City of Arlington

Final

Comprehensive Stormwater Plan

October 2010

Credits

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URS Consultants conducted hydraulic and water quality modeling (Chapter 5) and contributed to early drafts of this document.

Katy Isaksen & Associates conducted the financial modeling and authored Chapter 11.

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1 INTRODUCTION

This Stormwater Comprehensive Plan (SCP) updates the City of Arlington's Final Draft Stormwater Management Plan (Barrett Consulting Group 1995). The update presents current conditions of the stormwater infrastructure in the city and Urban Growth Area (UGA), revises or adds hydraulic and water quality modeling, identifies issues and challenges facing stormwater utility management (infrastructure, operations, regulations, compatibility with landscape processes), and presents capital improvement project (CIP) options for stormwater management along with associated cost of each CIP option.

Note that, for clarity, the name of this document has changed from its predecessor "Management Plan" to "Comprehensive Plan". This distinguishes its functions as a long term planning tool for the policies, procedures, and capital facilities of the Stormwater Utility. It is distinct from the annual Stormwater Management Program (SWMP) work plans required under the NPDES Phase II permit that describe how the City will address its permit requirements in any particular year.

1.1 Background and Need

In 1995, the City developed its most recent SCP to address the management of stormwater quantity and quality issues, including local flooding and stormwater pollution problems. Since that time, the city has experienced many changes, including continuing land development, annexations, regulatory updates/additions, and improved inventories of its stormwater infrastructure and natural environment. These changes are extensive, and require that stormwater management within the City of Arlington be updated. A new evaluation of capital projects and funding mechanisms—to ensure that spending on capital facilities is focused on appropriate goals—is past due.

Selected development events and regulations occurring since the 1995 SCP are identified chronologically below.

- Listing of City of Arlington receiving waters, including various channels in the Stillaguamish and lower Snohomish basins, as having impaired water quality for multiple parameters and beneficial uses under CWA Section 303(d) in 1996, 1998, 2004
- Listing of the Puget Sound Chinook salmon (August 2, 1999) as federally-recognized threatened species under ESA
- Listing of the Puget Sound bull trout (November 1, 1999) as federally-recognized threatened species under ESA
- Acquisition of stormwater infrastructure with the Smokey Point annexation (2000)
- EPA-approved water clean-up plan (TMDL) for fecal coliform in the lower Snohomish basin (August 9, 2001),
- Creation of a stormwater utility and municipal regulation of stormwater impacts of new development and redevelopment with Ordinance number 1266, adopted September 4, 2001

- City recognized by the Arbor Day Foundation as a Tree City (2002), indicating a move toward recognition of the value of open space and low impact development in reducing stormwater impacts
- EPA-approved water clean-up plan (TMDL) for fecal coliform, dissolved oxygen, and other parameters in the Stillaguamish River and its tributaries (June 21, 2005)
- Revision of the City's Comprehensive Plan, adopted December 5, 2005
- Revisions to Underground Injection Control (UIC) program rules (173-218 WAC, adopted January 3, 2006), with loopholes which may allow stormwater recharge to contaminate groundwater used by the City for potable water supplies
- EPA-approved water clean-up plan (TMDL) for water temperature in the Stillaguamish River and its tributaries (September 11, 2006)
- Commence collection of a basic assessment from ratepayers to finance stormwater utility operations and maintenance (it is not the intent of this initial assessment to finance stormwater capital facilities) (September 2006)
- Issuance of the NPDES Phase II stormwater permit (January 17, 2007)
- Improved understanding of the hydrogeology under the City, including groundwater elevations, flow paths, and draft delineations of wellhead protection areas (Pacific Groundwater Group study published January 2007)
- Pending growth within the Brekhus/Beach annexation (annexed May 19, 2007)
- Listing of the Puget Sound Steelhead (June 11, 2007) as federally-recognized threatened species under ESA
- Revisions to Snohomish County's Critical Aquifer Recharge Area (CARA) regulations (SCC 30.62C), adopted (August 7, 2007)
- Completion of the City's first inventory of stormwater infrastructure concurrent with this comprehensive planning effort (2007)
- Significant population growth, particularly in recent years, from about 4,555 in 1992, to 7,480 in 1999, to 17,554 in 2009
- Increase in surface area of more than 50%, from about 3,750 acres in 1995, to about 5,902 acres in 2009
- Hiring of the City's first dedicated staff member at the technician level (2008)

1.2 Goals and Objectives

The intended audience for this SCP is the City of Arlington, and any stakeholders with whom the City might consult to support the planning process (e.g., an advisory committee). The SCP meets the following goals:

- Summarize existing conditions: Describe the existing stormwater drainage systems, management programs, and stormwater related issues affecting the planning area

- Integrate historic and current stormwater issues: Present a complete inventory of past and present issues so that comprehensive, efficient, and cost-effective solutions may be developed; this in itself is an educational tool for staff and the general public

- Protect public health and safety

- Limit damage to public or private property
- Preserve and enhance natural resources, including salmon and other aquatic habitat
- Improve recreational uses of surface waters
- Minimize long-term expenditure of public funds
- Project development: Develop comprehensive, efficient, and cost-effective solutions to identified problems; use of bioengineering and low impact designs where possible
- Prepare a rate plan for support of project implementation

As mentioned previously in this section, the SCP is not to be confused with the separate Stormwater Management Program (SWMP) required under the NPDES Phase II Municipal Stormwater Permit. The SWMP will serve as an annual work plan to meet permit requirements. Neither should the SCP be confused with any operations and procedures manual(s) that may be developed to govern day-to-day operations and maintenance activities, including those established by ordinance, such as: the City's adopted Stormwater Manual (Ecology 2005); Engineering Standards (City of Arlington 2008); and Draft Stormwater Credit Manual (City of Arlington 2006).

1.3 Planning Area

This SCP focuses primarily on stormwater infrastructure and management in those areas currently within the city limits and those located within the Growth Management Act (GMA) urban growth area (UGA) boundary (Map 1). While not currently within the city limits and the UGA, basins west (downstream), south (downstream), and southeast (upstream) of Arlington are included in the SCP planning area (Map 1). These areas also contribute stormwater runoff to the streams and aquifers by which the City benefits, and for which the City is partly responsible. Portions of these drainages are also likely areas for future growth. Stormwater planning for the city should take into account both the current and future land uses in these basins. Within this document, "planning area", "SCP study area", and similar terms are intended to be synonymous to the area shown in Map 1; no distinction between terms is intended.

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2 KEY STORMWATER MANAGEMENT ISSUES

Five key issues were identified during development, and anticipated during implementation, of this SCP: urban drainage, stormwater permitting, water clean-up plans, aquifer protection, and protection of endangered species. For each issue, this section presents an issue summary, the institutional context identifying the primary stakeholders, and the regulatory context containing various legal requirements. These issues form the basis for the hydrologic and hydraulic modeling, stormwater monitoring, habitat protection, stakeholder involvement activities and improvement projects developed in the remainder of this plan.

2.1 Urban Drainage and Flood Damage

2.1.1 Issue Summary

The drainage problems that have been observed throughout the City of Arlington are relatively minor and most commonly affect localized areas such as road intersections and commercial parking lots. Less common is flood damage to properties along extended lengths of the small stream corridors within the City (primarily Portage and Edgecomb Creeks and their tributaries). Flooding within the City associated with high flows in the mainstem Stillaguamish and South Fork Stillaguamish Rivers has been limited to a few properties along the south bank inundated for short durations. With the annexation of Island Crossing the City has significant modeling and flood analysis to complete in order to properly design and permit stormwater systems in the floodplain environment. The North Fork Stillaguamish River has experienced a continuous increase in peak flood flows over the past several decades and that trend is expected to add to flood hazard concerns.

The risks of flood damage and unsafe traffic conditions during storm events in the City are greatest when warm, heavy rains fall on accumulated snow after larger snowstorms. These events are often associated with La Nina conditions in the South Pacific Ocean, and “Pineapple Express” events delivering tropical moisture rapidly to the Pacific Northwest. The floods of 1996 and 1997, considered by many locals to be the worst in recent memory, were rain-on-snow events generated by La Nina conditions. See also the climate discussion in Section 3.1.1.

A number of the areas with existing flooding problems may best be corrected through the development and implementation of specific capital improvements. Problem areas are identified in this SCP in Sections 4 (Basin Conditions) and 5 (Modeling), with corrective actions proposed in Sections 9 (Project Summaries) and 10 (Capital Improvement Program).

As the city grows and more areas are developed, problems could be exacerbated due to conversion of forested areas and undeveloped land to urban uses, and increases in impervious areas. These problems will likely require programmatic solutions, which are expressed in a stormwater management program developed by the Stormwater Utility, other City staff, and other affected stakeholders. The issues below are likely to require programmatic solutions; most are addressed within Section 6 (Regulatory Requirements, Policies, and Procedures) of this SCP.

- Protection of wetlands and forested areas. Conditioning development to provide for preservation of the hydrologic functions of wetlands and forested areas could reduce the need for capital-intensive drainage improvements. Adoption of Low-Impact Development (LID) policies (scheduled for 2010) could also promote this concept. If these measures are ineffective, additional restrictive or mitigative measures may be required to protect these resources.

- Design standards. The City will adopt the Western Washington Stormwater Manual (Ecology 2005) in 2010. Design and construction standards for development and redevelopment will change from the previous manual (Ecology 1992), requiring self-monitoring to assure the compulsory changes in City policies and procedures are implemented as required. Inadequate design or construction of some existing drainage system facilities may be contributing to flooding. In some places, city easements have been encroached upon, making maintenance difficult. Education and training opportunities for developers and contractors in LID practices are lacking.

- Plan reviews, inspection of construction sites, and enforcement within the fledgling Stormwater Utility may be limited due to staffing constraints and the scope of current stormwater ordinances.

- Maintenance and operations for the stormwater functions in the City are distributed among multiple City departments and may not be implemented in the most efficient manner. Though scheduling does occur, maintenance often occurs in a localized manner, often in response to a specific problem or complaint (e.g., when inlets become blocked with leaf-fall or debris; when snow removal efforts are overwhelmed).

- The regional nature of problems may not be recognized and addressed (e.g., with flood water received from an upstream entity or discharged to a downstream entity.

- The introduction of engineered stormwater systems within natural stream corridors results in impacts to aquatic habitats and species. Using low impact development (LID) techniques to maintain natural runoff processes to the maximum extent practicable is desirable.

2.1.2 Institutional Context

City departments and other entities that may affect or be affected by the resolution of this issue include, but are not limited to, those below.

- **Public Works Maintenance & Operations:** Road maintenance and facility management practices that would help reduce stormwater pollution.

- **Public Works Utilities:** Management of stormwater runoff associated with construction and new development. Storm facility inspections and enforcement. Developer education and training programs.

- **Public Works Engineering:** Development and implementation of stormwater standards and specifications. Road and storm facility construction.

- **Community Development Planning:** Continued coordination with ongoing infrastructure planning in the planning area in accordance with GMA requirements. Development of low impact development (LID) regulations. Development of joint regional stormwater management facilities, where feasible.

- **Community Development Natural Resources:** Improved education of the Public Works staff on the impact of programs on the fish and wildlife that depend on the water resources, and the spatial and temporal relationship with stormwater management.

- **Washington State Department of Transportation (WSDOT):** Several of the roads passing through Arlington are state highways. Any SCP recommendations regarding maintenance of or repairs to these highways require the involvement of WSDOT. When the City's population increases to 25,000, the City will assume the State's responsibility for state road maintenance in the city.

- **Washington State Department of Ecology (Ecology):** Ecology has provided Centennial Clean Water Fund grant money for implementation of the SCP, and ultimately must approve SCP recommendations. Ecology also administers other surface water and groundwater quality protection programs which affect the City's water, wastewater, and stormwater utilities.

- **Washington State Department of Fish and Wildlife (WDFW):** The City of Arlington has to apply for and receive a Hydraulics Permit Authorization prior to completing any work within the OHWM of waters of the state. The City will pursue a programmatic Hydraulics permit that will provide 5-year intervals between seeking state approval.

- **Puget Sound Regional Council (PSRC) Plan 2040:** The PSRC guides the development of our area through the establishment of comprehensive plans and a vision set out in the Plan 2040 document. The City submits its Comprehensive plans to the Dept. of Commerce to assure compliance with Plan 2040 and the Growth Management Act.

2.1.3 Regulatory Context

The Washington State Legislature enacted the Growth Management Act (GMA) in 1990. The GMA specifies a comprehensive framework for counties, cities, and towns to follow in managing growth and coordinating land use with infrastructure. This framework includes:

- Designation of critical areas, including aquifer recharge areas (which may coincide with wellhead protection areas), frequently flooded areas, and wetlands

- Designation of conservation and natural resource lands

- Adoption of county-wide planning policies that provide a general framework for regional planning
- Adoption of interim UGA boundaries and interim development regulations
- Adoption of city comprehensive plans, including capital facilities elements and implementing regulations
- Adoption of a final UGA as part of the County's comprehensive plan, which will establish the county-wide UGAs

At a regional level, Snohomish County began this process with the adoption of county-wide planning policies and adoption of UGA boundaries.

Many of the land use and policy decisions the City has made in its comprehensive plans under the GMA affect the SCP, 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 SCP identifies areas of poor drainage or other conditions that cannot be cost-effectively solved by stormwater system improvements.

2.2 National Pollutant Discharge Elimination System Phase II Municipal Stormwater (NPDES II) Permit

2.2.1 Issue Summary

The City of Arlington has long been accustomed to managing its water and wastewater utilities to meet Federal and State regulations that ensure the health and welfare of its citizens, and the protection of its water resources. Effective February 2007, the City's stormwater utility is now regulated to operate its municipal separate storm sewer systems (MS4s) under the NPDES II permit (Ecology 2007). Stormwater runoff is identified as a discharge of wastes to rivers and streams, and the City is "permitted to pollute" only within certain limits, and subject to specific program requirements.

Although elements of the following program areas are not new, they will change how the City does its stormwater business, and will affect many departments within the City:

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

- Pollution reduction and monitoring

The permit is renewable every five years. During this first permit cycle, Ecology, the State agency which administers the permit, allows many of the permit conditions to be phased in over time. However, the City is required to prepare a Stormwater Management Program (SWMP) early in the permit cycle that will guide how it will develop and implement its work plan for meeting the permit conditions. The current SWMP identifies a number of significant efforts for obtaining permit compliance, including: public education and outreach programs, ordinances, infrastructure inventories and inspections, enforcement, expansion of maintenance programs, and monitoring.

Despite the latitude within the permit for phasing implementation of the various requirements, permit compliance remains a significant staffing and financial effort. Accordingly, this SCP provides the basis for funding of activities required by the program elements of the NPDES Phase II permit.

2.2.2 Institutional Context

City departments and other entities that may affect or be affected by the resolution of this issue include, but are not limited to, those below.

- **Public Works Maintenance & Operations:** Modifications to good housekeeping procedures and maintenance schedules

- **Public Works Utilities:** Development of public education and outreach programs. Implementation of an illicit discharge detection and elimination program. Management of stormwater runoff associated with construction and new development. Storm facility inspections and enforcement.

- **Public Works Engineering:** Development and implementation of stormwater standards and specifications consistent with the Phase II permit. Adoption of ordinance(s) that govern construction and reconstruction practices. Road and storm facility construction,

- **Community Development Planning:** Adoption of ordinances governing the relationship and responsibilities of the City, neighborhood low impact design, homeowners' associations, and private enterprise with regard to stormwater.

- **Community Development Permit Center:** Changes in permitting practices. Education of developers and project proponents with regard to stormwater requirements.

- **Natural Resource Management:** Impacts of stormwater management on natural resources including fish and wildlife habitat. In particular, stormwater planning and compliance with the City's Endangered Species Act Response Plan. Also, coordination with watershed recovery plans, review of Arlington's plans by the Stillaguamish Technical Advisory Group, and the Puget Sound Partnership Action Agenda.

- **City recreation and maintenance programs:** City facilities including parks, the airport, the cemetery, streets, and vehicle maintenance might be affected by recommendations for revisions to landscape requirements, landscape maintenance, weed/pest control practices, equipment/material storage practices, street sweeping and disposal practices, and pet waste management. Specifically the retention and reintroduction of trees will play a major role in addressing stormwater management. Planning for large community events should consider stormwater impacts.

- **City of Marysville:** The permit requires cooperative efforts with neighboring jurisdictions, where feasible. Opportunities for coordinated programs and shared facilities with the City of Marysville in the Quilceda watershed should be considered.

- **Washington State Department of Ecology (Ecology):** Ecology administers the City's NPDES Phase II municipal stormwater permit, and other state surface water and groundwater quality protection programs, including total maximum daily loads (TMDLs), and the NPDES Industrial and Construction Stormwater General Permits.

- **Stillaguamish Tribe:** The Tribe has interests in protecting the natural resource base and is involved with many aspects of salmon restoration that relate to stormwater, including water quality monitoring, inventorying of fish passage blockages, and restoration of streams and wetlands.

- **Watershed Groups:** The permit requires cooperative efforts with entities active in promoting watershed health. Citizen and business groups such as the Stilly-Snohomish Fisheries Enhancement Task Force (SSFETF), Stillaguamish Watershed Council (formerly the Stillaguamish Implementation Review Committee [SIRC]), Stillaguamish Clean Water District (CWD), and the Allen-Quilceda Watershed Action (AQWA) Team are active in protecting and rehabilitating fish habitat. They are involved with several activities related to stormwater management, including storm drain stenciling, water quality monitoring, instream habitat projects, and riparian plantings and maintenance.

2.2.3 Regulatory Context

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 Ecology. 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 population currently served by the City's MS4 is approximately 17,500 (see Section 3.2.1). It expires on February 15, 2012. In this SCP, NPDES requirements are addressed further in Sections 6 and 9.

2.3 Total Maximum Daily Loads

2.3.1 Issue Summary

When Washington State's surface water quality standards are not being met in certain streams or lakes, Clean Water Act Section 303(d) requires that the impaired water bodies be identified. Once this is done, the State prepares a water clean-up plan each water body, including a quantification of the total maximum daily load (TMDL) of pollutants the water body can handle and remain within water quality standards. The TMDL process includes the identification of current contributors of pollutants that lead to the impairment of the receiving waters.

In and near the City of Arlington, a number of stream and river segments are identified as impaired, and three water clean-up plans are in place for a number of priority pollutants, particularly fecal coliform, dissolved oxygen, and temperature (Svrjcek 2003; Svrjcek and Lawrence 2007). In all TMDLs, the City is identified as a contributor to these impairments, either through point discharges from its wastewater treatment plant, or point and nonpoint discharges of stormwater, or both. With regard to stormwater, the City has specific responsibilities with regard to clean-up and monitoring efforts intended to restore water quality. The NPDES Phase II permit (see Section 2.2) is the regulatory authority for implementing TMDL requirements.

2.3.2 Institutional Context

City departments and other entities that may affect or be affected by the resolution of this issue include, but are not limited to, those below.

- **Public Works Utilities:** Development of public education and outreach programs. Implementation of an illicit discharge detection and elimination program. Preparation of a bacterial pollution control plan. Routine monthly monitoring of receiving water quality. Event-based monitoring of stormwater runoff quality. Special water quality studies. Operation of the WWTP to meet its NPDES permit discharge conditions.

- **Public Works Maintenance & Operations:** Modifications to maintenance procedures and schedules may be required as the result of monitoring or special studies.

