
2	1	Sixth Street East of Anthes Avenue to Brookhaven Creek	12-inch storm drain	No street drainage, runoff from street flows down driveway of Creekside Terrace Condos.	950	\$190,000.00
3	11	Wharf Street	12-inch storm drain and water quality treatment unit	Break in existing 6-inch storm drain and seepage causing pavement deterioration. No water quality treatment at this outfall.	225	\$60,000.00
4	3	Northview Subdivision Drainage and Detention Pond	Install riser with orifice, re-route existing 15-inch outfall to detention pond with a new 15-inch storm drain	Pond is not providing detention storage, resulting in unregulated flow downstream. A portion of the subdivision area that was designed to drain to the detention pond is flowing directly to Brookhaven Creek.	395	\$70,000.00
5	10	Melson Alley (4 th to 6 th)	12-inch storm drain	Insufficient drainage facilities on Fourth Street causes flooding and erosion near the intersection with Fourth Street.	665	\$130,000.00
6	6	Intersection of Anthes Avenue and First Street	Replace four existing catch basins with Type I structures	Catch basin grates clog easily and have inadequate sediment traps.	4 catch basins	\$20,000.00
7	4	Edgecliff Drive west of Furman Avenue	Ditch and 12- to 18-inch culverts/storm drains	No street drainage on Edgecliff Drive west of Furman Avenue results in ponding near Decker Avenue.	1340	\$280,000.00
8/9	5	Furman Avenue and Decker Avenue	12-inch storm drain	No street drainage on Furman or Decker Avenues results in ponding at the intersections with Edgecliff Drive.	2540	\$490,000.00
10	2	Second Street to Cascade Avenue to the Extension of Third Street	12-inch storm drain	Existing storm drain in Second Street ends halfway up the street towards Cascade Avenue. Cascade Avenue between Second and the extension of Third Streets has no drainage system.	890	\$180,000.00
11	7	Sixth Street from Anthes Avenue to Park Avenue	12-inch storm drain	Sub-standard drainage system and ponding occurs.	880	\$190,000.00

**Table 6-1 (Continued)
Proposed Drainage Improvements**

Project	Priority	Location	Proposed Improvement	Problem	Length / Quantity	Estimated Cost
12	12	First Street and DeBruyn Avenue	12-inch storm drain	No street drainage on First Street from DeBruyn to Park Avenues.	700	\$130,000.00
13	13	Second Street and DeBruyn Avenue	12-inch storm drain	No street drainage on Second Street from DeBruyn to Park Avenues.	730	\$150,000.00
14	Monitor/ Observe	Saratoga Creek Crossing at Saratoga Road	Monitor culvert capacity and pavement condition through field observation	Pipe capacity needs to be evaluated, erosion of the creek has been observed, and roadway pavement has longitudinal cracking.	n/a	n/a
15	Monitor/ Observe	Saratoga Creek Crossing at Brooks Hill Road	Monitor culvert capacity through field observation	Water level upstream of the road has been close to overtopping road during storms. Capacity of three existing 12-inch culverts needs to be evaluated.	n/a	n/a
16	7	Sixth Street west of Park Avenue	Include with Project No.11	Localized ponding along south side of Sixth Street.	n/a	See Project 11
17	Monitor/ Observe	County Outfall System	Monitor culvert capacity through field observation	Existing ditch along south side of Edgecliff Drive drains east and discharges to a 24-inch outfall. The ditch is overgrown and may be causing conveyance issues.	n/a	n/a
18	14	Edgecliff Drive East of Furman Avenue to City Limits	Install new and maintain existing ditches, use 12-inch minimum driveway culverts	Ponding on roadway, bluff erosion, wetland protection, and poor drainage in ditches that need maintenance, areas with no drainage system.	1375	\$120,000.00
19	Maintain	Brookhaven Creek from Fourth Street to Third Street	Maintenance of stream bank plantings by property owner(s)	Slow flow and ponding within creek caused by weeds overgrowing recent stream bank plantings.	n/a	n/a
20	9	Water Quality Treatment at existing outfalls	Replace existing manholes with water quality treatment unit inside new manhole.	Four existing outfalls (Park, Anthes (2), Camano Avenues) have no water quality treatment prior to discharge.	4 units at existing outfalls	\$200,000.00

6.3 IMPLEMENTATION SCHEDULE

The six-year stormwater improvement plan projects are listed in order of priority from 1 to 10 as presented in Table 6-2. Table 6-3 presents the 20-year (or long-term) CIP plan.

Several areas have been identified as potential problems that should be monitored through field observation over time to determine the severity of the problem. Projects to be monitored through observation are presented in Table 6-4. Monitoring will be conducted semi-annually and during and after a storm event. Records will be kept that document the date of observation, water surface elevation, culvert sedimentation build-up, debris at the culvert inlet and outlet, dimensions of erosion present, amount of recorded precipitation, pavement condition, and recent or required maintenance.