- **Community Development Planning:** Consider evaluation and/or adoption of a pet waste ordinance, critical areas ordinance, Low Impact Development (LID) regulations, tree retention requirements, etc. that may be required for achieving clean-up objectives.

- **Natural Resource Management:** Impacts of stormwater management on natural resources. In particular, stormwater planning and compliance with the City's Endangered Species Act Response Plan, and coordination with watershed planning efforts.

- **City recreation and maintenance programs:** Expansion or modification of landscape maintenance practices, including weed/pest control, tree retention, equipment/material storage practices, street sweeping and disposal practices, and pet waste management.

- **City of Marysville:** Cooperative monitoring and other clean-up efforts should be evaluated with the City of Marysville in the Quilceda watershed.

- **Snohomish County:** Since the County is also identified in the TMDLs as a contributor to water quality impairment, cooperative monitoring and other clean-up efforts should be evaluated with Snohomish County Surface Water Management in drainage basins shared by the city and county. Recommendations for stormwater policies and procedures in these basins may be made in the Snohomish County Comprehensive Plan through Planning and Development Services. Imperative to that effort is the continued reduction of impacts from the agricultural community that directly affect dissolved oxygen, temperature and fecal coliform in area streams and rivers.

- **Washington State Department of Transportation (WSDOT):** Since WSDOT is also identified in the TMDLs as a contributor to water quality impairment, cooperative monitoring and other clean-up efforts should be evaluated with them.

- **Washington State Department of Ecology (Ecology):** Ecology is the primary author of the TMDLs affecting the City. It maintains ongoing monitoring stations in the Stillaguamish and Snohomish basins, and is active in continuing water quality studies with the City as a cooperator. Ecology has TMDL enforcement authority under the NPDES Phase II permit. The Department ultimately must approve SCP recommendations.

- **Stillaguamish Tribe:** The Tribe was active in development of the water clean-up plans and maintains a number of monitoring sites throughout the Stillaguamish basin. It is active in the protection and restoration of aquatic and riparian habitats, including many sites within the City of Arlington.

- **Watershed Groups:** Citizen and business groups such as the Stilly-Snohomish Fisheries Enhancement Task Force (SSFETF), Stillaguamish Watershed Council (formerly the Stillaguamish Implementation Review Committee [SIRC]), Stillaguamish Clean Water District (CWD), and the Allen-Quilceda Watershed Action (AQWA) Team are active in monitoring and the implementation of many restorative measures identified in the TMDLs

2.3.3 Regulatory Context

2.3.3.1 <u>State Water Quality Standards</u>

Washington Administrative Code (WAC) 173-201A defines surface water quality standards for different classes of rivers, streams, lakes, and wetlands in the state of Washington. These standards are intended to protect and maintain the beneficial uses of those water bodies. Water bodies throughout the state have been classified according to their beneficial uses and the water quality required to support those uses. Surface water quality standards for specific rivers and streams within and near Arlington are addressed in greater detail in Section 3.1.7.

Under WAC 173-200, Ecology has established groundwater quality standards. The standards are designed to protect existing and future beneficial uses of groundwater through the reduction or elimination of the discharge of contaminants. The chapter defines water quality standards for all groundwater in the state. The anti-degradation policy prohibits degradation of any groundwater that currently has better water quality than its designated standards. The chapter also allows for designation of special groundwater protection areas based on unique characteristics (e.g., recharge areas, wellhead protection areas, sole source aquifers).

WAC 173-200 and 201A affect the management of stormwater discharges to both surface water and groundwater; consequently, the City's stormwater planning effort considers the state water quality standards in its stormwater monitoring, assessment, and control recommendations. For example, exceedences (violations) of standards are used to focus selection of monitoring parameters, sites, and best management practices.

2.3.3.2 Federal Clean Water Act Total Maximum Daily Load (TMDL) Requirements

Section 303 of the Clean Water Act requires states to promulgate water quality standards and identify waters that are not meeting these standards. Specifically, Section 303(d) requires the states to identify impaired and threatened water bodies and submit a list of these water bodies to the EPA every two years.

When an estuary, lake, or stream is listed as impaired or threatened, and technology-based effluent limitations or other legally required pollution control mechanisms (e.g., existing permitting approaches) are not sufficient or stringent enough to achieve the water quality standards, the Clean Water Act requires establishment of a TMDL (a clean-up plan) for that water body. The TMDL includes an analysis of how much pollution a water body can receive and still remain healthy for its intended beneficial uses (e.g., recreation, industrial, water supply, aquatic life support). The TMDL must specify controls needed to prevent or limit pollution, and a monitoring plan to test the effectiveness of the controls.

The following TMDLs for water bodies within the City of Arlington have been promulgated:

- Lower Snohomish Tributaries Fecal Coliform Bacteria TMDL: this TMDL applies in part to the Quilceda Creek basin, the upper portion of which lies within the City, including Edgecomb Creek, a Quilceda Creek tributary.
- Stillaguamish River Temperature TMDL
- Stillaguamish River Multi-Parameter TMDL: this TMDL addresses fecal coliform bacteria, dissolved oxygen, pH, arsenic and mercury in the Stillaguamish River and some of its tributaries including Portage Creek and March Creek.

The Lower Snohomish River Tributaries Fecal Coliform Bacteria TMDL (Svrjcek 2003) targets reductions in bacteria concentrations in Edgecomb Creek at 67th Avenue to specified seasonal levels. These targets constrain the City of Arlington to improve the quality of its stormwater runoff in the south-central area of the City. The TMDL specifies educational programs, targeted BMP implementation, and monitoring as City programs needed to achieve reductions in bacterial loading.

The Stillaguamish River Temperature and Multi-Parameter TMDLs have been combined into one Water Quality Implementation Plan (Svrjcek and Lawrence 2007). This document specifies the overall goal and timeframe for meeting the fecal coliform, dissolved oxygen, and temperature criteria and nutrient reductions, and identifies the types of corrective measures that will be taken. For Arlington, wasteload allocations (WLAs) are established for the Wastewater Treatment Plant for temperature and fecal coliform. Ecology's strategy for stormwater runoff and other nonpoint sources is the implementation and evaluation of land use controls, including development of programs and ordinances to manage pet waste, fertilizers, sediments, and private stormwater systems; evaluation of onsite septic systems; evaluation of wastewater conveyance systems; and promotion of high design standards and critical areas ordinances. The strategy also supports programs that will encourage water conservation and protection of instream flows, and voluntary planting of riparian vegetation to provide effective shade when mature.

Washington's municipal stormwater discharge permit explicitly requires the City to comply only with the TMDL governing Quilceda Creek (Ecology 2007). Compliance with TMDLs for the Stillaguamish River and its tributaries will not be required until the second permit cycle beginning in 2012. However, the City has been active in development of these TMDLs and intends to meet its obligations under the Stillaguamish TMDL Implementation Plan under the current permit cycle (Svrjcek and Lawrence 2007). The City (and all jurisdictions in Washington State) is faced with the potential of future pollutants such as copper, phosphorous and endocrine disrupters being added to the list as they are documented to violate water quality standards or cause harm to fish.

TMDLs are addressed further within this SCP in Section 3.1.7 and Appendix A.

2.4 Aquifer Protection

2.4.1 Issue Summary

The City operates several municipal water supply wells and has plans to develop additional wells in the future. Water supply opportunities for meeting the demands of population growth in the Puget Sound region are becoming increasingly limited. Instream flow rules and the closures of drainage basins to the allocation of new water supplies severely restrict expansion or modification of the City's water sources. Accordingly, the City's objectives for protection of its existing (and future) groundwater sources influence many city operations, including stormwater policies and practices.

The City's wells are situated in two different areas of the City with different hydrogeologic characteristics as described below.

Three wells composing the Haller wellfield are situated at the north end of the City in the Old Town 4th tier basin (see basin hierarchy in Section 3.1.3). Only about 50 feet from the Stillaguamish River, and screened from about 24 to 36 feet below the ground surface (bgs), the wells draw most of their water from the river through valley alluvium. A smaller volume is derived from recessional outwash soils on the upper riverbank. Other wells may be drilled within about a quarter mile of the existing wells in the future. Because of the strong surface water influence and shallow well depths in an unconfined aquifer, the Washington State Department of Health's Source Water Assessment Program (SWAP) has identified the Haller wellfield as highly susceptible to contamination (DOH 2009).

The airport wellfield is centered around the airport in the Marysville Trough landform of the Middle Fork Quilceda 4th tier basin (see basin hierarchy in Section 3.1.3). Airport Well 1 is completed and screened from 151 to 181 feet bgs in the advanced outwash aquifer. A test well drilled in anticipation of one or more additional wells on the airport wellfield is completed and screened from 155 to 178 feet bgs in the same aquifer. Future wells would probably be drilled north of 172nd Street up to and including the airport infield. Because well depths exceed 150 feet bgs in an unconfined aquifer, the SWAP has identified the airport wellfield as moderately susceptible to contamination (DOH 2009).

The City's wellhead protection and watershed control plan is still under development, but several issues for consideration in this SCP are understood. In general:

- High quality municipal water supplies are critical to the quality of life in the City of Arlington, including: maintaining the health of its citizens; fostering a vibrant economy; and controlling the cost of its water acquisition and treatment.
- The quality and health of the rivers and all tributaries within and near the city—whether real or perceived—affect all city utility operations (stormwater, wastewater, water) and the quality of life of its citizens
- Excellent groundwater quality is critical to existing and future municipal water supplies and deserves protection.
- Infiltration as a stormwater management technique has both advantages (e.g., treatment and dispersal of stormwater, protection of surface water quality and stream channel conditions) and risks (groundwater and aquifer contamination, potable water treatment costs)

More specifically, these issues include:

- High quality municipal water supplies originating from the Haller wellfield require excellent water quality in the Mainstem and South Fork Stillaguamish Rivers, which in turn are influenced by stormwater and non-point source pollution from the City of Arlington.

- The Butler and Talcott outfalls currently discharge stormwater from the two largest basins without treatment (284 and 67 acres, respectively) to the mainstem and South Fork, respectively.
- The Centennial Trail basin includes a ditch which typically infiltrates all stormwater adjacent to the Haller wellfield prior to its outfall at the mainstem river.

- High quality municipal water supplies originating from the airport wellfield require excellent water quality in the Marysville Trough, which in turn is influenced by stormwater infiltration near and up-gradient from (south and east of) the City's airport.
  - Industrial stormwater permits are generally not required for discharges to ground (as opposed to surface waters), and definitions within the Underground Injection Control code (173-218 WAC) may allow for infiltration of contaminated stormwater without any regulatory controls.
  - Infiltration as a stormwater management technique conflicts with groundwater protection objectives, particularly up-gradient of the airport wellfield, where soils are porous for great depths and the water tables is close to the surface. Urban stormwater pollutants, including aviation fuel, cannot be introduced to a municipal drinking water supply.

To address these issues, the SCP incorporates appropriate safeguards for the protection of source water from contamination by stormwater.

2.4.2 Institutional Context

City departments and other entities that may affect or be affected by the resolution of this issue include, but are not limited to, those below.

- **Public Works Utilities:** Maintenance and monitoring of the storm sewer system, and stormwater treatment. Implementation of wellhead protection and watershed control programs, including adoption of a wellhead protection ordinance. Planning and development of stormwater management (infiltration) facilities to avoid potential contamination of municipal water supply wells, private wells and prospective, undeveloped municipal water sources. Storm facility inspections and enforcement during and after construction.
- **Airport:** Revision and implementation of wellhead protection and stormwater infiltration requirements for the airport well field could affect operations at the City's airport. Airport master planning should evaluate stormwater effects on existing and future water supplies near the airport.
- **Community Development Planning:** Implementation of wellhead protection and stormwater infiltration requirements associated with zoning and land use codes.

- **Community Development Permit Center:** Changes in permitting practices. Education of developers and project proponents with regard to wellhead protection and stormwater requirements.

- **Natural Resource Management:** Impacts of stormwater management on natural resources. In particular, development and implementation of critical areas regulations for critical aquifer recharge areas. Groundwater provides base flow supply to streams necessary for the survival of aquatic species.

- **City recreation and maintenance programs:** Expansion or modification of landscape maintenance practices, including weed/pest control and equipment/material storage practices.

- **Washington State Department of Ecology (Ecology):** Ecology also administers the City's NPDES Phase II municipal stormwater permit, and other state surface water and groundwater quality protection programs, including Underground Injection Control (UIC), and the NPDES Industrial and Construction Stormwater General Permits.

- **Washington State Department of Health:** The Washington State Department of Health administers the state Wellhead Protection Program intended to protect drinking water supplies.

2.4.3 Regulatory Context

2.4.3.1 Federal Safe Drinking Water Wellhead Protection Requirements

Section 1428 of the 1986 Amendments to the Safe Drinking Water Act mandates that every state develop a wellhead protection program. In Washington, the State Department of Health has been designated as the lead agency for wellhead protection program development and administration. The federal regulations require the City to implement a wellhead protection program for its groundwater sources as well as a watershed control plan for its sources influenced by surface waters. The City is not subject to sole source aquifer regulations (SDWA Section 1424(e)).

In Washington State, local well head protection programs must include the following elements:

- A delineated wellhead protection area for each well, wellfield, or spring

- An inventory within the wellhead protection area of all potential sources of groundwater contamination

- A management plan to reduce the likelihood that potential contaminant sources will pollute the drinking water supply

- Contingency plans for providing alternate sources of drinking water in the event that contamination does occur

- Inclusion of public participation while the program is developing

The SCP addresses wellhead protection further in Section 3.1.4.4, and integrates wellhead protection requirements into its stormwater recommendations in Sections 4 and 9 (as appropriate, but without development of an actual plan). Issues identified include the potential impacts of stormwater discharges reaching its municipal water supply wells and the City of Marysville Ranney well (downstream of Old Town Arlington stormwater outfalls).

2.4.3.2 State Underground Injection Control Program Requirements

The City of Arlington MS4 discharges stormwater both to waters of the United States and to groundwater (i.e., portions of the city drains to infiltration systems). Ecology has developed guidance to implement long-standing regulations related to the control of discharges to groundwater, including Class V wells (Ecology 2006). Many infiltration systems meet the definition of a Class V injection well, and are thus regulated under this program. UIC requirements provide for varying thicknesses of required unsaturated vadose zone above the seasonal high groundwater table, depending on soil type. City development guidelines and/or stormwater disposal practices will need to be evaluated and modified in certain areas to comply with these regulations, and all infiltration facilities meeting the definition of a Class V well will need to be registered with Ecology. This UIC evaluation and consistency determination is outside the scope of this SCP; the effort is identified as a stormwater program requirement in Section 6.

2.4.3.3 State Instream Flow Setting Program

Ecology's Water Resource Program, through its Instream Resource Protection Program (IRPP), establishes minimum instream flows and/or closes basins to further appropriations of water as necessary to protect aquatic habitat and maintain channels in their natural form. Instream flows and basin closures condition new and modified water rights permits, potentially prohibiting further water withdrawals in some cases. Stormwater management policies and practices designed to encourage groundwater recharge can potentially reduce the typically negative impact of development on instream flows. However, infiltration and recharge practices need to consider and balance the risks of groundwater contamination.

The entire SCP study area is contained in basins with instream flows or basin closures. The Quilceda watershed was closed under a surface water source limitation on June 10, 1946. This closure was administratively incorporated into WAC 173-507 in 1979. The entire Stillaguamish basin was closed and instream flows established with a priority date of September 26, 2005 under the Stillaguamish Instream Flow Rule (WAC 173-505). No reservations of water for the purposes of municipal water supply were allotted under the instream flow rule.

2.5 Endangered Species Act

2.5.1 Issue Summary

The City has recently been implementing land use actions that do not conflict with the landscape processes that provide mutually beneficial function of stormwater management and aquatic habitat. The separation of engineered stormwater systems and natural streams when possible reduces the impacts to aquatic habitats. However, fish habitat in the smaller tributaries has suffered severe damage as a result of historic stormwater design and maintenance practices. There has been excessive erosion, sedimentation, removal of vegetation and loss of large woody debris habitat structure. The same solutions implemented to reduce urban flood damage can also protect and restore fish habitat preventing other species such as coho salmon and cutthroat trout from becoming listed under the Endangered Species Act.

Opportunities to remove fish passage blockages and restore wetlands and riparian and aquatic habitat, in coordination with the City's Endangered Species Act Response Plan (City of Arlington 2000), will be considered in evaluation of potential stormwater management measures. Wetlands protection and restoration is of high priority because of their role in the hydrology (decreasing peak flows, improving recharge and sustaining base flows) and water quality (stormwater treatment, contaminant removal) of the salmon streams.

2.5.2 Institutional Context

City departments and other entities that may affect or be affected by the resolution of this issue include, but are not limited to, those below.

- **Public Works Maintenance & Operations:** Modifications to good housekeeping procedures and maintenance schedules may be required to reduce instream impacts.
- **Public Works Utilities:** All utilities—water, wastewater, stormwater—have affect and are affected by streams and their associated groundwater. Development of adaptive management strategies for reducing instream impacts. Include ESA in public education and outreach programs. Implementation of an illicit discharge detection and elimination program. Storm facility inspections and enforcement.
- **Public Works Engineering:** Development and implementation of fish-friendly stormwater standards and specifications. Adoption of ordinance(s) that govern construction and reconstruction practices, such as low impact development. Road and storm facility maintenance and construction (including roadway culvert replacement).
- **Community Development Planning:** Adoption and implementation of ordinances governing critical areas regulations, impervious surfaces, zoning, land use, low impact development, tree retention, etc.
- **Community Development Permit Center:** Potential for changes in permitting practices. Education of developers and project proponents with regard to ESA requirements.
- **Natural Resource Management:** Impacts of stormwater management on natural resources. In particular, stormwater planning and compliance with the City's Endangered Species Act Response Plan.
- **Washington State Department of Ecology (Ecology):** Ecology has provided Centennial Clean Water Fund grant money for implementation of the SCP, and ultimately must approve SCP recommendations. Ecology also administers the City's

NPDES Phase II municipal stormwater permit, and other state surface water and groundwater quality protection programs, including total maximum daily loads (TMDLs), Underground Injection Control (UIC), and the NPDES Industrial and Construction Stormwater General Permits.

- **Washington State Department of Fish and Wildlife (WDFW), United State Fish and Wildlife Service (USFWS) and NOAA Fisheries (NOAA):** WDFW, USFWS, and NOAA implement and review programs to protect endangered species, including salmonids known to be present in surface waters in Arlington. Planning should be coordinated closely with Arlington's Endangered Species Act Recovery Plan.

- **Stillaguamish Tribe:** The Tribe has interests in protecting the natural resource base and is involved with many aspects of salmon restoration that relate to stormwater, including water quality monitoring, instream habitat restoration, endocrine disrupters, pre-spawning mortality, and inventorying of fish passage blockages.

- **Stillaguamish Watershed Council** This committee is the citizen's group component of the Stillaguamish Salmon Conservation Watershed Planning effort, being co-chaired by the City of Arlington and the Stillaguamish Tribe. The Stillaguamish Tribe and Snohomish County are Lead Entities. Formerly Stillaguamish Implementation Review Committee (SIRC).

- **Watershed Groups:** Citizen and business groups such as the Stillaguamish Watershed Council, Stilly-Snohomish Fisheries Enhancement Task Force (SSFETF), Stillaguamish Clean Water District (CWD), and the Allen-Quilceda Watershed Action (AQWA) Team are active in protecting and rehabilitating fish habitat. They are involved with several activities related to stormwater management, including storm drain stenciling, water quality monitoring, and riparian plantings and maintenance.

2.5.3 Regulatory Context

The Federal Endangered Species Act (ESA) requirements are relevant because the City conducts stormwater management activities with the potential to affect federally listed, threatened, or endangered plant or animal species, including Chinook salmon, bull trout and steelhead. The EPA recommends that the City and other NPDES permittees take the following steps to ensure compliance with the Endangered Species Act, and the prevention of other species such as coho or cutthroat from being listed:

- Determine whether the project site is found within the critical habitat of a listed species

- Determine whether listed species are located in the vicinity and are likely to be present in the project area

- Determine whether listed species or critical habitats are likely to be affected by stormwater discharges or control measures

- Identify measures to avoid adverse impacts

The potential impacts of stormwater discharges on ESA-listed threatened species are addressed in this SCP in Section 3.1.8, and the development of projects in Sections 4 and 9. Potential impacts include the alteration of water quality and quantity subsequent to land use changes and the management of stormwater facilities, such as catch basins, detention ponds and infiltration galleries, and streams that were historically used as urban stormwater conveyances. Culverts and pipes may also act as barriers to fish passage. This SCP evaluates whether design standards for stormwater detention, retention and conveyance (especially culverts) may need to be modified to meet salmonid protection requirements. Channel sediment maintenance practices (such as dredging) may need to be modified, or alternative sediment control approaches developed.

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3 PHYSICAL SYSTEM DESCRIPTION

This section describes Arlington's existing stormwater drainage system and the natural water bodies that receive stormwater runoff from the city. It summarizes the currently available information on water quality as well as quantity.

3.1 Characterization of Natural Resources

3.1.1 Climate

The City of Arlington is located in the Puget Sound geographic region and experiences a marine climate typical of the region. Summers are relatively dry and cool, while winters are mild, cloudy and rainy. The average temperature in summer is 62˚F, and the average temperature in winter is 40˚F, with temperatures occasionally falling below freezing (Barrett Consulting Group 1995).

Average annual precipitation in Arlington is approximately 46 inches, as measured at the Arlington Water Department near the confluence of the North and South Forks of the Stillaguamish River. The range in annual precipitation across the planning area extends from 42 inches on the west (mouth of Portage Creek) and south (mouth of Middle Fork Quilceda Creek), to about 49 inches to the east-southeast of the City (Getchell Plateau). October through April are the wetter months, while May through September is typically drier. The relative humidity ranges from 75 to 90 percent during the wetter months and from about 40 to 85 percent during the drier months. The prevailing winds are from the south or southwest during the wetter months and from the northwest or west during the drier months.

Fall and winter weather is generally wetter during La Nina conditions when tropical moisture originating in the South Pacific Ocean is delivered via the "Pineapple Express" to the Pacific Northwest (Taylor 1998). At the same time, the polar jet stream passes through the Bering Strait before heading toward the Pacific Northwest. These phenomena generate the larger storm events influencing the SCP study area. The risk of flooding is greatest when warm, heavy rains fall on accumulated snow after larger snowstorms. The large floods of 1996 and 1997 were rain-on-snow events generated during La Nina conditions.

3.1.2 Topography

The City of Arlington is situated in the morphological area known as the Puget Sound Lowlands (Barrett Consulting Group 1995). The City's topography, and that of the study area, is characterized by three distinct, glacially influenced landforms: gently rolling hills of the Getchell Plateau to the south and east; the flat to mildly sloped Marysville Trough to the south-central and southwest; and the broad floodplain of the Stillaguamish River to the west and northwest (Newcombe 1952, Thomas et. al. 1997). Steep slopes are encountered along escarpments that frequently separate the three landforms, including the upper reaches of the Portage Creek basin and along a bluff overlooking the Stillaguamish River. Elevations in the planning area include: approximately 560 feet above mean sea level (msl) on the Getchell Plateau in the upper reaches of Portage Creek; approximately 120 feet at the north-south divide on the Arlington Airport in the Marysville Trough; approximately 60 feet msl on the Stillaguamish River alluvium where State Highway 9 crosses the river; and approximately 40 feet msl lower in the Marysville Trough at the confluence of Middle Fork Quilceda Creek with Quilceda Creek. The elevation range within city limits is approximately 70 to 480 feet.

3.1.3 Watershed Hierarchy

The City straddles the divide between two river basins, the Stillaguamish and the Snohomish, which are regionally recognized as Water Resource Inventory Areas (WRIAs) 5 and 7, respectively. For management purposes, the City has further delineated five levels of nested subbasins within each of these larger basins, resulting in a six-tier watershed hierarchy. All tiers are delineated by: using basins and subbasins developed by Snohomish County; improving their accuracy within the planning area by applying conventional contour techniques to 2-foot resolution LIDAR grid; and further modifying the boundary to reflect the effects of stormwater infrastructure. The first four tiers are defined using only natural hydrography, including river and stream channels, and segmentation of channels using landforms or other natural features. The fifth and sixth-tiers further refine the basin hierarchy using either natural features, or artificial features of the stormwater infrastructure useful for stormwater management. (Note that in this SCP there is no intended distinction between terms such as basin, subbasin, and watershed. All references to a particular position in the hierarchy are introduced in the text as the "*nth*-tier basin".)

Fourth-tier basins are on the order of 1,000 to 10,000 acres in size, although this range can vary. The City limited its 3rd tier basin delineation within the Stillaguamish basin to the south side of the mainstem, and south and west sides of the South Fork. Excluding areas on the opposite river banks that will not be annexed by the City in the foreseeable future result in smaller 4th tier basin areas adjacent to these river channels.

The 1st through 4th tier basins delineated in the SCP study area (in and near Arlington) are given in Table 3-1 and shown in Map 1. The entire study area is delineated into two 1st tier basins, three 2nd tier basins, six 3rd tier basins, and ten 4th tier basins. Basin mapping extended upstream and downstream of the City limits and UGA in order to provide a whole-basin evaluation of water quantity and water quality issues. Consequently, the study area contains three times more area outside the City and UGA than within them (Table 3-1). Nevertheless, areas within the city and UGA were the dominant focus of this effort.

Portage Creek (12,362 acres) and Middle Fork (MF) Quilceda Creek (7,692 acres) are the two largest 4th tier basins contained both within the City limits, and within the SCP study area. Smaller named streams within 4th tier basins include March Creek and Eagle Creek.

For the remainder of this chapter, the 4th tier basins serve as an appropriate level for the characterization of the natural resources and built environment of the study area. Section 4 identifies known stormwater-related problems by 4th, 5th, or 6th tier basin, depending on the appropriate spatial scale. The basins referenced in this plan are delineated as shown in Maps 2 through 12.

Table 3-1. Watershed Hierarchy in the SCP Study Area

Basin Tier 1	Basin Tier 2	Basin Tier 3	Basin Tier 4	4th Tier Basin Area (acres)	Basin Area by Jurisdiction (acres) [percent of 4th Tier Basin]: City Limits	Outside City Inside UGA	Outside UGA Inside County
Stillaguamish	Mainstem Stillaguamish	Upper Mainstem Stillaguamish	Old Town	339	299 [88%]	0	40 [12%]
		Middle Mainstem Stillaguamish	March	954	104 [11%]	0	850 [89%]
			Dike Road Reach	127	0	0	127 [100%]
		Lower Mainstem Stillaguamish	Portage	12,362	2,422 [20%]	440 [3%]	9,500 [77%]
			I-5 Reach	811	0	35 [4%]	776 [96%]
	South Fork (SF) Stillaguamish	Lower SF Stillaguamish	Eagle	657	374 [57%]	106 [16%]	177 [27%]
			Old Town NE	189	96 [51%]	89 [47%]	4 [2%]
		Upper SF Stillaguamish	Burn Road	1,633	0	0	1,633 [100%]
			Tviet Loop Reach	683	9 [1%]	34 [5%]	640 [94%]
Snohomish	Ebey Slough	Quilceda	Middle Fork (MF) Quilceda	7,692	2,335 [30%]	81 [1%]	5,276 [69%]
			Multiple other 4th tier basins	*Not included in study area*			
Study Area Totals (acres) [percent]				25,447	5,640 [22%]	785 [3%]	19,023 [75%]

3.1.4 Hydrogeology

3.1.4.1 Hydrogeologic Units

The complex geology of the study area can be grouped into seven units or formations, most of which are the result of the glacial and interglacial depositional processes in the region (PGG 2007). These units can be envisioned as strata or layers that are youngest near the surface, and older with increasing depth. Not all the units are found continuously beneath the study area, however, and their distribution changes with the landforms across the study area. Units that are relatively coarse-grained (sands and gravels), store and release groundwater more efficiently and may be considered as water sources called aquifers. Fine grained units (silts and clays) may function as confining beds between aquifers (Thomas, et. al. 1997). The seven hydrogeologic units are discussed below in order from the youngest to the oldest.

The youngest hydrogeologic unit is the alluvial aquifer (Qal). This aquifer is primarily associated with the floodplain of the mainstem Stillaguamish River and its tributaries, Portage Creek and March Creek. It is also found to a lesser extent along the SF Stillaguamish River and its tributary, Eagle Creek. This unit consists of sand and gravel with cobbles and boulders, and is typically between 0 and 30 feet thick in the area, but does reach 100 feet below the surface of the Stillaguamish valley. Groundwater within the aquifer is unconfined and in hydrologic continuity with the rivers. The aquifer is a significant water source for domestic and municipal uses; it is the City of Arlington's largest water source. The porous nature of the unit provides a water quality concern to both groundwater and the river should groundwater become contaminated.

The Vashon recessional outwash aquifer (Qvr) is the next youngest hydrogeologic unit, consisting of upwardly-fining gravel and sand laid down by runoff from the retreating continental glacier. It has extensive surficial exposure in the Marysville Trough, including middle segments and tributaries of Portage Creek, Old Town Arlington, and the headwaters of Quilceda Creek in the south-central and southwest areas of the City. Along the rivers, it has been eroded away and/or overlain by alluvium. The recessional sand and gravel in this unit is typically about 100 feet thick, reaching 130 feet thick in some areas, and is the material that is most often mined in the region, including the Rinker Pit north of the City. The aquifer is commonly used as a water source for domestic and agricultural uses, although small saturated thicknesses can restrict use, particularly in the dry summer months. It is the dominant source of base flow in small streams and the Stillaguamish River, providing a late summer water supply to all life stages of salmonids. Although Qvr can and does include fine-textured deposits or "lenses" that impede water flow, they are generally thin and discontinuous in the study area. Consequently, the unit is susceptible to surface contamination.

The Vashon till (Qvt) consists of unsorted, gray, silt, sand, and gravel. It was deposited directly beneath the advancing glacier and compacted to form a very dense "hardpan". Because of its density and silt content, this glacial till impedes the vertical movement of water and functions as a confining layer to groundwater flow. The till is typically about 70 feet thick in the Arlington area, but can exceed 100 feet on the Getchell Plateau. Locally, it either underlies the younger coarse-grained aquifers (Qal and Qvr) or is present as the upper surface of hillsides and hilltops, such as on the Getchell plateau. The till is not a significant groundwater source. It can locally protect against the introduction and spread of groundwater contaminants, but is often discontinuous, having been incised by erosion. In the Stillaguamish River valley and the Marysville Trough, Vashon till has been eroded completely away.

Vashon advance outwash (Qva) was deposited by meltwater streams discharging from the Vashon glacier as it advanced south and west. As a result, this aquifer is comprised of finer grained deposits that coarsen as they grade upward. Where Qvt has not been eroded, it underlies the till confining unit. However, it is common to find it immediately beneath the Qal aquifer in the Stillaguamish valley, and beneath the Qvr aquifer in the Marysville Trough. The Qva is typically about 200 feet thick in the area, ranging between 100 and 350 feet thick. The deposit is exposed in escarpments, such as along the base of the Getchell Plateau. The Qva aquifer is locally confined, but unconfined in much of the area due to discharge to these lateral exposures. The aquifer is a significant water source for domestic and municipal uses.

The Qva is underlain by transitional beds (Qtb). These confining beds are either basal advance outwash or interglacial lakebed sediments and are typically made up of sandy to silty clay. The Qtb is approximately 100 feet thick, but may be up to 400 feet thick in some areas. These deposits are exposed at the ground surface in the study area only along the western toe of the Getchell Plateau south of 172nd Street. The transitional beds are thin (less than 50 feet thick) in the eastern portion of the study area, but are about 300 feet thick in the western portion of the Marysville Trough. This unit is not considered to be a local groundwater source, but functions to protect deeper aquifers from surface contamination.

Deeper undifferentiated units (Qu) underlie the transitional beds and overlay bedrock. This complex of deposits consists of both glacial and interglacial deposits and contains clay to gravel-sized deposits. These deposits are not exposed in the study area. The undifferentiated unit is relatively thick, ranging from 500 to 1,000 feet in the area. PGG (2007) identifies a subset of Qu as Quaternary Older Gravel (Qog), a relatively coarse-grained deposit that is thought to be 100 feet thick and is seldom tapped by area water wells. The overlying Qtb protects this aquifer from surface activity.

Basal bedrock (Br) underlies the glacial and interglacial units in the area. The bedrock is locally comprised of volcanic and sedimentary rock. Minor exposures of the bedrock occur in the Getchell Plateau in the southeast portion of the study area. The bedrock is not considered a groundwater source.

3.1.4.2 Functional Aquifers, Water Tables, and Groundwater Flow

The three aquifers identified above with surficial exposures—the Qal, Qvr, and Qva—can be considered to be just different layers of a single “Upper Aquifer” (PGG 2007). This is because the groundwater in each of these units is often in hydrologic continuity with groundwater in the adjacent units and with the rivers and streams, resulting in water tables and water surface elevations that uniformly transition across the various formations. Where glacial till (Qvt) is extensive or fine-textured lenses within Qva are common, groundwater may be partially confined due to the limited vertical hydraulic connection. However, because these fine textured strata are discontinuous, they do not prevent inter-deposit flows and add horizontal complexity to local groundwater flow patterns.

PGG (2007) defines a second "Deep Aquifer" as the Qog. It is distinct from the Upper Aquifer because it is confined by the fine-textured Qtb that overlies it. Wells penetrating this aquifer benefit from water which rises 200 feet up the well casing above the top of the aquifer.

Groundwater flow direction and rates within the Upper Aquifer in the study area are affected by landform and the hydrogeologic units. Groundwater in the Qva under the Getchell Plateau flows to the north and east to the Qvr and Qal associated with Arlington, the Stillaguamish River, and the South Fork Stillaguamish River. It also flows west off the Plateau into Qvr associated with the Marysville Trough. Within the Qvr, groundwater generally follows the surface gradient of the land from high to low elevation. Flow direction in the Qal is difficult to calculate due to typically flat gradients. It is understood to parallel to or toward the rivers, or northwest along the South Fork, and west-southwest along the mainstem Stillaguamish. Flow direction in the Deep Aquifer is unclear, but is understood to be westerly.

A groundwater divide exists in the Qvr of the Marysville Trough that forms a subterranean boundary between flows northerly toward the Stillaguamish River, and southerly toward Quilceda Creek and Ebey Slough. The divide is estimated to occur approximately one-half to one mile south of, and roughly parallel to, 172^{nd} Street NE. The divide is actually about two miles south of the topographic divide in the vicinity of the Arlington Airport. Consequently precipitation and infiltration within the headwaters of the state-recognized WRIA 7 (Snohomish basin) boundary in this vicinity likely ends up in WRIA 5 (Stillaguamish basin). The water table in the vicinity of the divide is very shallow and presents engineering challenges for development in this area, particularly with regard to separation distances between the water table and the bottom of infiltration facilities (trenches) required under state stormwater regulations.

3.1.4.3 Groundwater Recharge and Discharge

Recharge to the Upper Aquifer, as described above, is primarily from precipitation, which ranges across the study area from 42 to more than 48 inches each year. The amount of precipitation that recharges groundwater each year varies by total precipitation and the distribution of the hydrogeologic units. PGG (2007) applied a USGS methodology (Thomas, et. al. 1996) to estimate that recharge ranges from less than 20 inches per year (in/yr) to about 35 in/yr. At 30 to 35 in/yr, recharge is greatest in most of Old Town Arlington, the north end of the Getchell Plateau, and along the South Fork Stillaguamish River where higher precipitation falls on coarser soils developed in outwash and alluvium (Qvr, Qva, Qal). Recharge is generally least—20 to 25 in/yr—on the Getchell Plateau where soils developed in glacial till (Qvt) limit the deep percolation of water infiltrating the ground surface. The Marysville Trough and Stillaguamish valley recharge 25 to 30 in/yr to groundwater. These estimates do not consider the effects of impervious cover associated with development, such as roads and buildings, which can decrease recharge locally by up to 90 percent, particularly in urban areas.

Recharge to the Deep Aquifer would equal recharge to the Upper Aquifer reduced by groundwater discharges to streams and springs, and by water pumped from wells tapping the Upper Aquifer. No effort has been made to quantify recharge to the Deep Aquifer.

Other sources of recharge, such as surface water seepage, lateral inflow from unconsolidated materials, and lateral or upward flow from bedrock are considered small in scale, although the latter does occur in at least one location near the hospital.

In the Puget Sound basin, groundwater discharges to surface water such as lakes and rivers, to springs, and to the Puget Sound. In the study area, the majority of groundwater discharge likely occurs to streams or as springs along the base of the Getchell Plateau and in the Marysville Trough, and to the rivers and streams of the Stillaguamish valley. Several springs discharge in the Old Town area of the City where outcroppings of Vashon till (under hills) transition to outwash soils (on benches or terraces). Some of this water is collected within the City's stormwater infrastructure. Under current conditions, all small streams in the City have adequate flows to support resident cutthroat trout and juvenile salmon through all four seasons.

Ecology evaluated groundwater discharge from the Qal and Qvr hydrogeologic units to Quilceda Creek (the upper portion of which is in the SCP study area) in order to estimate the amount of baseflow that groundwater contributed to that stream. Water level elevation measurements were collected over a period of time from a number of representative wells completed into the Qvr aquifer, as well as stream elevation and discharge at a number of gages located throughout Quilceda Creek and its tributaries. They found that the creek appeared to receive 40 to 60 percent of its baseflow from groundwater. Seasonal groundwater contributions could be up to 80 percent of baseflow on some segments of this creek (Larson and Marti 1996). Decreased base flows in Quilceda Creek have resulted from changes to hydrology that decreased groundwater recharge (i.e., increased impervious surfaces due to development) (WSCC 2002).

3.1.4.4 Wellhead Protection Areas

The City of Arlington has designated two well fields for the production of municipal water supplies. As required by state regulations administered by the Washington Department of Health (DOH), the City maintains wellhead protection areas around the well fields in order to protect water quality and public health and minimize treatment costs.

The Haller well field is situated near the Stillaguamish River at the north end of the City. In addition to groundwater from the Qal and Qvr deposits of the Upper Aquifer, the well field obtains much of its water from the river by drawing and filtering it through the riverbank. Because of its shallow depth in deposits susceptible to surface contaminates, and because of the influence of river water quality, DOH has indicated the well field has a high vulnerability to contamination. The City is developing a watershed control plan for the river in addition to a wellhead protection area for the Haller well field.

The Airport well field generally consists of the southern half of the airport between 51st and 59th Avenues. One current well (and a reserve area for future wells) withdraw water from deep within the Qva deposit of the Upper Aquifer. Although the Qvr and Qva deposits have no significant fine-grained confining layers and are susceptible to surface contaminates, DOH has indicated the depth of wells in the well field make it moderately vulnerable to contamination. The shallow water table and recharge characteristics of this area of the Marysville Trough influence the airport wellhead protection area.