One project has been identified as requiring maintenance, which is **Brookhaven Creek from Fourth to Third Streets**. Brookhaven Creek recently underwent channel restoration and new plantings were installed along the stream bank. The plantings are now overgrown with weeds and tall grass. Flow within the creek is slowed by the weeds and causing ponding and stagnant water. The stream banks along the creek channel needs to have regular maintenance to control weeds. As this project is on private property, this work should be completed by the property owner(s).

**Table 6-2
Recommended Improvements – 6-Year Plan**

Project	Priority	Location	Proposed Improvement	Problem	Length / Quantity	Estimated Cost
2	1	Sixth Street East of Anthes Avenue to Brookhaven Creek	12-inch storm drain	No street drainage, runoff from street flows down driveway of Creekside Terrace Condos.	950	\$190,000.00
10	2	Second Street to Cascade Avenue to the Extension of Third Street	12-inch storm drain	Existing storm drain in Second Street ends halfway up the street towards Cascade Avenue. Cascade Avenue between Second and the extension of Third Streets has no drainage system.	890	\$180,000.00
4	3	Northview Subdivision Drainage and Detention Pond	Install riser with orifice, re-route existing 15-inch outfall to detention pond with a new 15-inch storm drain	Pond is not providing detention storage, resulting in unregulated flow downstream. A portion of the subdivision area that was designed to drain to the detention pond is flowing directly to Brookhaven Creek.	395	\$70,000.00
7	4	Edgecliff Drive West of Furman Avenue	Ditch and 12- to 18-inch culverts/storm drains	No street drainage on Edgecliff Drive west of Furman Avenue results in ponding near Decker Avenue.	1340	\$280,000.00
8/9	5	Furman Avenue and Decker Avenue	12-inch storm drain	No street drainage on Furman or Decker Avenues results in ponding at the intersections with Edgecliff Drive.	2540	\$490,000.00
6	6	Intersection of Anthes Avenue and First Street	Replace four existing catch basins with Type I structures	Catch basin grates clog easily and have inadequate sediment traps.	4 catch basins	\$20,000.00
11	7	Sixth Street from Anthes Avenue to Park Avenue	12-inch storm drain	Sub-standard drainage system and ponding occurs.	880	\$190,000.00
1	8	Second Street – Park Avenue to Melson Alley	12-inch storm drain	No existing drainage system. Erosion and flooding along the south shoulder of the street during storms.	565	\$110,000.00
20	9	Water Quality Treatment at existing outfalls	Replace existing manholes with water quality treatment unit inside new manhole.	Four existing outfalls (Park, Anthes (2), Camano Avenues) have no water quality treatment prior to discharge.	4 units at existing outfalls	\$200,000.00
5	10	Melson Alley (4 th to 6 th)	12-inch storm drain	Insufficient drainage facilities on Fourth Street causes flooding and erosion near the intersection with Fourth Street.	665	\$130,000.00

**Table 6-3
Recommended Improvements – 20-Year Plan**

Project	Priority	Location	Proposed Improvement	Problem	Length / Quantity	Estimated Cost
3	11	Wharf Street	12-inch storm drain and water quality treatment unit	Break in existing 6-inch storm drain and seepage causing pavement deterioration. No water quality treatment at this outfall.	225	\$60,000.00
12	12	First Street and DeBruyn Avenue	12-inch storm drain	No street drainage on First Street from DeBruyn to Park Avenues.	700	\$130,000.00
13	13	Second Street and DeBruyn Avenue	12-inch storm drain	No street drainage on Second Street from DeBruyn to Park Avenues.	730	\$150,000.00
18	14	Edgecliff Drive East of Furman Avenue to City Limits	Install new and maintain existing ditches, use 12-inch minimum driveway culverts	Ponding on roadway, bluff erosion, wetland protection, and poor drainage in ditches that need maintenance, areas with no drainage system.	1375	\$120,000.00

**Table 6-4
Recommended Improvements – Maintenance and Monitoring**

Project	Action	Location	Proposed Improvement	Problem
14	Monitor/ Observe*	Saratoga Creek Crossing at Saratoga Road	Monitor culvert capacity and pavement condition through field observation	Pipe capacity needs to be evaluated, erosion of the creek has been observed, and roadway pavement has longitudinal cracking.
15	Monitor/ Observe*	Saratoga Creek Crossing at Brooks Hill Road	Monitor culvert capacity through field observation	Water level upstream of the road has been close to overtopping road during storms. Capacity of three existing 12-inch culverts needs to be evaluated.
17	Monitor/ Observe*	County Outfall System	Monitor culvert capacity through field observation	Existing ditch along south side of Edgecliff Drive drains east and discharges to a 24-inch outfall. The ditch is overgrown and may be causing conveyance issues.
19	Maintain	Brookhaven Creek from Fourth Street to Third Street	Maintenance of stream bank plantings by property owner(s)	Slow flow and ponding within creek caused by weeds overgrowing recent stream bank plantings.

* Monitoring through field observation to be conducted semi-annually and during and after a storm event. Records will be kept showing the date of monitoring, water elevation, culvert sedimentation build-up, debris at inlet and outlet, erosion, amount of recorded precipitation, and recent or required maintenance.