In addition to the City of Arlington, DOH (2008) identifies eight other Group A water systems (including those permitted by DOH to provide water to 15 or more service connections) in or near the stormwater study area, including: Arlington Terrace; Meadowbrook Homeowner's Association; Stilli Ridge Estates; McPherson Hills; New Start Landowner's Association; Sudden View; City of Marysville; and Arlington Fuel Stop. The former two systems are within the City or its UGA. All are understood to use wells as their water sources; the City of Marysville uses a Ranney well within the bed of the Stillaguamish River. State and county regulations require careful design of stormwater infrastructure within zones of influence around these wells, and prohibit certain activities altogether.

DOH (2008) also identifies eight Group B water systems (including those permitted by DOH to provide water to less than 15 residential connections) in the study area. Numerous other individual and shared wells exist within the study area for domestic, irrigation, and other uses, but no complete inventory is known to exist. The City manages three other wells for irrigation, the Arlington Cemetery well, the Arlington Airport irrigation well, and the Butler well. All known wells are considered in the design and management of stormwater facilities associated with new development or redevelopment within the City.

3.1.4.5 Implications for Stormwater Management

Infiltration of stormwater on site is a generally preferred approach for stormwater management over collection, conveyance, and discharge to surface waters. The City of Arlington has opportunities to incorporate infiltration methods in development and redevelopment (see additional discussion under Soils). Infiltration, however, can introduce surface contaminants into groundwater, degrade water quality, and place beneficial uses of groundwater at risk. This risk is greater where the alluvial and outwash deposits of the Upper Aquifer (Qal, Qvr, Qva) are exposed at the ground surface. Risks are greatest where municipal and domestic water supplies are obtained from shallow depths within the Upper Aquifer.

The following 4th tier basins in the SCP study area dominated by (greater than 80%) alluvial and outwash units and are at increased risk of affecting the Group A water systems indicated: Old Town (City of Arlington Haller well field); March Creek; Dike Road Reach (City of Marysville); I-5 Reach; and Old Town NE (Table 3-2). Only the Unnamed Burn Road Creek is dominated by glacial till near the surface, and may affect or be affected by the Sudden View water system.

All other 4th tier basins have a mix of hydrogeologic exposures that generally vary by landform within the basin. All of the water systems identified in these basins are situated on till associated with the Getchell Plateau. These include: Portage Creek (Arlington Terrace water system); Eagle Creek (Meadowbrook Homeowner's Association); Tviet Loop Reach (Stilli Ridge Estates); and Middle Fork Quilceda (McPherson Hills and New Start water systems) (Table 3-2).

Some spring water discharged in Old Town and Old Town NE is collected within the City's stormwater infrastructure. This water generally flows through the storm system year round and affects the design of conveyance, detention, and treatment facilities.

continued

Table 3-2. Hydrogeology by 4th Tier Basin in the SCP Study Area

Basin Tier				4th Tier Basin Area (acres)	Basin Area by Surficial Geology (acres) [percent of 4th Tier Basin]					
1	2	3	4		Qal	Qvr	Qvt	Qva	Tb	Br
Stillaguamish	Mainstem Stillaguamish	Upper Mainstem Stillaguamish	Old Town	339	35 [10%]	243 [72%]	61 [18%]	0	0	0
		Middle Mainstem Stillaguamish	March	954	795 [83%]	159 [17%]	0	0	0	0
			Dike Road Reach	127	127 [100%]	0	0	0	0	0
		Lower Mainstem Stillaguamish	Portage	12,362	2,300 [19%]	4,148 [34%]	5,364 [43%]	459 [4%]	0	0
			I-5 Reach	811	811 [100%]	0	0	0	0	0
	South Fork (SF) Stillaguamish	Lower SF Stillaguamish	Eagle	657	120 [18%]	119 [18%]	311 [47%]	107 [16%]	0	0
			Old Town NE	189	68 [36%]	119 [63%]	3 [2%]	0	0	0
		Upper SF Stillaguamish	Burn Road	1,633	45 [3%]	0	1,375 [84%]	132 [8%]	0	81 [5%]
			Tviet Loop Reach	683	304 [44%]	48 [7%]	190 [28%]	141 [21%]	0	0
Snohomish	Ebey Slough	Quilceda	Middle Fork (MF) Quilceda	7,692	88 [2%]	4,564 [59%]	2,710 [35%]	217 [3%]	112 [1%]	0
Study Area Totals (acres) [percent%]				25,447	4,692 [18%]	9,400 [37%]	10,014 [39%]	1,057 [4%]	112 [0.4%]	81 [0.3%]

Shallow depths to water tables (generally less than 5 feet) can constrain otherwise desirable opportunities for infiltration of stormwater by minimizing the capacity of soils to remove contaminants. This is particularly true near the groundwater divide along the 172nd Street corridor in the Middle Fork Quilceda 4th tier basin. Approaches to mitigate these concerns include the use of amended soils, rain gardens, pervious pavements, dispersion techniques, and other low impact development (LID) techniques on individual projects, as well as consideration of city-sponsored regional facilities with advanced treatment trains that could serve individual sites through the use of recovery contracts.

3.1.5 Soils

A wide range of soils have developed on the surface of the glacial deposits and bedrock identified in the previous section. They mantle the earth, grow vegetation, store nutrients, distribute water, and support development. Different types of soils do these things differently. The 10 most common soil series (by area) in the SCP study area are listed in Table 3-3, including a summary of some water-related characteristics that are addressed in this section (City of Arlington Utilities Division GIS data, January 2008).

Three soil series—Tokul, Alderwood, and Lynnwood—cover more than half of the study area (Table 3-3). Four other series—Puget, Everett, Norma, and Custer—compose about 1/3 of the study area, for cumulative coverage of 84% of the study area.

Drainage class identifies the natural drainage condition of the soil (NRCS 2008). The class roughly indicates the degree, frequency, and duration of wet periods, which are factors in rating soils for various uses. Nearly the entire range of drainage classes are observed in the study area, from: Somewhat Excessively drained to Well drained (24%); to Moderately Well drained (46%); to Poorly drained to Very Poorly drained (30%).

Hydrologic group is a group of soils having similar runoff potential under similar storm and cover conditions (NRCS 2008). Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonally high water table, intake rate and permeability after prolonged wetting, and depth to a layer with a very slow water transmission rate. Hydrologic groups are used in equations that estimate runoff from rainfall. These estimates are needed for solving hydrologic problems that arise in planning watershed-protection and flood-prevention projects, for planning or designing structures for the use, control, and disposal of water. Four hydrologic groups are defined below.

> A. (Low runoff potential). The soils have a high infiltration rate even when thoroughly wetted. They chiefly consist of deep, well drained to excessively drained sands or gravels. They have a high rate of water transmission. About 21% of the soils in the study area are Group A soils.
>
> B. The soils have a moderate infiltration rate when thoroughly wetted. They chiefly are moderately deep to deep, moderately well drained to well drained soils that have moderately fine to moderately coarse textures. They have a moderate rate of water transmission. About 3% of the soils in the study area are Group B soils.

C. The soils have a slow infiltration rate when thoroughly wetted. They chiefly have a layer that impedes downward movement of water or have moderately fine to fine texture. They have a slow rate of water transmission. About 63% of the soils in the study area are Group C soils (or are undefined).

D. (High runoff potential). The soils have a very slow infiltration rate when thoroughly wetted. They chiefly consist of clay soils that have a high swelling potential, soils that have a permanent high water table, soils that have a "hardpan" or clay layer at or near the surface, and shallow soils over nearly impervious material. They have a very slow rate of water transmission. About 13% of the soils in the study area are Group D soils.

A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (NRCS 2008). Hydric soils, along with water-loving vegetation and wetland hydrology, are all required to be present on a site to define wetlands. Since the City does not have a complete wetland inventory, hydric soils are an indicator of potential wetland area under natural and/or historic conditions. Historic practices such as drainage modification and vegetation conversion have produced modified sites with hydric soils that are not necessarily wetlands, but would be good candidates for wetland restoration. About 29% of the soils in the study area are mapped as hydric soils. A wetland characterization study identified known wetlands, evaluated their hydrologic functions, and identified restoration needs, but provides incomplete coverage for the City (Ecology 1997). It is important to utilize up-to-date wetland inventories as site conditions may change following development or changes to drainage patterns.

3.1.5.1 Implications for Stormwater Management

Soils help define the capacity of a site to assimilate and store water and generate runoff. Hydrologic groups are used in stormwater modeling to determine the Curve Number of a site under vegetation. Curve numbers range from 0 to 100; the greater the value, the greater the proportion of precipitation delivered to the site that is released from the site as stormwater runoff. Curve numbers are used with precipitation of various storm events to calculate runoff rates and volumes, which in turn are used to design the best stormwater infrastructure for a site. The actual hydrologic response of a site depends on the combination of soils and underlying geology (Section 3.1.4) and is evaluated for any specific site during the development review process. The approval of any system design will require consideration of the continued base flow connectivity of the site to adjacent streams and wetlands.

Much of Old Town Arlington (Old Town and Old Town NE 4th tier basins), with 51% to 76% Group A and B soils, is well-suited to stormwater infiltration (Table 3-4). Most other 4th tier basins provide a good mix of Hydrologic Groups, suggesting opportunities exist for innovative stormwater management from a land use perspective.

Middle Fork Quilceda Creek, Portage Creek, March Creek, and Eagle Creek are the 4th tier basins most constrained by the presence of Group D soils (greater than 10%) (Table 3-4). These same basins, and the I-5 Reach have significant areas of hydric soils, ranging from 12% to 73% (Table 3-4).

Table 3-3. Top Ten Soils Common to the SCP Study Area

Soil Series	Area		Texture	Drainage Class[1]	Hydrologic Group[2]	Hydric? [3]
	Acres	Percent				
Tokul	7,025	28%	Gravelly Loam	MW	C	N
Alderwood	3,510	14%	Gravelly Sandy Loam	MW	C	N
Lynnwood	2,620	10%	Loamy Sand	SE	A	N
Puget	2,395	9%	Silty Clay Loam	P	C	Y
Everett	2,287	9%	Gravelly Sandy Loam	SE	A	N
Norma	1,904	7%	Loam	P	D	Y
Custer	1,529	6%	Fine Sandy Loam	P	C	Y
Puyallup	750	3%	Fine Sandy Loam	W	B	N
Mukilteo	736	3%	Muck	VP	D	Y
Kitsap	698	3%	Silt Loam	MW	C	N
All Others	1,993	8%	n/a	n/a	n/a	n/a
Study Area Totals	25,447	100%				

[1] Drainage Classes: Roughly identify the natural drainage condition of the soil, including the degree, frequency, and duration of wetness, which are factors in rating soils for various uses

[2] Hydrologic Groups: Groups of soil series having similar runoff potential under similar storm and cover conditions; groups are used in equations that estimate runoff from rainfall; diagnostic indicators include presence of a soil layer with the low water transmission rates, depth to any layer that is more or less water impermeable (e.g., “hardpan”), and/or depth to a water table

[3] Hydric Soils: Soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part; hydric soil is one of three characteristics commonly used in the delineation of wetlands

Table 3-4. Soils by 4th Tier Basin in the SCP Study Area

Basin Tier				4th Tier Basin Area (acres)	Basin Area by Soil Hydrologic Group (acres) [percent of 4th Tier Basin]					Hydric Soils Area (acres) [%]
1	2	3	4		A	B	C	D	Un-defined	
Stillaguamish	Mainstem Stillaguamish	Upper Mainstem Stillaguamish	Old Town	339	235 [69%]	23 [7%]	73 [22%]	3 [1%]	5 [3%]	24 [7%]
		Middle Mainstem Stillaguamish	March	954	139 [15%]	139 [15%]	573 [60%]	101 [11%]	1 [0.1%]	382 [40%]
			Dike Road Reach	127	0	14 [11%]	87 [69%]	3 [2%]	24 [19%]	11 [9%]
		Lower Mainstem Stillaguamish	Portage	12,362	2,813 [23%]	311 [3%]	7,828 [63%]	1,297 [10%]	113 [1%]	3,004 [24%]
			I-5 Reach	811	0	209 [26%]	587 [72%]	4 [1%]	12 [1%]	591 [73%]
	South Fork (SF) Stillaguamish	Lower SF Stillaguamish	Eagle	657	84 [13%]	20 [3%]	477 [73%]	60 [9%]	15 [2%]	79 [12%]
			Old Town NE	189	83 [44%]	13 [7%]	87 [46%]	4 [2%]	3 [2%]	9 [5%]
		Upper SF Stillaguamish	Burn Road	1,633	0	0	1,531 [93]	105 [6]	7 [0.4]	108 [7%]
			Tviet Loop Reach	683	92 [13]	23 [3]	513 [75]	50 [7]	6 [1]	96 [14%]
Snohomish	Ebey Slough	Quilceda	Middle Fork (MF) Quilceda	7,692	1,876 [24]	0	4,166 [54]	1,642 [21]	9 [0.1]	3,050 [40%]
Study Area Totals (acres) [percent%]				25,447	5,321 [21]	752 [3]	15,911 [62]	3,268 [13]	195 [1]	7,353 [29%]

3.1.6 River and Stream Channels

The streams and rivers that dissect the Arlington area landscape, including five of the larger 10 4^{th} tier basins delineated in the study area, provide a natural stormwater conveyance system. As described under Watershed Hierarchy, basin mapping utilized the mainstem Stillaguamish River and South Fork Stillaguamish River as basin boundaries where appropriate. Smaller named streams within the study area that are tributary to these rivers include: Portage Creek, and its tributaries Prairie, Kruger and Fish Creek; March Creek; and Eagle Creek. Edgecomb Creek and Heyho Creek drain south into Middle Fork Quilceda Creek.

The City's stormwater infrastructure includes a collection, treatment, and storage systems with outfalls to some of these streams, relying on them to convey storm flows away from the City. Runoff from urbanizing areas often results in greater volumes and more rapid rates of water flow over shorter durations relative to undeveloped areas. These modified flows can degrade the channels and harm the aquatic ecosystems they support. For example, the Stillaguamish Tribe has shown a relationship between increased peak flows and reduced out-migrants of listed Stillaguamish Chinook indicating that the increasing flows are causing listed species mortality (Pers. comm., Jason Griffiths). There are also studies in more urban areas of Puget Sound that have shown where fish populations change from coho to resident cutthroat trout as a result of the impacts from stormwater (Lucchettti and Fuerstenberg 1993).

Rivers and streams are classified according to the Washington Department of Natural Resources (DNR) stream classification system. Five water types with abbreviated definitions that apply to conditions in the study area (see WAC 222-16-030 for complete definitions) are:

- S Shorelines of the state as inventoried under 90.58 RCW, including streams with mean annual flow greater than 20 cubic feet per second
- F Streams other than Type S waters that contain fish habitat, regardless if they flow year-round or are seasonally dry
- Np Streams other than Type S and F waters that flow year round
- Ns Streams other than Type S, F, and Np waters that:
  - do not flow for during some portion of a year under normal rainfall,
  - are not downstream from any reach that is a Type Np, and
  - are physically connected by a channel system to other water types
- U Channels that are not yet typed and field verified

The total length of all stream channels in a basin divided by the basin area is the drainage density of that basin. Basins with higher drainage densities are at greater risk of upland (off-channel) influences will reach streams than basins with lower drainage densities.

3.1.6.1 Implications for Stormwater Management

The SCP study area abuts about 14 miles of the mainstem and South Fork Stillaguamish Rivers. Nearly 85 miles of tributaries dissect the study area, draining either to these rivers or to Quilceda Creek (Table 3-5). Within the City's UGA, there are about 2.2 miles of riverfront, and 14.1 miles of streams (82% in the Stillaguamish and 18% in the Snohomish basins).

More than 52 miles of streams (about 62%) internal to the study area (not river front) are Type S and Type F streams that have high to moderate value for fish, wildlife, and human use (Table 3-5). More than 25 miles of streams (almost 1/3) are non-fish streams, many of which flow intermittently. About 6.5 miles of streams (8%) are not yet classified. The drainage density for the study area, about 2.13 miles per square mile, indicates the area has a typical length of natural streams for the Puget Sound Lowlands.

Type S and Type F streams compose about 61% to 78% of total stream length across 4th tier basins (Table 3-5). Fourth tier basins with the greatest length of these streams are Portage Creek (29.04 miles), Middle Fork Quilceda Creek (12.89 miles), Unnamed Burn Road Creek (4.70 miles), Eagle Creek (3.61 miles), and March Creek (2.23 miles).

Compared to one another, the Eagle Creek 4^{th} tier basin, with a drainage density of 4.52 mi/mi^2, has a greater risk of off-channel activities impacting streams (Table 3-5). Middle Fork Quilceda Creek has the lowest risk (1.79 mi/mi^2).

Table 3-5. Rivers and Streams by 4th Tier Basin in the SCP Study Area

Basin Tier				4^{th} Tier Basin Area (acres)	River Channel Length (mi)	Tributary Channels		Tributary Length by DNR Stream Type (miles) [percent of 4^{th} Tier Basin Tributaries]				
1	2	3	4			Length (mi)	Drainage Density (mi/mi^2)	S	F	Np	Ns	U
Stillaguamish	Mainstem Stillaguamish	Upper Mainstem Stillaguamish	Old Town	339	0.76	0	0.00	0	0	0	0	0
		Middle Mainstem Stillaguamish	March	954	1.73	3.50	2.35	0	2.23 [64%]	0	1.26 [36%]	0
			Dike Road Reach	127	1.80	0	0.00	0	0	0	0	0
		Lower Mainstem Stillaguamish	Portage	12,362	0	48.99	2.54	3.05 [6%]	25.99 [53%]	4.46 [9%]	10.58 [22%]	4.90 [10%]
			I-5 Reach	811	4.37	0.05	0.04	0	0	0	0	0.04 [100%]
	South Fork (SF) Stillaguamish	Lower SF Stillaguamish	Eagle	657	0	4.64	4.52	0	3.61 [78%]	1.03 [22%]	0	0
			Old Town NE	189	1.10	0	0.00	0	0	0	0	0
		Upper SF Stillaguamish	Burn Road	1,633	0	5.96	2.34	0.02 [0.3%]	4.68 [78%]	0.29 [5%]	0.88 [15%]	0.08 [1%]
			Tviet Loop Reach	683	4.24	0	0.00	0	0	0	0	0
Snohomish	Ebey Slough	Quilceda	Middle Fork (MF) Quilceda	7,692	0	21.55	1.79	0.01 [0%]	12.88 [60%]	1.55 [7%]	5.57 [26%]	1.54 [7%]
Study Area Totals (miles) [percent of tributary length]				25,447	14.00	84.68	2.13	3.08 [4%]	49.41 [58%]	7.33 [9%]	18.29 [22%]	6.57 [8%]

3.1.7 Surface Water Quality

The streams and rivers identified in Section 3.1.6 are managed to meet freshwater quality standards, per WAC 173-201, which are intended to protect the beneficial uses of the streams. The parameters and their acceptable levels for various beneficial uses of freshwater in the SCP study area are summarized in Table 3-6. All streams in the study area are managed for the quantitative criteria given for contact recreation, water supply, and miscellaneous uses (Table 3-6). The specific categories to which the aquatic life beneficial uses are managed are given in Table 3-7; quantitative criteria are obtained by linking the categories in Table 3-7 with the criteria in Table 3-6. Supplemental spawning and incubation temperature criteria for the mainstem and South Fork Stillaguamish River are also included in Table 3-7.

Stormwater runoff and other contamination reaching streams from point source pollution (such as pipe outfalls) and dispersed areas (called nonpoint source pollution) has degraded the water quality of many area streams, negatively affecting their beneficial uses. When water samples are found not to satisfy the standards, the stream, or selected segments of the stream are identified as impaired (for that parameter) and placed on a list of water bodies needing to be cleaned up. This list is known by the Clean Water Act (CWA) section which requires it—the 303d list. Ecology then studies the impaired streams and prepares water quality clean-up plans called Total Maximum Daily Loads (TMDLs). The TMDLs include load allocations for each pollutant source identified during the study. These are effectively limits on the various sources of effluent under which the receiving stream would not be impaired.

Impaired streams in the study area have been determined for this effort using queries of Ecology's "Water Quality Assessment for Washington" online database (Ecology 2008), and by referencing completed water cleanup plans (Svrjcek 2003; Svrjcek and Lawrence 2007). The database evaluates water quality data collected in the various stream segments, compares the data to WQS and assigns a status for each of the parameters evaluated. Status includes (among other things): impaired; impaired with a TMDL in place; parameter of concern; and meets WQS.

As shown in Table 3-8, and described earlier in Sections 2.3, many of the streams and rivers within or bordering the 4th tier basins in the SCP study area have for many years been identified as impaired for any or all of the these parameters: fecal coliform (FC), dissolved oxygen (DO), and water temperature (Temp). Each of these parameters has been addressed, where appropriate, in one of three TMDLs. One Stillaguamish TMDL addresses fecal coliform, dissolved oxygen, pH, and mercury in the larger rivers and their impaired tributaries, while another Stillaguamish (and Skagit) TMDL addresses water temperature. The Lower Snohomish Tributaries TMDL addresses fecal coliform in Quilceda Creek (including its Middle Fork) and other Snohomish River tributaries.

Only Portage Creek has any impaired parameters that have not yet been addressed by a TMDL, and that is turbidity. Numerous other parameters have been observed at concentrations that suggest a level of concern is warranted, but do not qualify for impaired status. These parameters include: ammonia, copper, lead, pH, bioassessments, turbidity, and others (Table 3-8).

Table 3-6. Fresh Water Quality Standards Applicable to Any Streams in the SCP Study Area

Beneficial Use: Aquatic Life Uses[a]		
Parameter (units of measurement)	**Category**	
	Core summer salmonid habitat	**Salmonid spawning, rearing, migration**
Water temperature (highest 7-day average daily maximum, ºC)	16	17.5
Dissolved oxygen (lowest 1-day minimum, mg/L)	9.5	8.0
Turbidity (maximum increase, NTUs, when background <= 50 NTU)	5	5
Turbidity (maximum increase, Percent, when background > 50 NTU)	10	10
Total dissolved gas (maximum percent saturation)	110	110
pH (range)	6.5 to 8.5	6.5 to 8.5
pH (maximum human-caused variation within range shown)	0.2	0.5

Beneficial Use: Recreational Uses[a]	
Parameter (units of measurement)	**Category**
	Primary Contact
Fecal coliform (maximum geometric mean, colonies/100 mL)	100
Fecal coliform (maximum 90th Percentile, colonies/100 mL)	200

Beneficial Use: Water Supply[a]	
Parameter (units of measurement)	**Category**
	Domestic, agricultural, industrial, stockwatering
Toxic, radioactive, and deleterious materials (WAC 173-201A-240)	Concentrations not exceeding levels that adversely affect beneficial uses, sensitive biota, or public health (WAC 173-201A-260(2)(a))
Aesthetic values	Aesthetics not offensive to sight, smell, touch, taste (WAC 173-201A-260(2)(b))

Beneficial Use: Miscellaneous Uses[a]	
Parameter	**Category**
	Wildlife, harvesting, commerce, navigation, boating, aesthetics
Toxic, radioactive, and deleterious materials (WAC 173-201A-240)	Concentrations not exceeding levels that adversely affect beneficial uses, sensitive biota, or public health (WAC 173-201A-260(2)(a))
Aesthetic values	Aesthetics not offensive to sight, smell, touch, taste (WAC 173-201A-260(2)(b))

[a] All streams in the SCP Study Area are managed for the criteria shown for recreational, water supply, and miscellaneous beneficial uses. Aquatic Life criteria for each stream belong to one of two categories shown; the categories are designated for the various streams in Table 3-7.

Table 3-7. Aquatic Life Use Designations Applicable to Various Streams in the SCP Study Area by 4th Tier Basin

Basin Tier				Stream Name	Aquatic Life Beneficial Use Designation[a]	Supplemental Temperature Standard[b]
1	2	3	4			
Stillaguamish	Mainstem Stillaguamish	Upper Mainstem Stillaguamish	Old Town	Mainstem Stillaguamish River	Salmonid S, R, M	13ºC Oct 1 – May 15
		Middle Mainstem Stillaguamish	March	March Creek	Salmonid S, R, M	None
			Dike Road Reach	Mainstem Stillaguamish River	Salmonid S, R, M	13ºC Oct 1 – May 15
		Lower Mainstem Stillaguamish	Portage	Upper Portage Creek	Salmonid S, R, M	None
				Prairie Creek	Salmonid S, R, M	None
				Kruger Creek	Salmonid S, R, M	None
				Lower Portage Creek	Salmonid S, R, M	None
			I-5 Reach	Mainstem Stillaguamish River	Salmonid S,R, M	13ºC Oct 1 – May 15
	South Fork (SF) Stillaguamish	Lower SF Stillaguamish	Eagle	Eagle Creek	Salmonid S, R, M	None
			Old Town NE	South Fork Stillaguamish River	Core Summer Salmonid Habitat	13ºC Sept 15 – July 1
		Upper SF Stillaguamish	Burn Road	Unnamed Stream	Salmonid S, R, M	None
			Tviet Loop Reach	South Fork Stillaguamish River	Core Summer Salmonid Habitat	13ºC Sept 15 – July 1
Snohomish	Ebey Slough	Quilceda	Middle Fork (MF) Quilceda	Edgecomb Creek	Salmonid S, R, M	None
				Heyho Creek	Salmonid S, R, M	None

[a] Quantitative criteria for Aquatic Life Uses in Table 3-6 apply to the streams shown by the categories in this column. Salmonid S, R, M is spawning, rearing, migration.
[b] Supplemental temperature criteria supersede the water temperature criteria in Table 3-6 for the range of dates shown.

Table 3-8. Stream Water Quality Impairments by 4th Tier Basin in the SCP Study Area

Basin Tier				Parameters[a] for which any stream segment is considered impaired[b] and a water clean-up plan is			Parameters[a] of concern[b] in any stream segment
1	2	3	4	Prepared	Name of the Water Cleanup Plan[c]	Not Yet Prepared	
Stillaguamish	Mainstem Stillaguamish	Upper Mainstem Stillaguamish	Old Town	FC, Temp	Stilly Mutli-parameter	None	Am-N, Cu, DO, FC, Pb, pH, Temp
		Middle Mainstem Stillaguamish	March	FC	Stilly Multi-parameter	None	None
			Dike Road Reach	FC, Temp	Stilly Multi-parameter	None	Am-N, Cu, DO, FC, Pb, pH, Temp
		Lower Mainstem Stillaguamish	Portage	FC, DO	Stilly Multi-parameter	Turbidity	As, Hg, pH, Bio
			I-5 Reach	FC, Temp	Stilly Multi-parameter	None	Am-N, Cu, DO, FC, Pb, pH, Temp
	South Fork (SF) Stillaguamish	Lower SF Stillaguamish	Eagle	None	N/A	None	None
			Old Town NE	FC, DO, Temp	Stilly Multi-parameter	None	FC, Hg, pH, Temp, Turbidity
		Upper SF Stillaguamish	Burn Road	None	N/A	None	None
			Tviet Loop Reach	FC, DO, Temp	Stilly Multi-parameter	None	FC, Hg, pH, Temp, Turbidity
Snohomish	Ebey Slough	Quilceda	Middle Fork (MF) Quilceda	FC	Sno Tribs FC	None	FC, DO

[a] Parameter abbreviations: fecal coliform (FC), dissolved oxygen (DO), temperature (Temp), ammonia-nitrogen (Am-N), copper (Cu), mercury (Hg), lead (Pb)
[b] Impaired parameters are TMDL Categories 4 and 5; parameters of concern are TMDL Category 2.
[c] Stilly Multi-parameter (Svrjcek and Lawrence 2007); Snohomish Tributaries FC (Svrjcek 2003); also see Appendix A

Recent studies have suggested that some of the problems with depressed dissolved oxygen levels in the lower Snohomish River tributaries and the mainstem Stillaguamish are related to a nutrient-driven mechanism. High nutrient loads from nonpoint source pollution drive the excessive growth of algae and other organisms, which may produce oxygen during daylight hours, but then continue to respire and consume large amount of oxygen during night-time hours. This continuous day-night cycling can plunge dissolved oxygen levels below water quality standards. Accordingly, the TMDLs affecting the City also address nutrient sources in most nonpoint source runoff. These sources are often associated with fecal coliform sources, including sediments, animal wastes, failing septic systems, and fertilizers.

Read (2006) studied trends in Stillaguamish basin water quality (bacteria, temperature, dissolved oxygen, and sediment) using data from multiple sources. Some data at some locations was collected as a early as 1959, but most was collected between 1994 and 2006. Many of the river and stream stations analyzed, including those near Arlington, showed improvements for all parameters, including some statistically significant changes (probability < 0.5). However, despite improving or maintained conditions, fecal coliform bacteria in the mainstem and South Fork Stillaguamish Rivers and in Portage Creek still do not meet water quality standards. In addition, trends in water temperature and sediment in the South Fork near Arlington were shown to be degrading. Results are summarized in Table 3-9.

Table 3-9. Trend analysis of water quality data in the Stillaguamish Watershed[a,b]

Stream Name	Bacteria	Temperature	Oxygen	Sediment
Mainstem Stillaguamish—Arlington	None*	Improving	Improving	Improving
South Fork Stillaguamish—Arlington	Improving*	Worsening	None	Worsening
Portage Creek	Improving*	Improving	None	Improving

[a] Table is an abbreviated version of Table 3 in Svrjcek and Lawrence (2007)

[b] Recent analysis of water quality data (Read 2006) indicate whether the trends for the parameters and water courses shown are improving, staying the same (no trend, or none), or worsening. A gray box indicates the trend is statistically significant (p<0.5). An asterisk indicates bacterial pollution remains a problem (does not meet WQS).

3.1.7.1 Implications for Stormwater Management

Generally, correcting water quality problems is more of a challenge in the more urbanized areas of and basins in the Puget Sound. Arlington, in the more rural Stillaguamish basin, has the opportunity to prevent many pollutants from becoming expensive problems to solve.

One reason for expanding the study area is to include areas in the Portage Creek and Unnamed Burn Road Creek 4th tier basins upstream of the City, and the Portage Creek and Middle Fork Quilceda Creek 4th tier basins downstream of the City is to help understand the nonpoint pollution sources in these rural residential and agricultural areas and how they may magnify or mask the effects of stormwater on rivers and streams in the vicinity of Arlington.

Water quality in the mainstem Stillaguamish River and its tributaries are within Watershed Control Areas (source water protection designations) of the Cities of Arlington and Marysville. Stormwater discharges influence one of the sources of drinking water in these cities and could affect the treatment processes and quality of water delivered to their customers.

Copper and lead appeared on the 1998 303d list as exceeding state water quality criteria in the Stillaguamish River near Arlington, and lead was on the list for Portage Creek as well. These exceedences were deemed to not require TMDL development, due to suspicions about the reliability of the data.

Similarly, Quilceda Creek also appears on the Section 303(d) list as requiring TMDL development for lead, copper, zinc, and dissolved oxygen. However, Johnson, et. al. (2001) indicate that these metals are *not* present in concentrations approaching the water quality criteria in Quilceda Creek. Previous listings were due to measuring total recoverable metals, which are not comparable to the water quality standards. Ecology does not anticipate developing a TMDL for these metals unless new information indicates the need.

Further water quality data collection could result in a requirement to develop a metals TMDL for these water bodies. Metals are commonly found in stormwater runoff, and development of a metals TMDL in the future would require the issue to be addressed in a future SCP.

Ecology's approach to the dissolved oxygen issue in Quilceda Creek is to wait until results of the implementation of the TMDL for fecal coliform are known (Svrjcek 2003). BMPs implemented under the fecal coliform TMDL may result in dissolved oxygen improvement, removing the need for a dissolved oxygen TMDL.

3.1.8 Fisheries and Aquatic Resources

3.1.8.1 Fish Species Common to the Plan Area

As shown earlier in Table 3-5, fish are known to inhabit all rivers bordering the study area, and 62% of the total stream length within the study area. Fish species inhabiting these streams at any time of the year are summarized in Table 3-10. These include both anadromous fish—those ocean-going fish who spend a portion of their life-cycle in fresh water streams, and resident fish—those fish that spend their entire life in fresh water streams.

The life stages of many of the species in area streams and listed in Table 3-10 are displayed across a range of months of the year in Figure 3-1.

Three species that inhabit area streams are federally listed as *threatened* under the Endangered Species Act. These are addressed individually below.

Puget Sound Chinook salmon were listed in 1999 with recent populations at about 7% of historic levels. In the Stillaguamish basin, most Chinook spawn in the mainstem river, the forks, and the larger tributaries, and rear throughout the river system. After hatching, most juvenile Chinook spend one to five months rearing in freshwater before migrating to the estuary, but, under current degraded habitat conditions only, 1-2% will rear in freshwater for a full year (SIRC 2005). Two distinct populations are recognized in the Stillaguamish basin. The North Fork Stillaguamish

Chinook is the stronger population, with an average number of 1,080 fish returning in the summer to spawn (SIRC 2005). The South Fork/mainstem Stillaguamish Chinook begin arriving in mid-September with a current average population of only 246 fish (SIRC 2005). In the immediate vicinity of the City, Chinook salmon typically do not utilize Portage and Eagle Creek systems, except for temporal rearing use at their confluence with the rivers, or as flood refuge during inundation of the Stillaguamish floodplain. In the Snohomish basin, the Quilceda watershed generally provides low levels of Chinook salmon use as far upstream as Middle Fork Quilceda Creek, and they do not utilize Edgecomb Creek. Ebey Slough, however, provides extensive Chinook rearing habitat for out-migrants.

Listed in 1998, bull trout need cold water to survive, so they are seldom found in waters where temperatures exceed 59-64 °F (USFWS 2008). These fish may exhibit three different life histories—resident (non-migrating), adfluvial (migrating to rivers and larger streams), and anadromous (migrating to the ocean). In the Stillaguamish basin, four local populations of bull trout, including North Fork and South Fork Stillaguamish, are known to be anadromous (SIRC 2005). Resident populations also occur. Bull trout are opportunistic foragers, and the USFWS considers the entire distribution area for Coho salmon to be potential foraging habitat for bull trout. Hence, mimicking the distribution of Coho salmon, bull trout are presumed to occupy the rivers and all small streams in the vicinity of Arlington. Similarly, in the Snohomish basin, bull trout have not been confirmed, but are suspected to inhabit Edgecomb Creek and other tributaries and reaches of Quilceda Creek. Ebey Slough is also presumably a high traffic area for bull trout when they out-migrate during the warm summer and early fall months. Immature adults will overwinter at the head of Ebey Slough (Shared Strategy 2007).

Puget Sound steelhead trout were listed in 2007. In the Snohomish basin, the Quilceda watershed generally provides low levels of steelhead trout use as far upstream as Middle Fork Quilceda Creek, but they are not known to utilize Edgecomb Creek. The Stillaguamish River also hosts several populations of steelhead, but their essential habitats in the basins managed by Arlington have not yet been mapped.

3.1.8.2 Habitat Conditions in the Plan Area

During the development of the City's Endangered Species Act Response Plan (unpublished) in 2003, Natural Resources' staff completed an evaluation of habitat and watershed influences on the health of fish populations in five Arlington area streams. The procedure evaluates the current conditions of a wide range of characteristics or processes that affect fish populations favorably or negatively (National Marine Fisheries Service 1996). Each of the 18 characteristics is rated as either: Properly Functioning (PF) to support aquatic life; placing aquatic populations At Risk (AR); or Not Properly Functioning (NPF), thus negatively impacting fish. Together, the evaluation of all attributes establishes what is called the "Environmental Baseline" for each stream.

Though stormwater is not necessarily the only influence resulting in habitat losses, a review of the Environmental Baseline results for area streams suggest stormwater may be influencing declining populations (Table 3-11). For example, a number of the attributes evaluated are directly influenced by stormwater runoff, including: sediment and chemical contamination of diminished water quality; reduced access to habitat by poorly installed culverts; degraded habitat quality through sedimentation of pools and spawning gravels, and loss of off-channel habitat through construction of levees; loss of channel complexity through channelization and bank hardening; and changes in hydrologic regime, including increases in peak flows and diminishing base flows.

The Washington State Conservation Commission (1999) also identified limiting factors associated with land uses that negatively affect fish populations in Portage Creek and Quilceda Creek. A summary of these studies are summarized in Appendix B.

3.1.8.3 Implications for Stormwater Management

A number of observations from Tables 3-10 and 3-11, and Figure 3-1 are synthesized into lessons learned for stormwater management.