7.0 CAPITAL IMPROVEMENT PROGRAM AND FUNDING OPTIONS

This chapter summarizes the financial history of the stormwater utility, describes the financial policies, capital funding sources and provides a financing plan for the capital improvements along with the impact on rates and other fees.

7.1 SUMMARY FINANCIAL HISTORY

The City of Langley accounts for the stormwater utility within the combined Streets/Storm Drainage Fund 101. The revenues and expenditures for streets are combined with stormwater in this operating fund. For the purposes of this financial plan, an attempt has been made to identify and allocate stormwater-related revenue and expenditures in order to evaluate whether the utility is self-sufficient. Based on the allocation in Table 7-1, the stormwater utility has not been self-sufficient by approximately \$80,000-\$90,000 per year.

**Table 7-1
Summary History of Street/Storm Fund 101**

Street/Storm Drainage 101	2008	Percent	\$ Allocated to Storm			
	Budget	To Storm	2005	2006	2007	Budget 2008
<i>*Storm at 60% of Shared Expenditures*</i>						
Revenue						
Grants - TIB & STP	464,569	0%	0	0	0	0
Capron Refunds	104,684	0%	0	0	0	0
Street Fuel Tax	26,595	0%	0	0	0	0
Storm Services	24,349	100%	4,437	22,663	23,706	24,349
Misc. Revenue (ROW permit, interest)	700	0%	0	0	0	0
Trnsfr-In/Gen Fund (Fire Bdg/prop tax)	70,012	0%	0	0	0	0
Fire Hall Rent (part)	5,500	0%	0	0	0	0
Public Works Trust Fund Planning Loan	75,000	100%	0	0	15,000	75,000
Total Streets/Storm Revenue	771,409		4,437	22,663	38,706	99,349
Expenditures						
Street & Storm Maintenance	146,365	*60%	57,126	67,904	66,712	68,040
Transfers Out & Debt	81,934	*60%	37,061	37,646	42,233	60,936
Capital Projects/Improvements	560,870	0%/100%	0	0	9,994	65,000
Total Streets/Storm Expenditures	789,169		94,187	105,550	118,938	193,976
Annual Increase/(Use) of Reserves	(\$17,760)		(\$89,750)	(\$82,887)	(\$80,232)	(\$94,627)

Beginning Balance = \$64,000

The combined revenues include grants for pedestrian projects, a Public Works Trust Fund Loan (PWTF) loan for this comprehensive plan, Capron Refunds (street-related), street fuel tax, stormwater service charges, a transfer-in from the general fund property taxes and miscellaneous smaller amounts. Of these revenue sources, only the Stormwater service charges have been allocated to stormwater on an ongoing basis, along with the planning loan for this project. Shared expenditure line items, such as wages, benefits, equipment, supplies, etc. have been

allocated 60% to Storm. Debt and capital improvements were identifiable as either Street (grant-funded) or Storm. The bottom line indicates whether there is an increase or (use) of reserves for each year shown. Stormwater has not been generating sufficient revenue to meet its share of the allocated costs.

The Annual Increase/ (Use) of Reserves line at the bottom of Table 7-1 provides a quick view of whether the revenue was sufficient to meet the expenses in each year. If revenue exceeds expenses, then the reserves are increased, and if revenues do not meet expenditures, then the reserves are used to balance the year.

While Stormwater revenue has not been meeting the allocated 60% of shared expenses, the combined fund has been balanced. The result indicates that either the 60% allocation is too generous or that the Stormwater rates are too low. An allocation of 40% to Stormwater was also tested and resulted in smaller differences of \$50,000 to \$60,000 annually. The Stormwater rates are not sufficient to meet allocated costs even at 40% of shared expenses.

The combined Street/Storm fund has been successful at obtaining grant-funding for capital improvements that include a storm element. Two current projects for pedestrian improvements on Anthes Avenue and Camano Avenue are funded by TIB and STP grants. It is estimated that approximately 15-20% of the each project may be storm-related, however the grant funding does not differentiate on such projects.

The City has been averaging approximately 10 new residences per year.

7.2 CURRENT RATE STRUCTURE AND ACCOUNTS

There were 615 Stormwater accounts in 2008, including single family residential, multifamily, commercial, primary commercial with residential, public and undeveloped. The single family monthly rate is \$2.90 or \$34.80 per year, and has been in effect for some years. Table 7-2 shows the rate schedule as it appears in the City's annual fee schedule.

**Table 7-2
Storm Rate Schedule**

Storm Drainage Rate Schedule	Rate/Mo
Single Residential Developed	\$2.90
Residential Multifamily	\$3.50
Residential Multifamily over 2 units	\$6.00
Residential Undeveloped	\$1.50
Commercial Developed	\$4.00
Commercial Undeveloped	\$1.50
Dedicated Undeveloped	\$0.00
Acreage Developed	\$3.50
Acreage Undeveloped	\$1.50
Primary Residential w/ Commercial	\$2.90
Primary Commercial w/ Residential	\$4.00
Public Facilities	\$6.00

The City Council established the City Storm and Surface Water Utility Service Charge in 1991, with Ordinance No. 595. The 1994 Stormwater Comprehensive Plan indicates that the \$1.90/month rate was comparable with nearby communities of Mukilteo \$3.50/month, Anacortes \$1.50/month and La Conner \$2.00/month.