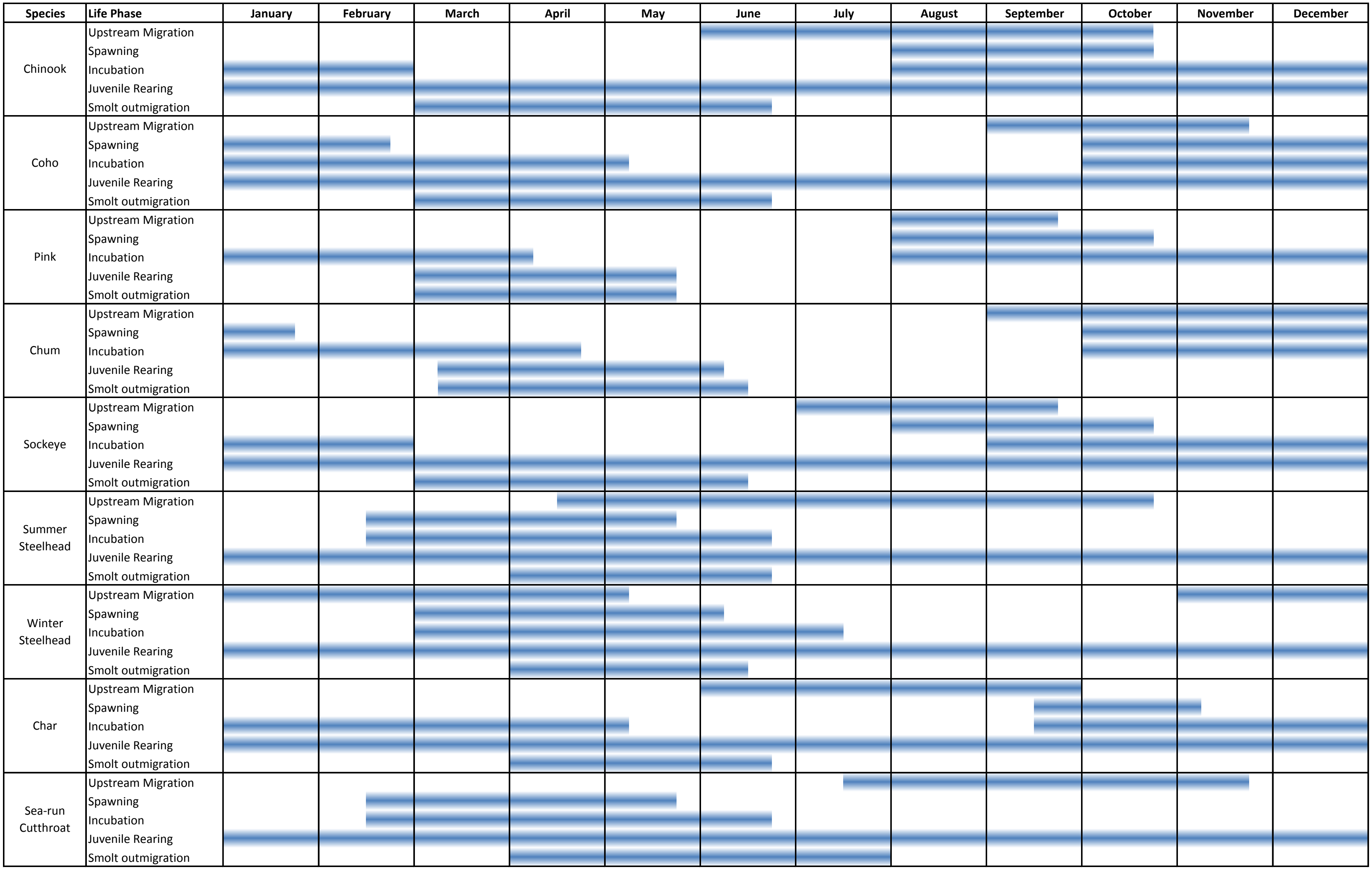
- Anadromous salmonids are present nearly year-round in nearly every stream in the Plan area.
- Instream construction windows for work in fish-bearing streams minimize risks to fish, but still could impact both spawning adult and rearing juvenile fish.
- Degraded water quality has direct detrimental impacts on fish—or places their habitat at risk—in every stream evaluated in the Plan Area (Table 3-11).
- Sedimentation of spawning beds limits reproductive success.
- Off-channel refuge habitats, such as wetlands or side channels, are in need of protection or restoration.
- Culverts have high potential for becoming barriers to fish passage.
- Stormwater influences on stream discharge affect fish and their habitat, and can be reduced through improved stormwater management.
- Stormwater influences on stream water quality affect fish, their habitat, and their reproductive success, and can be reduced through improved stormwater management.
- Introduced aquatic species in stormwater ponds can escape and negatively impact native populations in natural systems.
- Stormwater management practices, particularly those in riparian settings, can negatively impact the food web base for aquatic life (e.g., invertebrates).
- Capital improvement projects for stormwater can incorporate fish and habitat-restoring components.

Table 3-10. Fish presence in streams by 4th Tier Basin in the SCP Study Area

Basin Tier				Species Presence [a]								
1	2	3	4	Chinook	Chum	Coho	Pink	Steel-head	Bull Trout	Sea-run Cut-throat	Other Salmonids	Other Resident Fish
Stillaguamish	Mainstem Stillaguamish	Upper Mainstem Stillaguamish	Old Town	K	K	K	K	K	K	K	K	K
		Middle Mainstem Stillaguamish	March	U	U	S	U	U	U	S	U	K
			Dike Road Reach	K	K	K	K	K	K	K	K	K
		Lower Mainstem Stillaguamish	Portage	U	K	K	U	S	S	K	U	K
			I-5 Reach	K	K	K	K	K	K	K	K	K
	South Fork (SF) Stillaguamish	Lower SF Stillaguamish	Eagle	U	U	K	U	U	U	S	S	K
			Old Town NE	K	K	K	K	K	K	K	U	K
		Upper SF Stillaguamish	Burn Road	U	U	U	U	U	U	U	S	S
			Tviet Loop Reach	K	K	K	K	K	K	K	U	K
Snohomish	Ebey Slough	Quilceda	Middle Fork (MF) Quilceda	U	K	K	U	U	U	S	S	S

[a] Species presence Known (K), Suspected (S), or Unknown (U). Note that resident cut-throat trout may exist upstream of barriers to anadromous fish passage.

Figure 3-1. General timing of life stages of Stillaguamish basin salmon species [a].



[a] Adapted from Washington Conservation Commission (1999)

Table 3-11. The Influence of Watershed and Habitat Conditionsa on Fish in Selected Streams in the SCP Study Area

Watershed and Habitat Conditions[a] by Third Tier Basin and Stream Reach					
Third Tier Basin:	Lower Mainstem Stillaguamish		Lower SF Stillaguamish		Quilceda
Stream Reach:	Upper Portage Creek (UGA boundary d/s to 204th St)	Mid-Portage Creek (204th St d/s to Stillaguamish Floodplain)	Eagle Creek (Headwaters to confluence with SF Stillaguamish)	SF Stillaguamish River (Adjacent to UGA boundary)	Edgecomb Creek (70th Ave NE d/s to UGA boundary)
Water Quality					
Temperature	PF	**NPF**	AR?	AR	AR?
Sediment	PF	AR	AR	**NPF**	**NPF**
Chemical Contamination, Nutrients	AR	AR	AR?	**NPF**	AR?
Habitat Access					
Physical Barriers	AR	AR	AR?	PF	NPF
Habitat Elements					
Substrate	PF	**NPF**	AR	PF	**NPF**
Large Woody Debris	PF	**NPF**	**NPF**	**NPF**	**NPF**
Pool Frequency	PF	AR	**NPF**	**NPF**	**NPF**
Pool Quality	PF	**NPF**	**NPF**	PF	**NPF**
Off-channel Habitat	PF	**NPF**	AR	AR	**NPF**
Refugia	PF	**NPF**	PF	**NPF**	**NPF**

Table continued on next page

Table 3-11. Continued

Watershed and Habitat Conditions by Third Tier Basin and Stream Reach					
Third Tier Basin:	Lower Mainstem Stillaguamish		Lower SF Stillaguamish		Quilceda
Stream Reach:	Upper Portage Creek	Mid-Portage Creek	Eagle Creek	SF Stillaguamish River	Edgecomb Creek
Channel Conditions and Dynamics					
Width/Depth Ratio	AR	PF	AR	**NPF**	AR
Streambank Condition	PF	PF	**NPF**	**NPF**	**NPF**
Floodplain Connectivity	PF	**NPF**	AR	**NPF**	**NPF**
Flow, Hydrology					
Peak/Base Flows	AR	AR	AR	**NPF**	**NPF**
Increases in Drainage Network	**NPF**	**NPF**	**NPF**	**NPF**	AR
Watershed Conditions					
Road Density & Location	**NPF**	**NPF**	**NPF**	**NPF**	**NPF**
Disturbance History	AR	**NPF**	**NPF**	**NPF**	**NPF**
Riparian Reserves	PF	**NPF**	AR	**NPF**	**NPF**

[a] Using the procedure established by National Marine Fisheries Service (1996) to evaluate a "Matrix of Pathways and Indicators" to establish an "Environmental Baseline", as documented in the city's Endangered Species Act Response Plan (City of Arlington 2000). Condition ratings include: Properly Functioning (PF) in a light background; At Risk (AR) in a gray background; and Not Properly Functioning (NPF) in a dark background.

3.2 Built Environment and the Municipal Separate Storm Sewer System

3.2.1 Land Use

The City of Arlington is home to 17,554 residents (as of April 2009). As shown in Table 3-12, population growth has been steadily increasing from about 2% to 10% since 1988 (with a large increase in 2000 associated with the Smokey Point annexation). Population is expected to reach 30,500 by the year 2025, largely due to the City's participation in a Transfer of Development Rights (TDR) program with Snohomish County. The Brekhus-Beach annexation of 2007 is designated as the receiving area for a dense population of residents that otherwise might have settled in the agricultural areas of the Stillaguamish valley.

Table 3-12. Historical and Forecast City of Arlington Populations

Year	Population	Percent Change Per Year
1980	3,282	n/a
1988	3,582	1.1%
1999	7,480	9.9%
2000[a]	11,927	59.5%
2001	12,770	7.1%
2002	13,500	5.7%
2003	14,330	6.1%
2004	14,700	2.6%
2005	14,980	1.9%
2006	16,137	7.7%
2007	16,720	3.6%
2008	17,050	2.0%
2009	17,554	2.9%
2010 [b]	*18,554*	*5.7%*
2015 [b]	*23,554*	*5.4%*
2025 [b]	*30,500*	*2.9%*

[a] Includes Smokey Point annexation
[b] *Italicized* years and values are projected

Commercial and industrial growth has kept pace with the population. The City of Arlington is somewhat unique for a small city in that local businesses provide 2.22 employment opportunities for every residence (City of Arlington 2005).

The City of Arlington manages this growth and development according to the City's Comprehensive Plan as required under the Growth Management Act (GMA). The City Comprehensive Plan directs land use through zoning and land use maps. The Plan completed its last 10-year update in 2005; it is revised annually to reflect changes incurred through annexations, zoning modifications, capital projects (such as this SCP), and similar efforts.

3.2.1.1 Implications for Stormwater Management

Land use zoning in the City of Arlington and its UGA under the current City Comprehensive Plan is summarized by 4th tier basin in Table 3-13. The number of land use classes has been simplified for this table to include seven zones: low to moderate density residential (RLMD); high density residential (RHD); Commercial (Com); Industrial (Ind); Public (Pub), which includes a wide range of public to semi-public uses, including parks, aviation flightline, and other municipal facilities; and Not Zoned (zoning to be determined).

RLMD is the dominant zoning within the City's jurisdiction in most 4th tier basins (range of 8% to 52% of 4th tier basins when the City occupies more than about 20% of the basin). RLMD and RHD are generally well-distributed across basins containing significant city area. Commercial areas are also found throughout all these basins, although Portage and Middle Fork Quilceda contain 83% and 99% of all commercial and industrial areas, respectively. These areas are predominately in the central and southeast areas of the City, and not uncommonly will infiltrate all of their stormwater on-site. Public areas include areas with high percentages of open space and low to moderate coverage by impervious surfaces.

Land outside of the City or its UGA is under the jurisdiction of Snohomish County for most 4th tier basins. These lands are primarily rural residential and agricultural in nature. The one exception is the Middle Fork Quilceda basin, which also includes land within the City of Marysville. No effort was made to include City of Marysville zoning in this analysis, but land use zoning currently in place includes low to high density residential areas, commercial and light industrial areas, and some rural residential areas and recreational parks.

Changes in land use patterns in Arlington since the adoption of the previous 1995 SCP are limited to the extent to which the City has annexed new areas within the UGA boundary. The extent of agricultural activities, implicated in some water quality issues, has decreased since 1995. However, increasing urbanization tends to result in a different set of water quality problems.

More detailed descriptions of land use are presented in subsequent sections of this plan, including Basin Conditions (Section 4), and Hydraulic, Hydrologic, and Water Quality Modeling (Section 5).

Table 3-13. Land Use Zoning by 4th Tier Basin in the SCP Study Area

Basin Tier				4th Tier Basin Area (acres)	Basin Area by Land Use Zoning (acres) [percent of 4th Tier Basin]						
1	2	3	4		RLMD	RHD	Com	Ind	Public	Not Zoned	Not City
Stillaguamish	Mainstem Stillaguamish	Upper Mainstem Stillaguamish	Old Town	339	154 [45%]	9 [3%]	87 [26%]		49 [15%]		40 [12%]
		Middle Mainstem Stillaguamish	March	954	68 [7%]		23 [2%]	13 [1%]			850 [89%]
			Dike Road Reach	127							127 [100%]
		Lower Mainstem Stillaguamish	Portage	12,362	1,203 [10%]	173 [1%]	332 [3%]	733 [6%]	363 [3%]	59 [0.5%]	9,500 [77%]
			I-5 Reach	811			35 [4%]				776 [96%]
	South Fork (SF) Stillaguamish	Lower SF Stillaguamish	Eagle	657	128 [19%]	21 [3%]	8 [1%]		30 [5%]	293 [45%]	177 [27%]
			Old Town NE	189	98 [52%]	45 [24%]	21 [11%]		21 [11%]		4 [2%]
		Upper SF Stillaguamish	Burn Road	1,633							1,633 [100%]
			Tviet Loop Reach	683	34 [5%]					9 [1%]	640 [94%]
Snohomish	Ebey Slough	Quilceda	Middle Fork (MF) Quilceda	7,692	630 [8%]	19 [0.2%]	543 [7%]	567 [7%]	576 [7%]	81 [1%]	5,276 [69%]
Study Area Totals (acres) [percent%]				25,447	2,314 [9%]	267 [1%]	1,049 [4%]	1,313 [5%]	1,039 [4%]	442 [2%]	19,023 [75%]

3.2.2 Drainage System Overview

As part of this SCP planning effort, the City initiated an intensive inventory of its stormwater facilities using field surveys and as-built drawings. Field surveys were patterned after the methodology Snohomish County used to prepare its Drainage Needs Reports (Snohomish County 2002). The City's inventory is largely complete with respect to: the subsurface collection and conveyance network (catch basins, manholes, pipes); the surface collection and conveyance network (ditches, swales, culverts); watersheds (see section 4.1.3); and outfall locations. Those features with an incomplete inventory include detention basins and infiltration systems.

The City's inventory focused on city-owned facilities within public rights-of-way; it includes limited information on private stormwater systems, especially those with infiltration systems on-site. In addition, this document summarizes only the City's inventory. It does not attempt to quantify Snohomish County's stormwater infrastructure outside of the City, which is predominately a ditch and culvert system along rural roads. We also ignore the City of Marysville's infrastructure within the Middle Fork Quilceda 4th tier basin. Some infrastructure associated with Interstate 5 near the Smokey Point interchange is included in the City's inventory.

The collected data have been stored within an ArcGIS geodatabase. In 2008, the City began using the geodatabase within an asset management system developed by Cartegraph. This system is intended to facilitate maintenance and improvements to the stormwater infrastructure.

The City of Arlington's stormwater infrastructure is summarized by 4th tier basins in Table 3-14. Across the entire City, the subsurface network includes 3,253 catch basins and manholes, and about 48 miles of pipe. The surface network includes more than 18 miles of ditches and swales, and 2.9 miles of culverts. There are about 86 known outfalls—points of interchange where stormwater is discharged from City infrastructure to a natural feature, whether river, stream, wetland, or ground surface. The City has inventoried 114 detention ponds, stormwater wetlands, and vaults to date.

Continued

Table 3-14. Stormwater Infrastructure Attributes by 4th Tier Basin in the SCP Study Area

<table>
<tr><th colspan="4">Basin Tier</th><th rowspan="2">4th Tier Basin Area (acres)</th><th colspan="6">Features (units) [percent]</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>CB, MH (number)</th><th>Pipes (miles)</th><th>Ditches, Swales (miles)</th><th>Culverts (miles)</th><th>Outfalls (number)</th><th>Detention Basins (number)</th></tr>
<tr><td rowspan="9">Stillaguamish</td><td rowspan="5">Mainstem Stillaguamish</td><td>Upper Mainstem Stillaguamish</td><td>Old Town</td><td>339</td><td>519 [16%]</td><td>8.34 [17%]</td><td>0.61 [3%]</td><td>0.03 [1%]</td><td>3 [3%]</td><td>3 [3%]</td></tr>
<tr><td rowspan="2">Middle Mainstem Stillaguamish</td><td>March</td><td>954</td><td>102 [3%]</td><td>1.17 [2%]</td><td>0.79 [4%]</td><td>0.04 [1%]</td><td>6 [7%]</td><td>0</td></tr>
<tr><td>Dike Road Reach</td><td>127</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Lower Mainstem Stillaguamish</td><td>Portage</td><td>12,362</td><td>1,410 [43%]</td><td>19.72 [41%]</td><td>7.08 [39%]</td><td>1.41 [49%]</td><td>33 [38%]</td><td>66 [58%]</td></tr>
<tr><td>I-5 Reach</td><td>811</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">South Fork (SF) Stillaguamish</td><td rowspan="2">Lower SF Stillaguamish</td><td>Eagle</td><td>657</td><td>33 [1%]</td><td>0.23 [0.5%]</td><td>0.09 [1%]</td><td>0.07 [2%]</td><td>2 [2%]</td><td>1 [1%]</td></tr>
<tr><td>Old Town NE</td><td>189</td><td>82 [3%]</td><td>1.49 [3%]</td><td>0.01 [0.1%]</td><td>0</td><td>2 [2%]</td><td>1 [1%]</td></tr>
<tr><td rowspan="2">Upper SF Stillaguamish</td><td>Burn Road</td><td>1,633</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Tviet Loop Reach</td><td>683</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Snohomish</td><td>Ebey Slough</td><td>Quilceda</td><td>Middle Fork (MF) Quilceda</td><td>7,692</td><td>1,107 [34%]</td><td>17.04 [35%]</td><td>9.57 [53%]</td><td>1.35 [47%]</td><td>40 [47%]</td><td>43 [38%]</td></tr>
<tr><td colspan="4">Study Area Totals by Feature</td><td>25,447</td><td>3,253 [100%]</td><td>47.99 [100%]</td><td>18.15 [100%]</td><td>2.90 [100%]</td><td>86 [100%]</td><td>114 [100%]</td></tr>
</table>

3.2.3 Stormwater Quality

Stormwater quality, like the quantity and rate of stormwater runoff, is highly variable in time and location. Minton (2002) provides an extensive review of literature to describe stormwater quality as a basis for developing treatment technologies and making stormwater treatment decisions. Key concepts are briefly summarized here.

Pollutants can be grouped into various types, including but not limited to:

- bacteria, including fecal coliform;
- nutrients, such as phosphorus and nitrogen;
- metals, especially zinc, copper, cadmium, lead, and chromium;
- petroleum products, such as oil and grease, fuel spills, and asphalt derivatives;
- heat (causing temperature increases);
- pesticides and herbicides
- toxic organics, including aromatic hydrocarbons, solvents, etc.
- sediments, including soil erosion and road sand
- coarse debris (road side trash)

The mechanisms by which pollutants are delivered to stormwater in the urbanizing setting include the following (adapted from Table 2.3 in Minton, 2002):

Atmospheric deposition	Transport of pollutants from off-site sources, or settlement on runoff generating surfaces
Litter and leaf fall	Discarding personal and commercial debris; direct and indirect (runoff) deposition of leaves and organic debris
Residential and roadside landscape maintenance	Soil amendments; pesticides and herbicide application; fertilizer application
Urban wildlife and pets	Bacteria, nutrients from pet waste in backyards, parks, and streets; wildlife congregating in open space areas
Transportation vehicles	Fuel combustion; brake and tire wear; rust
Pavement and pavement maintenance	Warming of runoff; derivatives of asphalt and other petroleum products; application of deicing chemicals and road sand
Building exteriors	Chipping and eroding of paints; surface corrosion
Industrial businesses	Illicit discharges, leaks, spills
Commercial businesses	Illicit discharges, leaks, spills, parked vehicles, improper refuse disposal
Residential activities	Landscaping, pest control, moss and weed control, vehicle maintenance, painting, wood preservation, illicit discharges
Site development	Erosion of disturbed sites, runoff across fresh concrete; landscaping; improper waste disposal
Public infrastructure	Corrosion of storm infrastructure; maintenance yard runoff; overflows and leaks from sewers

> Pollutants are seldom present in stormwater as free ions. They are most often either in particulate form, such as being adsorbed to sediments, or dissolved (generally finer than 0.45 microns) in chemical complexes with other constituents.
>
> Pollutants are not evenly distributed across sediment sizes; therefore pollutant removal does not directly relate to removal of particulates through sedimentation or filtration.
>
> Many pollutants are regulated with regard to the quality of the receiving water body (as defined by established standards) rather than the discharge itself. Some parameters, such as for petroleum hydrocarbons, have limits placed on the discharge volume itself.

There have been limited studies of stormwater quality conducted to date in the vicinity of Arlington. The Stillaguamish Tribe of Indians, Ecology, Snohomish County, and the City of Arlington have conducted monitoring of streams in the Stillaguamish basin. The City has collected a limited number of stormwater samples from several outfalls, but certainly nothing which provides a thorough characterization of contaminants and their sources.

The Stillaguamish Watershed Action Plan (Snohomish County 1990), a study initiated after the closure of Port Susan shellfish beds for bacterial contamination, concluded water quality data in existence at that time was limited, and the extent of pollution within the Stillaguamish basin could not be determined. They did indicate that bacteria and sediment are the two most prevalent nonpoint source pollutants in the basin, and that the four major land use activities contributing to this trend are agriculture, septic systems, urban runoff, and forest practices.

The Northwest Land Information System Network (NLISN), an interstate and interagency network of resource management agencies, conducted a Geographic Information System (GIS) analysis of potential nonpoint pollution sources in Portage Creek in the late 1980s (URS 2003). The report indicated that mean concentrations of instream fecal coliform, turbidity, and dissolved oxygen violated Class A water quality standards.

The report implicated agricultural activities as the primary sources of nonpoint pollution, including grazing and manure or fertilizer applications which were associated with increases in suspended solids, inorganic nitrogen and fecal coliform bacteria (URS 2003). It also identified septic systems as a potential source of fecal coliform bacteria, noting that 78 percent of the study area residences were located on soils that are poorly drained, contain a layer of hardpan, or otherwise pose limitations for conventional septic systems. Direct water quality impacts from the urbanized areas around Arlington were summarized as minimal.

The City began collecting samples from several stormwater outfalls as early as 2003 to establish “baseline” conditions for four parameters: fecal coliform, dissolved oxygen, temperature, and specific conductance. Flow is also measured at all smaller outfalls during sample collection (but not at Butler, the largest outfall). Results of data collected through 2006 are included in Table 3-15. Data suggest that fecal coliform is the parameter of greatest concern. Although the geometric mean values are generally low, the 90^{th} percentile values for fecal coliform concentrations indicate that storm events can be a source of this pollutant in receiving streams. Specific conductance data provide an opportunity to distinguish surface water and groundwater sources in stream flows.

Table 3-15. Stormwater quality data summaries

Outfall (No. of samples) [a]	Statistic[b]	Parameter[c]				
		Flow (gpm)	Temperature (° C)	DO (mg/L)	Conductivity (µS/cm)	Fecal Coliform (col/100 mL)
Butler (40)	Maximum	ND	17.8	11.5	197	2000
	90th %-ile	ND	16.1	10.8	187	847
	Mean	ND	12.7	9.6	147	33
	Minimum	ND	7.4	6.3	23	1
Talcott (31)	Maximum	240	16.9	13.0	147	2000
	90th %-ile	98	16.5	11.6	135	541
	Mean	13	11.9	10.0	104	27
	Minimum	1	5.8	8.6	18	1
Stuller (5)	Maximum	45	12.3	12.7	29	570
	90th %-ile	31	11.0	12.3	28	542
	Mean	13	8.6	11.4	24	113
	Minimum	1	6.2	10.0	15	10
West (5)	Maximum	15	12.3	12.6	27	500
	90th %-ile	13	11.2	12.2	27	381
	Mean	6	8.7	11.3	23	93
	Minimum	1	5.8	10.0	14	14

[a] Samples collected by the City of Arlington.

[b] Mean values are the simple average of all values recorded, except that for fecal coliform, the value is the geometric mean of all values recorded.

[c] Parameter definitions are given in Table 3-6 (although the standards given in that table apply to streamflows, not stormwater discharges themselves). DO is dissolved oxygen. ND is no data.

4 BASIN CONDITIONS

This section summarizes the known stormwater-related problems located within the City of Arlington and its UGA, organized by the 4th tier basins defined in Section 3.1.3, and for which the natural and built environments were summarized throughout Section 3. Where appropriate, 5th tier basins are used to summarize problems. The absence of any subbasin (i.e., nested basin) indicates that no problems have been identified at a finer scale. A general description of each basin is followed by a brief description of the general source of flooding or water quality problems in the basin. The problems are enumerated and carried forward through the document in order to track development of capital projects, BMPs, and other solutions to these issues, and to assure all identified problems are addressed.

Stormwater flooding problems were identified through review of past studies (see references herein) and interviews with current City staff in utilities, public works, maintenance, and natural resources departments. Briefly, ponding on streets and overland flows outside the stormwater conveyance system are the most common drainage problems. The most common causes of the drainage problems are:

- Inadequately designed/sized drainage systems, including culverts
- Debris such as leaf litter blocking inlets to storm sewers and preventing runoff from entering the drainage system.
- Private property owners building structures over drainage systems, precluding maintenance
- Improperly modified drainage systems

Water quality issues were identified through the same process. Understanding of water quality issues was supplemented through use of loads modeling (URS Corporation2006a). Water quality model results are discussed in Section 5.4.

4.1 Old Town 4th tier basin

The Old Town 4th tier basin drains much of the downtown portion of Old Town to the Stillaguamish River (generally located east of SR9 about three-quarters of a mile and north of Highland Drive, but excluding the northeast area draining to the South Fork). As shown in Map 2, it includes shoreline areas from of the confluence of the North Fork and South Fork downstream to a point where the south bank of the mainstem river abuts the Dike Road. Approximately 299 acres of the 339 acres in the basin are within the City and its UGA; 48% of the basin is zoned residential, 26% is business/commercial, 15% is in parks, utilities, and public facilities; and 12% is in the County. The commercial activities include restaurants, gas stations, lumber yards, automotive repair shops, and dry cleaners. The basin is undissected by natural surface drainages, discharging to the river via groundwater or through three outfalls shown in Table 4-1. Outside of the UGA, the basin is primarily in pasture. Other important features within this basin are the City's Haller wellfield and the City's wastewater effluent outfall.

Table 4-1. Basin Delineation and Outfall Attributes within the Old Town 4th Tier Basin in the SCP Study Area

Basin Tier			n^{th} Tier Basin Area (acres)[a]	Outfall[b]					
4	5	6		ID[c]	Drainage Area (acres)[d]	Size[e]	Type	To	Treatment
Old Town	Butler	Butler DT	152.4	Butler	284	36 in.	Pipe	River	None
		Butler East	78.1						
		Butler West	5.8						
		Division Main	43.2						
		SR9 4^{th} to Division	2.2						
		4^{th} to Division	2.3						
	Centennial Trail	n/a	4.2	Centennial Trail		18 in.	Ditch	River	Usually infiltrates
	Haller Park	n/a	2.6	Haller Park	~2	Unknown	Pipe	River	Usually infiltrates
	Utilities	n/a	3.7	None	3.7				WWTP[f]
	West RR	n/a	7.6	None					Infiltration
	Residual	n/a	37.1	None					Infiltration
4^{th} tier basin totals			339.3						

[a] Basin area values apply to the smallest delineated basin shown.
[b] An outfall is a point of interchange where stormwater is discharged from City infrastructure to a natural feature, whether river, stream, wetland, or ground surface.
[c] Where outfall ID is "None", no outfall as defined above is known to exist.
[d] Area draining to an outfall may be smaller than the nth tier basin that it is contained in.
[e] Size is pipe diameter in inches (in.), or ditch top width in feet (ft.), or it may be unknown.
[f] All stormwater within the City's water and wastewater treatment facilities is collected and treated in the wastewater treatment plant.

4.1.1 Butler 5th tier basin

The Butler outfall, located just west of SR9, is a 36-inch culvert that drains six 6th tier basins totaling 284 acres. The four largest 6th tier basins are Butler East, Butler West, Butler Downtown, and Division Main.

Butler East is 78 acres of primarily Old Town Residential zoning with an estimated impervious surface percentage of 51%. The primary storm drain (trunk line) extends up French Street from Division Street. The average slope in the basin is about 3%.

Butler West is 5.7 acres of commercially-zoned area along West Street from Division Street to 3rd Street. It is 65% impervious, and very flat (about 0.2%).

Butler Downtown is the largest 6th tier basin draining to the Butler outfall—152 acres of mostly commercial and residential zoning with an estimated 53% impervious area. The basin extends from Division Street in the north to Highland Drive in the south. The basin is divided into two relatively flat areas divided by a north-south trending "bluff" where the ground slope exceeds 80% in some locations. In the lower area, Olympic Avenue improvements in 2007 added new trunk line in the street south to Maple, while maintaining older trunk line in the alley west of Olympic and north of 3rd Street. Four storm drain laterals convey runoff from the upper area above the escarpment to the lower basin.

Division Main is 45 acres of primarily commercial and residential zoning with an estimated 65% impervious area. Division Main is the lowest and northern-most basin area draining to the Butler outfall. It collects runoff from the three 6th tier basins above at three points along Division Street, and conveys it along and under State Route 9 to the outfall on the Upper Mainstem Stillaguamish River. This system is understood to collect and convey about 50 gpm of groundwater during non-storm periods, primarily from perforated drain pipe in East Division Street.

Problem Areas: Problems or issues specific to the Butler 5th tier basin identified during the SCP process (excluding modeling results in Section 5) are identified below. Information sources include previous planning documents, field inventories concurrent with the SCP, and interviews with City staff and citizens.

Problem No.:	**1** **Basin ID:** **OT-B-1**
Primary Issue(s)	Local flooding
Problem Description	Surcharging along First Street between McLeod and Lenore Avenues, Lenore Avenue between First and Second Streets; and along French Avenue between First and Fourth Streets (variable pipe diameters in French Avenue). The result is localized flooding during intense rainfall, when flows surface from catch basins to flow down slope across roads and properties. Roots have historically been an issue, but the most likely cause now is a bottleneck caused by smaller pipe sizes on French between 3rd and 4th Streets.
Information Sources	1995, 1999, and 2003 assessments; residual areas of Project 11,

	Downtown Drainage System Improvements, not addressed by the Olympic Avenue renovation in 2007; also Project 201

Problem No.:	**2**	**Basin ID:**	**OT-B-2**
Primary Issue(s)	Conveyance limitations		
Problem Description	Trunk line along SR9 surcharges at manholes north of Burke Avenue. Trunk line along Division has variable pipe sizing near Broadway, and has opportunity to redirect and receive flow that currently is discharge through the Broadway outfall.		
Information Sources	1995, 1999, and 2003 assessments; residual areas of Project 12, Old Town Outfall Trunk Line		

Problem No.:	**3**	**Basin ID:**	**OT-B-3**
Primary Issue(s)	Infrastructure damage		
Problem Description	Downstream-most pipe segment to outfall is old and outlet is crushed. Pipe outlet feeds ditched channel ~30 ft in from river bank.		
Information Sources	1995, 1999, and 2003 assessments; residual areas of Project 22, Old Town Stormwater Treatment Facility		

Problem No.:	**4**	**Basin ID:**	**OT-B-4**
Primary Issue(s)	Water quality, TMDL, ESA		
Problem Description	The Haller (Butler or Old Town) outfall discharges to the mainstem Stillaguamish River with little or no treatment, which impacts river water quality and affects the City's ability to meet its TMDL and ESA responsibilities. A constructed wetland on the old Hammer farm has been proposed, has received grant funding, and is in permitting. This item assures funding for proper maintenance of the constructed wetland facility.		
Information Sources	1995, 1999, and 2003 assessments; residual areas of Project 22, Old Town Stormwater Treatment Facility		

Problem No.:	**5**	**Basin ID:**	**OT-B-5**
Primary Issue(s)	Infrastructure unknown		
Problem Description	The manhole at Division and High Streets conveys perennial flow from the east under Division Street. It is assumed to convey groundwater from a perforated pipe under the Division Street road cut across an outwash deposit, but the actual source is unknown. Infrastructure at/near the intersection of Division St and Dunham Ave conveys perennial groundwater that used to supply an old creamery, but the extent of the source and infrastructure is unknown.		
Information Sources	SCP inventory; City staff		

Problem No.:	6	Basin ID: OT-B-6
Primary Issue(s)	Infrastructure unknown, possible illicit connection	
Problem Description	2 inch PVC pipe discharges from east near Haller Middle School to trunk line along First Street; flow intermittent but regular and appears to be pumped; source unknown; possible footer (foundation) drain pump?	
Information Sources	SCP inventory; City staff	

4.1.2 Centennial Trail 5th tier basin

The Centennial Trail 5th tier basin drains the right-of-way of West Avenue (old SR9) and the former Burlington Northern railroad right of way, which is being converted to use as the Centennial Trail. The approximately 4.2-acre area (45.2% impervious) is designed to discharge via open ditch to the mainstem Stillaguamish River immediately below the confluence of the North and South Forks.

The ditch along the east side of West Avenue and west side of the Centennial Trail has never been observed to discharge to the River. Even when flowing full, all water infiltrates behind a check dam (sediment control basin) in the ditch at the toe of the railroad fill about 80 feet from the City's Haller well field.

Problem Areas: Problems or issues specific to the Centennial Trail 5th tier basin identified during the SCP process are identified below.

Problem No.:	7	Basin ID: OT-CT-1
Primary Issue(s)	Groundwater quality, wellhead protection	
Problem Description	Infiltration of small volumes of untreated stormwater occurs within the Sanitary Control Area of the Haller well field with potential to contaminate the City's primary water supply.	
Information Sources	SCP inventory; City staff	

4.1.3 Haller Park 5th tier basin

This 2.6-acre 5th tier basin is located just east of the SR-9 bridge and west of the Centennial Trail 5th tier basin. It is currently zoned Public/Semi-Public (PSP) and has about 10% impervious area. There are no current plans to change the zoning.

Approximately 8 catch basins within the park are understood to connect to an outfall near the old boat launch. The outfall has not been observed in recent years and is assumed to be buried. High flow events deposit sand in the catch basins and pipes during floods making maintenance difficult

Problem Areas: Problems or issues specific to the Haller Park 5th tier basin identified during the SCP process are identified below.

Problem No.:	8	Basin ID: OT-HP-1
Primary Issue(s)	Conveyance limitations	
Problem Description	Outfall location unknown; flood deposition hinders maintenance; local flooding not significant during smaller storm events.	
Information Sources	SCP inventory; City staff	

Problem No.:	9	Basin ID: OT-HP-2
Primary Issue(s)	Water quality, TMDL	
Problem Description	Park allows leashed and off-leash pet use on river bank; dog waste contributes to fecal coliform levels in the river; (also high recreational use by swimmers in summer, and by fishermen nearly year-round).	
Information Sources	SCP inventory; City staff	

4.1.4 Utilities 5th tier basin

All runoff from impervious surfaces in the Utilities 5th tier basin (3.7 acres) is collected and treated in the Wastewater Treatment Plant as a protection for water quality. This assures that any spills of chemicals or waste in or near the treatment plants are contained and treated prior to discharge to the environment. No problems have been identified.

4.1.5 West Railroad 5th tier basin

This 7.6-acre 5th tier basin includes the BNRR switchyard and adjacent areas between West and Olympic Avenues. The area is flat, 65% impervious based on commercial zoning, and there is no storm drain collection system. However, all rainfall infiltrates and no problems have been identified.

4.2 March Creek 4th tier basin

The March Creek 4th tier basin contains approximately 2.2 miles of low gradient fish-bearing streams and 1.3 miles of nonfish-bearing streams draining westerly across the Stillaguamish River floodplain from the western margin of Old Town to its Middle Mainstem segment (Map 3; Table 3-5). Although most of the nonfish-bearing streams probably started as agricultural ditches, they are now identified as waters of the state. Only about 104 acres of the basin's 954 acres (11%) are within the City's UGA. The basin is zoned by the City as residential (more than 7%) and commercial-industrial (3%). Except for 7 residential and 4 business/commercial acres, all of this area infiltrates with no direct discharge to March Creek. Outside of the UGA, the remaining 850 acres (89%) is entirely in agriculture, with an emphasis on pasture, nursery plants, and row crops, on the Stillaguamish floodplain. All of the floodplain properties in the basin are identified as potential sending areas within the Transfer of Development Rights Program (TDR) instituted by the City and Snohomish County to preserve agriculture in the basin.

Stormwater outfalls within the March Creek 5th tier basin are shown in Table 4-2. All of the outfalls drain small areas, ranging only from 0.5 to 4.6 acres in size.

Table 4-2. Basin Delineation and Outfall Attributes within the March Creek 4th Tier Basin in the SCP Study Area

Basin Tier			nth Tier Basin Area (acres)[a]	Outfall[b]					
4	5	6		ID[c]	Drainage Area (acres)[d]	Size[e]	Type	To	Treatment
March	211th_SR530	n/a	0.53	211th_SR530	0.53	8 in.	Pipe	Wetland	None
	211th_Ronning	n/a	0.55	211th_Ronning	0.55	12 in.	Pipe	Wetland	None
	Ronning_Hilltop	Pioneer Meadows I	1.08	None					Primarily infiltration
		Ronning Hilltop	16						
		Ronning Rd North	0.21						
	Kona	n/a	52	None					Primarily infiltration
	Stuller	n/a	4.6	Stuller	4.6	18 in.	Pipe	Stream[f]	O/W Sep
	TCF	n/a	2.0	TCF	<<2	n/a	Cistern	Ground	None
	Nelson	n/a	0.67	Nelson[g]	0.67	12 in.	Pipe	Ground	O/W Sep, cartridges, infiltrates
	West	n/a	4.6	West	4.6	18 in.	Pipe	Ground	Infiltrates
	Stilly Floodplain[h]	n/a	862	None					
	All others[i]	n/a	11.32	Various	0.5 to 3	?		Ground	Usually infiltrates
4th tier basin totals			954						

[a] Basin area values apply to the smallest delineated basin shown.
[b] An outfall is a point of interchange where stormwater is discharged from City infrastructure to a natural feature, whether river, stream, wetland, or ground surface.
[c] Where outfall ID is "None", no outfall as defined above is known to exist.
[d] Area draining to an outfall may be smaller than the nth tier basin that it is contained in.
[e] Size is pipe diameter in inches (in.), or ditch top width in feet (ft.), or it may be unknown.
[f] Stuller outfall construction in the mid-1980s included about 300 feet of constructed channel to connect to March Creek. It is now considered an intermittent stream channel.
[g] Nelson is a privately owned and managed stormwater system. After treatment, any discharge infiltrates on the escarpment above the Stillaguamish floodplain.
[h] Primarily agricultural land outside of city limits. Any stormwater associated with roads is under the jurisdiction of Snohomish County or the Washington Department of Transportation (WSDOT)
i Larger basins or basins with outfalls of interest are included in the table; "All others" primarily includes areas within or immediately adjacent to city limits, often associated with WSDOT managed facilities on SR9 and SR530; outfalls to ground usually infiltrate

4.2.1 211th_SR530 5th tier basin

This half-acre 5th tier basin drains the intersection of 211th Place and SR 530. A single catch basin drains from the east side of 211th Place east into a wetland with dense reed canary grass. March Creek and the culvert inlet under SR 530 are approximately 250 feet further east, and the small discharge volume from the outfall is assumed to infiltrate.