Table 7-3 shows the current monthly rates for the same nearby communities. This table indicates that all jurisdictions have increased their monthly rates by varying degrees. At \$2.90 per month, Langley is below the other cities range of \$4.00 - \$11.55.

**Table 7-3
Comparison of Single Family Monthly Rates**

Comparison to Other Jurisdictions	Monthly
La Conner	\$11.55
Mukilteo	\$7.85
Anacortes	\$4.00
Langley	\$2.90

There is no system development fee for Stormwater on new homes or construction.

7.3 OUTSTANDING DEBT

There are two issues of outstanding Storm-related debt. The first is a Public Works Trust Fund (PWTF) Construction loan of approximately \$178,000 for the Park Avenue interceptor project. There is currently \$93,910 principal remaining and the 20-year repayment will end in 2018.

The second outstanding debt issue is a PWTF Planning loan for the completion of this Stormwater Comprehensive Plan. The loan carries a six-year term with zero interest. It is estimated that \$90,000 will be drawn, and repaid by 2012. Annual payments in 2009-2012 are

estimated to be \$21,750. The repayment will be adjusted downward should the project be completed for less and funds returned.

7.4 STORMWATER FUNDING PRIORITIES

Stormwater service charges, or monthly rates, are the primary source of revenue for storm maintenance, operations, administration, debt, and capital improvements. The combined Street/Storm Fund includes other revenue sources that have been supporting the stormwater program.

The Stormwater utility has budgeted to make contributions toward two future equipment reserves. The City has an Equipment Maintenance Reserve (Fund 303) that is used to maintain and operate equipment throughout the City. Stormwater also budgets annual transfers to a vehicle/equipment reserve. The six-year financial plan includes stepping up these annual contributions similar to what was included in the recent sewer and water financial plans.

The combined Street/Storm Fund maintains a fund balance. Because Storm has not been covering its expenditures, the fund balance was assumed to belong to Streets.

7.5 CAPITAL IMPROVEMENT FUNDING

7.5.1 Capital Funding Sources

The City of Langley has successfully used a variety of capital funding sources for improvements in the past. These include Street-related grants for pedestrian improvements with a stormwater element or drainage improvements as part of road improvement projects funded by State and Federal grants through the State Transportation Improvement Board (TIB). Sewer-related sources may also apply to Storm such as the Department of Ecology Clean Water SRF loan, Utility Local Improvement District (ULID) bonds and assessments, a rate surcharge for debt repayment and rate reserves.

There are also other sources of capital funding available for storm. Grants and loans are available from the Washington State Department of Ecology (DOE) water quality program. These include Centennial Clean Water Fund, Clean Water State Revolving Fund (SRF) and Section 319 Non-point Pollution Program. Washington State also provides the Public Works Trust Fund (PWTF). The Public Works Board operates the PWTF within the Department of Community Trade and Economic Development. There have been some additional grants from DOE specific to stormwater, however they have been directed at communities required to meet Phase II NPDES requirements and Langley is not yet required to do so.

The PWTF has both construction and pre-construction loan programs. The pre-construction program is available year round and offers a five-year term that can be lengthened to a 20-year term if construction financing is secured within two years of the pre-con loan. The construction program encourages projects to be ready to proceed and thus the loans must be drawn within 36 months of approval. This is a competitive program with an annual application cycle in May of

each year, and funds typically available the following year. Recently the PWTF construction program has awarded its entire biennial allocation in the first year of the biennium (odd years). It will be important to target 2009/2011/2013 for applications if this funding source is to be used. The City has been successful with this program in the past.

DOE's water quality programs are also competitive with an application cycle in October of each year. There is one application for three or more programs. Early planning is recommended, as DOE requires certain approvals prior to application. The funds would be available the following year. The city has had success on the sewer side with these in the past. This funding may be appropriate for the outfalls identified in the CIP program.

Washington State is also pursuing the Puget Sound Partnership (PSP) with the goal of cleaning up Puget Sound. At this time, there are no new funding programs available but the City should continue to watch and be prepared to pursue grants if they should become available.

USDA-Rural Development (RD) provides grants and loan guarantees for sanitary sewer, drinking water, solid waste and storm drainage facilities in rural areas and cities or towns with population up to 10,000. These programs are open year-round. USDA-RD has met with the City and discussed funding for a combined water, sewer, storm project in Langley in the form of a grant/loan package with a 30-year term. This funding source should be pursued.

There is an infrastructure funding program database that is provided by the Infrastructure Assistance Coordinating Council (IACC). This can be accessed on the web directly at www.infracfunding.com or through the Public Works Board Website, www.pwb.wa.gov. This database is very helpful in determining which funding assistance programs may be available at the time the City is considering a project and how to contact the agencies.

7.5.2 Capital Improvement Funding Plan

In the previous chapter, Table 6-2 identified \$1,860,000 in recommended capital improvements for the six-year planning period. Table 6-3 identified another \$460,000 in recommended capital improvements for the 20-year planning period. The cost estimates were made in 2008 dollars. The City does not have the storm reserves on hand to fund these projects. It is assumed that grants and loans or bonds would be required to fund the projects, to be repaid with monthly rates.

7.5.3 Six-Year Capital Improvement Funding

The recommended six-year projects are primarily improvements to add or expand street drainage throughout the downtown portion of the City. These projects have been identified to fit in with the water and sewer improvements planned for the six-years to take advantage of savings that can be realized by completing combined projects.

After evaluating the cost of completing the six-year projects and the debt repayment impact on monthly rates, the six-year storm projects were further reviewed and split into two priority levels – 6-Year Priority and 6-Year Secondary, as presented in Table 7-4. The 6-Year Priority projects are those that must be completed along with the combined water and sewer projects. The 6-Year

Secondary projects are ones that are needed but the City is not willing to borrow additional funds at this time. It is anticipated that these projects may be funded with additional grants, cost savings from the priority projects, or further evaluated when the priority projects are complete.

**Table 7-4
Stormwater Capital Improvement Projects**

CIP Projects	6-Yr Priority	6-Yr Second	20-Yr CIP
Six Year CIP – Priority			
1. 6th Street - East of Anthes to Brookhaven Creek, 12"	190,000		
4. Edgecliff Drive - West of Furman Avenue, 12" to 18"	280,000		
5. Furman Avenue & Decker Avenue, 12"	490,000		
6. Intersection of Anthes & First Street, 4 catch basins	20,000		
10. Melson Alley (4 th to 6 th), 12"	130,000		
Six Year CIP - Secondary			
2. 2nd Street - to Cascade Ave, to Extension of 3rd Street, 12"		180,000	
3. Northview Subdivision - drainage & detention pond, 15"		70,000	
7. 6th Street -Anthes Avenue to Park Avenue, 12"		190,000	
8. 2nd Street -Park Avenue to Melson Alley, 12"		110,000	
9. Water Quality Treatment at 4 existing outfalls		200,000	
20-Year CIP			
11. Wharf Street, 12" & water quality treatment unit			60,000
12. 1st Street and DeBruyn Avenue, 12"			130,000
13. 2nd Street and DeBruyn Avenue, 12"			150,000
14. Edgecliff Drive - East of Furman Avenue to City Limits			120,000
Subtotal CIP Projects	\$1,110,000	\$750,000	\$460,000
Total CIP Projects	\$1,860,000		\$460,000

Because the City has already identified USDA-RD and other transportation grant funding as the preferred sources of funding for the water and sewer projects, similar assumptions were applied to storm. The City should be eligible for some portion of grant to be matched with a loan. USDA-RD uses a target of 25% grant to 75% loan however this is determined on an individual project basis depending on a number of community factors. The actual grant offer may be more or less. The loan funds are used first, with grant funds used last.

The recommended funding scenario is to pursue funding for the 6-Year Priority projects through a joint water/sewer/storm project with USDA-RD grant and loan funding. It is assumed that application and design could be during 2009, with construction in 2010 and debt repayment to begin in 2011. This would give the City two years to step rates up to meet operations before taking an additional step for new debt related to the priority capital improvements. Table 7-5 summarizes the 6-Year Priority Projects funding plan.

**Table 7-5
Six-Year Priority Projects Funding Plan**

Capital Funding Source: USDA-RD	25% Grant
6-Year Priority Projects (Proj.1,4,5,6,10)	\$1,110,000
Escalate to 2010	1,212,148
Est. Loan Principal After Grant	909,111
Annual Debt (Interest 4.5%, 30 Yr)	\$55,812
<i>Est. Monthly Impact to Support Debt</i>	<i>\$6.60</i>

Additional funding scenarios were developed for discussion. The original scenario included funding of the full six-year project list and resulted in an estimated monthly impact of \$10 - \$12. This was determined to be much too high and after a variety of scenarios and splitting the six-year projects into the two priority levels, the recommended funding scenario was developed.

With more focus on stormwater and Puget Sound cleanup in Washington State, additional grants should be sought for the projects that are not part of the combined water/sewer/storm project. In particular, #9 Water Quality Treatment at Existing Outfalls may be an excellent candidate for DOE water quality program grants with applications due each October.

The recommended projects were reviewed to determine whether it would be feasible to begin collecting a system development fee to help pay for the projects. This would be similar to the connection fees collected in water and sewer when new homes are constructed and connect to the system. The conclusion was that the projects are recommended to meet existing conditions and are not caused by new development. Therefore, a new system development fee is not recommended at this time.

7.6 SUMMARY STORMWATER OPERATING OUTLOOK

The six-year Stormwater outlook is summarized in Table 7-6. The annual test compares revenue and expenditures to determine whether the utility is increasing or decreasing its reserves in each year. If the Annual Increase/ (Use) of Reserves has (), then the utility will be decreasing or using reserves to balance the annual budget. There are no specific Stormwater reserves to be used.

**Table 7-6
Summary Stormwater Outlook**

City of Langley Storm Financial Outlook	PROJ. 2009	PROJ. 2010	PROJ. 2011	PROJ. 2012	PROJ. 2013	PROJ. 2014
Storm Revenue (Portion of 101)						
Storm Service Charges (existing rate)	24,523	24,697	24,871	25,045	25,219	25,393
Total Storm Operating Revenue	24,523	24,697	24,871	25,045	25,219	25,393
Storm Expenditures (Portion of 101)						
Operating Expense	104,651	112,516	120,821	129,607	138,923	148,824
Existing Debt Repayment	33,958	33,677	33,395	33,113	11,081	10,800
Total Storm Expenditures	138,609	146,193	154,216	162,720	150,004	159,624
<i>Net Operating Income</i>	<i>(114,086)</i>	<i>(121,496)</i>	<i>(129,345)</i>	<i>(137,675)</i>	<i>(124,785)</i>	<i>(134,231)</i>
<i>Est. Single Family Rate to Break Even</i>	<i>\$13.49</i>	<i>\$14.27</i>	<i>\$15.08</i>	<i>\$15.94</i>	<i>\$14.35</i>	<i>\$15.33</i>
New Debt for CIP			55,812	55,812	55,812	55,812
<i>Annual Increase/(Use) of Reserves</i>	<i>(114,086)</i>	<i>(121,496)</i>	<i>(185,157)</i>	<i>(193,487)</i>	<i>(180,597)</i>	<i>(190,042)</i>
<i>Est. Single Family Rate to Break Even</i>	<i>\$13.49</i>	<i>\$14.27</i>	<i>\$21.59</i>	<i>\$22.40</i>	<i>\$20.77</i>	<i>\$21.70</i>

The current revenue from existing stormwater rates is approximately \$25,000 per year. This is not sufficient to fund the allocated maintenance, operations and existing debt service payments of approximately \$140,000 per year. The current single family monthly rate of \$2.90 would need to be \$13.50 to \$15.00 to meet this program. In addition, the new debt for capital improvements would begin in 2011 and require an additional \$6.60 per month increase in rates.

It is clear that these are large impacts on the Stormwater rates. An effort has been made to phase in rate recommendations over the three years 2009-2011. This was done by scheduling the priority level projects for capital improvements and continuing a partial subsidy in the combined Streets/Storm Fund to allow stepping up of rates. Table 7-7 provides the recommended rate schedule.

**Table 7-7
Recommended Stormwater Monthly Rates**

ALT 4 Rate Stepping	2009	2010	2011	2012	2013	2014
<i>Continue with partial Street subsidy</i>	<i>30,000</i>	<i>2,000</i>		<i>10,000</i>		
Rate for Operations & Existing Debt	\$10.00	\$14.00	\$15.00	\$15.00	\$15.00	\$15.50
Rate for Debt-funded CIP			\$6.60	\$6.60	\$6.60	\$6.60
Recommended Monthly Rate	\$10.00	\$14.00	\$21.60	\$21.60	\$21.60	\$22.10

The financial outlook should be reviewed every two to three years or when borrowing funds for capital improvements to ensure that the rates are sufficient to meet obligations. Grants should be actively pursued in order to bring down the cost of the projects to the ratepayers.

An option for future consideration would be to adjust the Stormwater rate structure. Currently, the City charges a flat rate per parcel depending on the use of the property, such as residential, commercial, undeveloped, etc. A more common stormwater rate structure includes a flat rate for single family, and all other properties are charged based on the amount of impervious surface

area. The non-single family parcels would have measured impervious area divided into an equivalent service unit (ESU). For example, if the average single family parcel had 2,000 square feet of impervious area, and a sample commercial had 4,000 square feet, the commercial parcel would pay 2 times the single family ($4000 / 2000 = 2$ ESU). The result may be that there are more ESU's to pay for the program, thus reducing the cost per ESU. An analysis of the impervious area on each non-single family parcel would be needed to determine the potential for reducing the cost per ESU.

7.6.1 Detailed Six-Year Financial Plan

The summary financial outlook and recommended rates are presented earlier in this chapter. This detailed section is provided for information to allow the City to monitor its progress as it prepares for the annual budget.

The detailed six-year plan was developed based on the 2008 and preliminary 2009 budgets, several adjustments were made and future year revenue and expenses were projected using key assumptions. The key assumptions used in the rate model are shown in Table 7-8.

**Table 7-8
Key Assumptions in Rate Model**

Assumptions	
New Customer ERUs	10
Wage Escalation	5.0%
Fuel/Utilities Cost Escalation	20.0%
General Cost Escalation	3.5%
Construction Cost Escalation	4.5%

Attempts were made to be conservative in the projections (lower on revenues and higher on expenses) to avoid results that are not achievable.

Detail tables included:

- Table 7-9: Storm Outlook Detailed Six-Year Plan.
- Table 7-10: Storm Outlook Detail Page 2.
- Table 7-11: Storm Outlook – Capital Funding Scenarios.

**Table 7-9
Storm Outlook Detail – Six-Year Plan**

Storm Portion of Fund 101 Storm Revenue (Portion of 101)	2008	2009	2010	2011	2012	2013	2014	Comments
Storm Service Charges (existing rate)	24,349	24,523	24,697	24,871	25,045	25,219	25,393	# of new cust., 6 mo.
Total Storm Operating Revenue	24,349	24,523	24,697	24,871	25,045	25,219	25,393	
Storm Expenditures (Portion of 101)								60%
Wages	32,156	33,486	35,696	38,052	40,563	43,241	46,095	by wage escal+growth
Add'l Staff & Benefits								
Benefits	10,721	11,408	12,161	12,964	13,820	14,732	15,704	by wage escal+growth
Roadside Equipment	4,571	4,571	4,804	5,049	5,306	5,577	5,861	by general + growth
Engineering	10,724	10,680	11,225	11,797	12,399	13,031	13,696	by general + growth
Utilities/Phone	401	439	534	649	790	960	1,168	by fuel/util + growth
Storm Maintenance	1,083	1,500	1,577	1,657	1,741	1,830	1,924	by general + growth
Fuel & Maintenance	3,932	1,800	2,189	2,662	3,236	3,936	4,786	by fuel/util + growth
Travel & Training	300	300	315	331	348	366	385	by general + growth
Uniforms	240	210	221	232	244	256	269	by general + growth
Supplies	2,280	2,100	2,207	2,320	2,438	2,562	2,693	by general + growth
Office Rent	2,220	2,220	2,333	2,452	2,577	2,709	2,847	by general + growth
Storm Excise Tax	494	502	528	555	583	613	644	by general + growth
Operating Xfer to General Fund	27,297	31,234	32,827	34,501	36,261	38,110	40,054	by general + growth
Xfer to Equip Maintenance Reserve	1,200	1,200	1,400	1,600	1,800	2,000	2,200	ramp up by \$200/yr
Xfer to Vehicle/Equip Reserve	3,000	3,000	4,500	6,000	7,500	9,000	10,500	ramp up by \$1500/yr
Existing PWTF Loan Repayments /1	15,490	33,958	33,677	33,395	33,113	11,081	10,800	by debt sched.
Total Storm Expenditures	116,110	138,609	146,193	154,216	162,720	150,004	159,624	
<i>Net Operating Income</i>	<i>(91,761)</i>	<i>(114,086)</i>	<i>(121,496)</i>	<i>(129,345)</i>	<i>(137,675)</i>	<i>(124,785)</i>	<i>(134,231)</i>	
<i>Est. Single Family Rate to Break Even</i>		<i>\$13.49</i>	<i>\$14.27</i>	<i>\$15.08</i>	<i>\$15.94</i>	<i>\$14.35</i>	<i>\$15.33</i>	<i>Before Capital</i>
Storm Capital Revenue								
PWTF Planning Loan	75,000							
Total Capital Revenue	75,000	-	-	-	-	-	-	
Storm CIP Projects - Funded by Rates	65,000							
New Debt for CIP								
Total Capital Expenditures	65,000	-	-	55,812	55,812	55,812	55,812	USDA-RD 6-Yr Priority
<i>Annual Increase/(Use) of Reserves</i>	<i>(81,761)</i>	<i>(114,086)</i>	<i>(121,496)</i>	<i>(185,157)</i>	<i>(193,487)</i>	<i>(180,597)</i>	<i>(190,042)</i>	
Est. Single Family Rate to Break Even	\$9.74	\$13.49	\$14.27	\$21.59	\$22.40	\$20.77	\$21.70	Includes Capital

**Table 7-10
Storm Outlook – Detail Page 2**

Storm Outlook Detail	2008	2009	2010	2011	2012	2013	2014	Comments
1) Storm PWTF Debt Service								
PWTF - Park Ave Interceptor	12,490	12,208	11,927	11,645	11,363	11,081	10,800	ends 2018
PWTF Planning - Storm Comp Plan	3,000	21,750	21,750	21,750	21,750	-	-	ends 2012
Existing Storm Debt Service	15,490	33,958	33,677	33,395	33,113	11,081	10,800	
2) CIP Projects								
Storm Comprehensive Plan	65,000							
Six Year CIP – Priority		<u>6-Yr Priority</u>						
1. 6th St - East of Anthes to Brookhaven Creek, 12"		190,000						
4. Edgecliff Dr - West of Furman Ave ,12" to 18"		280,000						
5. Furman Ave & Decker Ave, 12"		490,000						
6. Intersection of Anthes Ave & First St, 4 catch basins		20,000						
10. Melson Alley (4th to 6th), 12"		130,000						
Six Year CIP - Secondary			<u>6-Yr Sec</u>					
2. 2nd St - to Cascade Ave, to Extension of 3rd St, 12"			180,000					
3. Northview Subdivision - drainage & detention pond, 15"			70,000					
7. 6th St - Anthes Ave to Park Ave, 12"			190,000					
8. 2nd St - Park Ave to Melson Alley, 12"			110,000					
9. Water Quality Treatment at 4 existing outfalls			200,000					
20-Year CIP				<u>20-Yr CIP</u>				
11. Wharf Street, 12" & water quality treatment unit				60,000				
12. 1st St and DeBruyn Ave, 12"				130,000				
13. 2nd St and DeBruyn Ave, 12"				150,000				
14. Edgecliff Dr - East of Furman Ave to City Limits				120,000				
Total CIP Projects	65,000	1,110,000	750,000	460,000	-			

**Table 7-11
Storm Outlook Detail – Capital Funding Scenarios**

Capital Funding Alt. 1 - USDA-RD Grant/Loan All 6-Yr CIP	1,860,000						
Escalate to 2009	1,953,000						
15% Local Match	292,950						
Assume USDA 15% Grant	1,660,050						
Term	30						
Interest Rate	4.5%						
Annual Debt	\$101,913						
<i>Est. Monthly Impact to Support Debt</i>	<i>\$12.05</i>						
Capital Funding Alt. 2 - Seek separate grant for outfalls	1,953,000						
Apply for grant: 9. WQ Treatment - 4 Outfalls	200,000						
USDA Grant/Loan for all other	1,753,000						
Assume USDA 15% Grant	1,490,050						
Annual Debt	\$91,476						
<i>Est. Monthly Impact to Support Debt</i>	<i>\$10.82</i>						
Capital Funding Alt. 3.a & b - 6-Year Priority Projects (Proj. 1,4,5,6,10) Escalate to 2010	15% Grant	25% Grant					
Est. Loan Principal After Grant	1,110,000	1,110,000					
	1,212,148	1,212,148					
	1,030,326	909,111					
Annual Debt	\$63,253	\$55,812					
<i>Est. Monthly Impact to Support Debt</i>	<i>\$7.48</i>	<i>\$6.60</i>					
Monthly Rate Scenarios	2008	2009	2010	2011	2012	2013	2014
ALT 3b Smoothing	\$2.90	\$13.50	\$17.60	\$21.70	\$21.70	\$21.70	\$22.00
Increase in Monthly SF Rate	\$10.60	\$10.60	\$4.10	\$4.10	\$0.00	\$0.00	\$0.30
ALT 4 Rate Stepping with 3b 25% grant	2008	2009	2010	2011	2012	2013	2014
Continue with partial Street subsidy	\$2.90	\$30,000	\$2,000	\$10,000	\$10,000	\$10,000	\$10,000
Rate for Operations & Existing Debt	\$2.90	\$10.00	\$14.00	\$15.00	\$15.00	\$15.00	\$15.50
Rate for Debt-funded CIP	\$6.60	\$6.60	\$6.60	\$6.60	\$6.60	\$6.60	\$6.60
Est. Monthly Rate this Scenario	\$2.90	\$10.00	\$14.00	\$21.60	\$21.60	\$21.60	\$22.10

8.0 REFERENCES

- Cantrell & Associates. Critical Areas Assessment Report: Wetland Buffer Mitigation Plan, Noble Creek Property Parcel B. 2005.
- City of Langley, Washington. Comprehensive Plan. December 2007.
- City of Langley, Washington. Critical Areas Ordinance 861. Date 2005.
- City of Langley, Washington. Critical Areas Ordinance 820. Date October 2002.
- City of Langley, Washington. Langley Six Year Transportation Improvement Plan. 2008.
- City of Langley, Washington. Land Use Inventory. 2007.
- City of Langley, Washington. Langley Municipal Code, Title 15, Building Construction. December 2003.
- Clear Creek Solutions, Inc. Western Washington Hydrology Model, Version 3. August 2006.
- FEMA. Flood Insurance Study. Flood Insurance Rate Map. Map 53029C0341E; Map 53029C0342E; and Map 53029C0345E. Island County, Washington. February 2007.
- Hammond, Collier & Wade – Livingstone Associates, Inc. Comprehensive Stormwater Management Plan. June 1994.
- Island County, Washington. Stormwater Design Manual. September 1998.
- NOAA Atlas 2, Volume 9 (1973)
- Puget Sound Action Team. Low Impact Development, Technical Guidance Manual for Puget Sound, January 2005.
- Puget Sound Action Team. Puget Sound Water Quality Management Plan (2000). December 2000.
- Puget Sound Action Team. Puget Sound Conservation & Recovery Plan (2005-2007). August 2005.
- Puget Sound Action Team. Sound Waves, Vol. 21, No. 1. Spring 2006.
- United States Department of Agriculture Natural Resource Conservation Service. Soil Survey of Langley, Island County, Washington. 2006.
- URS Corporation. Comprehensive Sewer System Plan. November 2006.

Washington Department of Ecology, Stormwater Management Manual for Western Washington. February 2005.

Washington Administrative Code (WAC). Chapter 173-200: Water Quality Standards for Ground Waters of the State of Washington; Chapter 173-201A: Water Quality Standards for Surface Waters of the State of Washington; and Chapter 173-204: 1995; Chapter 173-240: 2000; Chapter 400-12: 1996.

Washington State University Extension Pierce County. Rain Garden Handbook for Western Washington Homeowners. June 2007.