Problem Areas: Problems or issues specific to the 211th_SR530 5th tier basin identified during the SCP process are identified below.

Problem No.:	**10**	**Basin ID: M-211-1**
Primary Issue(s)	Local ponding	
Problem Description	Outfall is sometimes buried under sand at the toe of the road fill; catch basin can back up into the street during heavy storms.	
Information Sources	SCP inventory; City staff	

4.2.2 211th_Ronning 5th tier basin

This half-acre 5th tier basin drains 211th Place at and downstream of its intersection with Ronning Road. Catch basins at the intersection and south side of the street discharge to the north-northeast from an outfall that is buried within the road fill above the Stillaguamish floodplain. and was not located during inventories drains from the east side of 211th Place east into a wetland with dense reed canary grass. March Creek and the culvert inlet under SR 530 are approximately 500 feet further east, and the small discharge volume from the outfall is assumed to infiltrate. The outfall is sometimes buried under sand at the toe of the road fill; otherwise there are no known problems at this site.

Problem Areas: Problems or issues specific to the 211th_Ronning 5th tier basin identified during the SCP process are identified below.

Problem No.:	**11**	**Basin ID: M-211R-1**
Primary Issue(s)	Conveyance limitations	
Problem Description	Outfall location unknown and understood to be crushed near the edge of the road fill; fill slope is unstable and road has settled in the past, so there is potential for damage to road prism; catch basin on south side of 211th often covered by leaves and sediment;	
Information Sources	SCP inventory; City staff	

4.2.3 Ronning Hilltop 5th tier basin

This 17.3 acre 5th tier basin drains the area generally bounded as follows: 211th Place on the north, the railroad paralleling 67th Avenue on the east, the escarpment above the Stillaguamish floodplain on the west, and, on the south, the basin divide extending west from Pioneer Hall Museum. There are no streams draining the area. More than three-fourths of the area is situated on Lynnwood and Everett soils that are somewhat excessively drained with a low runoff potential. Approximately 16 catch basins and other structures and more than 700 feet of pipe collect and infiltrate stormwater on approximately 1.5 acres. The City has zoned 12.1 acres (70%) as residential area, and the remaining 30% of the basin as mostly commercial and some industrial land use.

Problem Areas: Problems or issues specific to the Ronning Hilltop 5th tier basin identified during the SCP process are identified below.

Problem No.:	**12**	**Basin ID:**	**M-211RH-1**
Primary Issue(s)	Local flooding		
Problem Description	Despite the generally well drained soils, the infiltration system under 67th Avenue south of 211th Place (along the bulkhead by the railroad tracks) cannot accommodate larger storm events; water backs up and floods street across from the gas station and storage units.		
Information Sources	SCP inventory; City staff		

4.2.4 Stuller 5th tier basin

The Stuller 5th tier basin primarily covers 67th Avenue from near the 211th Place intersection to near the West Avenue intersection. The basin is delineated such that it primarily includes the road with some adjacent commercial and residential areas. Runoff is treated with an oil-water separator just upslope of the outfall, which is located near the toe of the escarpment (at the floodplain). The outfall was constructed in the mid-1980s with about 300 feet of constructed channel to connect it to a segment of March Creek that is understood to have been excavated for drainage in the early 1900s. These segments are now considered streams managed as waters of the state. The outlet channel is now an intermittent, discontinuous stream course in very soft sediments.

Problem Areas: Problems or issues specific to the Stuller 5th tier basin identified during the SCP process are identified below.

Problem No.:	**13**	**Basin ID:**	**M-S-1**
Primary Issue(s)	Water quality, TMDL		
Problem Description	Apart from basic oil-water separation, runoff in the Stuller 5th tier basin discharges untreated to March Creek (identified as impaired for fecal coliform and dissolved oxygen in the Stillaguamish TMDL) SW of Twin City Foods. From pipe outlet, stormwater flows through ~300 ft poorly defined ditch with coarse debris, sediment, and vegetation. Stormwater easement in place. 67th Ave location is constrained by the steep and unstable slope in which the outfall pipe is located.		
Information Sources	1995, 1999, and 2003 assessments No. 119; SCP inventory; City staff;		

Problem No.:	**14**	**Basin ID:**	**M-S-2**

Primary Issue(s)	Loss of use of property (water table)
Problem Description	Landowners on floodplain near outfall have complained of loss of trees and changes in vegetation apparently associated with an elevated water table; outlet channel created with placement or replacement of pipe outlet has not been maintained and spreads rather than conveys water; property also is understood to be naturally wet; unclear whether a valid easement across property exists.
Information Sources	SCP inventory; City staff; citizen comments

Problem No.:	15	Basin ID: M-S-3
Primary Issue(s)	Water quality, TMDL	
Problem Description	Natural springs discharge from the recessional geology that Arlington is built upon and supply this wetland located in the floodplain on Young alluvial geology. The groundwater is close to the surface in the lower areas. This area receives untreated stormwater discharge via the Stuller and West outfalls.	
Information Sources	1995, 1999, and 2003 assessments No. 119; SCP inventory; City staff;	

4.2.5 Nelson and Twin City Foods Outfalls

The 2/3 acre Nelson 5th tier basin is private commercial property used for the storage and distribution of petroleum products. The stormwater system contains and treats runoff in a vault. Treated water may overflow during large storm events through an outfall to ground located in riprap on the escarpment on the west side of the facility above the Stillaguamish floodplain. Inventories observed no evidence of overland flow downslope of the outfall; any discharge is understood to infiltrate the soil. No problems have been identified.

Immediately south of Nelson Petroleum is the Twin City Foods facility. Any condensation from the self-contained cooling system is infiltrated on-site. Roof and parking runoff is discharged to an old cistern-like reservoir located mid-slope on the escarpment above the floodplain. Overflows from the reservoir observed during storm events discharge to ground and are infiltrated. No current problems have been identified, but agricultural landowners downstream have reported to City staff that there had been historic fish kills from Twin City Foods operations..

4.2.6 West 5th tier basin

Approximately 4.6 acres along West Avenue between 3rd Street and Lebanon Street and some SR 9 right of way compose the West 5th tier basin. The storm system passes under SR 9 near the day care facility on its east side, and discharges to ground near the toe of the slope on its west side. Overland flow has been observed during heavy storm events extending 25 feet downslope before completely infiltrating the soil. No problems have been identified, although jurisdiction of the outfall, including the pipe under SR 9, is not known. It is unclear whether WSDOT has issued the city an easement for discharge, and who holds maintenance responsibility.

Problem Areas: Problems identified in the West 5th tier basin during the SCP process that may also apply across the City are identified below.

Problem No.:	16	Basin ID: M-W-1
Primary Issue(s)	Jurisdiction	
Problem Description	No current inventory of easements and maintenance responsibilities where the city's stormwater infrastructure crosses private property and state rights-of-way.	
Information Sources	SCP inventory; City staff	

4.3 Dike Road Reach 4th tier basin

The Middle Mainstem segment of the Stillaguamish River (in itself a 3rd tier basin) includes March Creek (previous section) and the Dike Road Reach. The Dike Road Reach 4th tier basin contains the residual lands along the river between the meander bends at the Dike Road downstream to SR 530 (Map 1, Map 3). This 127 acres lies entirely within the County, is undissected by streams, and supports agriculture (pasture, nursery plants, and row crops) and industrial uses. Other important features within this 4th tier basin include the City of Marysville's Ranney well in the Stillaguamish River.

No specific management concerns have been identified. This 4th tier basin is identified primarily for a comprehensive overview of land uses adjacent to the city that may also influence water quality in the Stillaguamish River.

4.4 Portage Creek 4th tier basin

With 2,862 acres within its UGA, Portage Creek, tributary to the mainstem Stillaguamish River, is the largest 4th tier basin influenced by the City of Arlington (Map 1). Five 5th tier basins have been delineated within the Portage Creek 4th tier basin. Upper Portage Creek, Prairie Creek, and Kruger Creek (and their basins) originate in the low hill and plateau area southeast of the city, and collectively merge to form the mainstem of Portage Creek within the Arlington city limits. From the confluence with Prairie Creek downstream, Lower Portage Creek flows in a westerly direction, leaving the UGA as it enters the Stillaguamish floodplain, but remaining adjacent to the UGA boundary until I-5. West of I-5, Lower Portage Creek joins with the Fish Creek 5th tier basin and other minor tributaries before turning northwest and entering the mainstem Stillaguamish River approximately six miles from its mouth at Port Susan.

Total stream length in the basin, including tributaries, is approximately 49 miles (Table 3-5). About 29 miles (58%) are known to bear fish or provide fish habitat, but nearly 5 miles of streams (10%) have not yet been classified (Table 3-5).

Three-fourths of the 4th tier basin—the area under County jurisdiction—is in rural residential and agricultural land use (the most intensive agriculture generally occurring on the Stillaguamish floodplain). The City has zoned 10% of the basin (2,581 acres) for residential uses, including one percent (267 acres) for high density residential purposes (Table 3-12). Commercial and industrial uses occupy 9% of the basin, and public uses, including 192 acres in Aviation Flightline open space around the Arlington Airport, occupy 4%.

Numerous stormwater outfalls to streams occur within the basin as shown in Table 4-3. Many of the outfalls are overflow pipes from detention or infiltration facilities that discharge to streams during large storm events after storage in detention ponds or the soil has been fully utilized. The range of design storms for which these facilities has been constructed has not been evaluated.

The recent annexation of Island crossing also added South Slough a channel for which Portage Creek was originally named. Although South Slough is included in City mapping (see Map 4), the City needs to perform additional analysis to provide accurate information and assure full integration of South Slough in to our stream, wetland and stormwater inventories.

4.4.1 Fish Creek 5th tier basin

Fish Creek is a 5th tier basin tributary to Lower Portage Creek (Map 4) a short distance upstream of the confluence of Portage Creek with the Stillaguamish River. This 4,977 acre basin contains nearly 20 miles of streams, of which almost 2/3 are fish-bearing or contain fish habitat. Happy Valley Creek, a nonfish-bearing tributary, is the only known named tributary. Land use in the basin is primarily rural residential and agricultural. Fish Creek is identified as impaired for <list parameters here> in the Stillaguamish TMDL.

Fish Creek is considerably outside of the City's UGA and near the perimeter of the SCP study area. The city conducted no inventories in the basin, and the area was apparently also not included in the County's Drainage Needs Reports. No specific management concerns have been identified. This 5th tier basin is identified primarily for a comprehensive overview of land uses adjacent to the city that may also influence water quality in Portage Creek and the Stillaguamish River.

4.4.2 Lower Portage Creek 5th tier basin

Lower Portage Creek (Map 4) is that part of the creek downstream of the confluence of Upper Portage Creek and Prairie Creek. Areas common to the City and the 5th tier basin include the residential neighborhoods north and west of the airport and north of about 180th Street, including but not limited to: High Clover, River Crest, Sweetwater (most), and northern Smokey Point. Other areas include undeveloped parcels inside the UGA along I-5. Downstream of the city of Arlington, land use is primarily agricultural. The Portage Creek Wildlife Park, managed by Snohomish County, is situated within this basin where the floodplain meets the escarpment below the Marysville Trough (east-northeast of High Clover).

Problem Areas: Problems or issues specific to the Lower Portage 5th tier basin identified during the SCP process are identified below.

Problem No.:	17	Basin ID:	P-LP-1
Primary Issue(s)	Infrastructure damage, local flooding		
Problem Description	At the Contech (formerly Washington Culvert) site on 188th Street near 66th Avenue, an infiltration system previously installed on private property to accept both street and parking lot run-off has failed; all runoff drains to the road and is damaging the street (located near the divide with the Middle Fork Quilceda 4th tier basin and included in Lower Portage because of groundwater flow direction).		
Information Sources	Project 215; City staff		

Problem No.:	18	Basin ID:	P-LP-2
Primary Issue(s)	Local flooding		
Problem Description	Flooding occurs on an annual basis on 59th Avenue near 192nd Street as a result of poor infiltration in an area with a primarily surface stormwater network (ditches and culverts)		
Information Sources	SCP inventory; City staff		

Problem No.:	19	Basin ID:	P-LP-3
Primary Issue(s)	Local flooding		
Problem Description	Water ponds on Cemetery Road during storm events in an area from 51st to 67th Avenues where there is no storm drain system.		
Information Sources	City staff		

Problem No.:	20	Basin ID:	P-LP-4
Primary Issue(s)	Water quality		
Problem Description	Current and future fecal coliform and BOD5 loading by the City to Portage Creek exceeds the City's WLAs determined by Ecology in the Stillaguamish TMDL. Sources need to be identified so appropriate solutions may be developed.		
Information Sources	Stillaguamish TMDL; SCP modeling results, Section 5.4		

Problem No.:	21	Basin ID:	P-LP-5
Primary Issue(s)	Loss of use of property (flooding)		
Problem Description	Flooding of agricultural lands near 43rd Avenue; landowner reports flooding of farm crossings that were well above flood levels in the 1950s; implicates City of Arlington.		
Information Sources	1995, 1999, and 2003 assessments, Project 106, Wetland #1051; City staff		

continued

Table 4-3. Basin Delineation and Outfall Attributes within the Portage Creek 4th Tier Basin in the SCP Study Area

Basin Tier			n^{th} Tier Basin Area (acres)[a]	Outfall[b]					
4	5	6		ID[c]	Drainage Area (acres)[d]	Size[e]	Type	To	Treatment[f]
Portage	Fish	Happy Valley	904	Not inventoried	4,977				
		Residual	4,073						
	Lower Portage	High Clover	3.3	High Clover	3.3	12 in.	Pipe	Stream	I-O
		Sweetwater	13.7	Sweetwater 1	13.7	12 in.	Pipe	Stream	I-O
		Foster's Tributary	291	Not inventoried					
		South Slough	248	Not inventoried					
		Residual	4,139	River Crest	n/a	12 in.	Pipe	Stream	I-O
	Prairie	Mainstem Prairie	509	204th St	n/a	8 in.	Pipe	Stream	I-O
				Newell 1	n/a	8 in.	Pipe	Stream	O/W Sep
				Newell 2	n/a	8 in.	Pipe	Stream	O/W Sep
				Crown Park 1	n/a	14 in.	Pipe	Stream	D-O
				SR 9-1am	n/a	18 in.	Pipe	Stream	None
				SR 9-2	n/a	18 in.	Pipe	Stream	None
		WF Prairie GE	19.9	Gleneagle 1	n/a	n/a	Pipe	Stream	D-O
		WF Prairie	665	Arlington Terrace	n/a	7 ft.	Ditch	Stream	None
				Gleneagle 2	n/a	n/a	Pipe	Stream	D-O
				Gleneagle 3	n/a	24 in.	Pipe	Stream	D-O
				Magnolia 1	n/a	18 in.	Pipe	Stream	D-O
				Magnolia 2	n/a	18 in.	Pipe	Stream	D-O
				Magnolia 3	n/a	12 in.	Pipe	Stream	D-O
				Magnolia 4	n/a	12 in.	Pipe	Stream	D-O
				Eagle Hts	n/a	18 in.	Pipe	Stream	D-O
				172nd 1	n/a	12 in.	Pipe	Stream	None
				172nd 2	n/a	5 ft.	Ditch	Stream	None
				172nd 3	n/a	12 ft.	Ditch	Stream	None
	Kruger	n/a	416	Jensen Farm Ln	n/a	12 in.	Pipe	Stream	D-O
				Portage 1	n/a	12 in.	Pipe	Stream	O/W Sep

Basin Tier			n^{th} Tier Basin Area (acres)[a]	Outfall[b]					
4	5	6		ID[c]	Drainage Area (acres)[d]	Size[e]	Type	To	Treatment[f]
				Portage 2	n/a	12 in.	Pipe	Stream	None
				Stillaguamish	n/a	12 in.	Pipe	Stream	O/W Sep
				Twin Ponds	n/a	54 in.	Pipe	Stream	Unknown
				207th Place	n/a	12 in.	Pipe	Stream	O/W Sep
	Upper Portage	204th_Kent Prairie	21.0	Safeway	n/a	8 ft.	Ditch	Stream	D-O, bioswale
				Olympic Place	n/a	48 in.	Pipe	Stream	I-O
				Jensen 1	n/a	12 in.	Pipe	Stream	D-O
				Jensen 2	n/a	Unknown	Pipe	Stream	D-O
		Sweetwater East	0.8	Sweetwater2	0.8	12 in.	Pipe	Stream	I-O
		Residual	1,059	High School	n/a	Unknown	Pipe	Stream	D-O
4th tier basin totals			12,362						

[a] Basin area values apply to the smallest delineated basin shown.

[b] An outfall is a point of interchange where stormwater is discharged from City infrastructure to a natural feature, whether river, stream, wetland, or ground surface.

[c] Where outfall ID is “None”, no outfall as defined above is known to exist.

[d] Area draining to an outfall may be smaller than the nth tier basin that it is contained in.

[e] Size is pipe diameter in inches (in.), or ditch top width in feet (ft.), or it may be unknown.

[f] Water quality treatment BMPs can include: oil-water separators (O/W Sep); infiltration, with overflow to outfall (I-O); detention pond or vault, with overflow to outfall (D-O)

Problem No.:	22	Basin ID: P-LP-6
Primary Issue(s)	Land use; loss of use of property; wetland flood storage	
Problem Description	This naturally occurring peat bog wetland system occurs in the 100-year Stillaguamish river floodplain just upstream of the freeway. This large wetland has unsuccessfully been ditched, tiled and drained over the past century. The combination of peat soils and continuing high water levels have resulted in the majority of this land sitting fallow. The majority of the site is dominated by reed canary grass. There is great potential to restore this to historic wetland conditions that will solve hydrograph, water quality and habitat problems in the Portage Creek and potentially the main river system. The site may be instrumental in the development of the City's plans for the Island Crossing area. The geology is Young Alluvial which allows infiltration of stormwater.	
Information Sources	City staff ; former SCP Project 106;	

Problem No.:	23	Basin ID: P-LP-7
Primary Issue(s)	Land use development long term plan	
Problem Description	Need a plan, or input to a regional plan, to address stormwater needs in the newly acquired Island Crossing annexation. Significant portions of this area lie within the 100 year floodplain.	
Information Sources	City staff	

4.4.3 Upper Portage Creek 5th tier basin

The Upper Portage Creek 5th tier basin (Map 5) contains 4.3 miles of streams, more than 90% of which are fish-bearing. The City and its UGA occupy 300 of the basin's 1,080 acres (28%). The City has zoned 163 acres (15%) of the basin residential, including 44 acres (4%) of high density residential area. Another 100 acres (9%) are zoned commercial and industrial, and 37 acres (3%) are zoned as open space public areas. Outside of the UGA, the remaining 780 acres (72%) is primarily rural residential with forested land cover

Problem Areas: Problems and opportunities specific to the Upper Portage 5th tier basin identified during the SCP process are identified below.

Problem No.:	24	Basin ID: P-UP-1
Primary Issue(s)	Infrastructure, Monitoring	
Problem Description	Gaging station including structures, electronic equipment, telemetry, etc is in place but has not been maintained and is in need of refurbishing; located at Pioneer Hall.	
Information Sources	City staff	

Problem No.:	25	Basin ID: P-UP-2
Primary Issue(s)	Flooding, fish passage	

Problem Description	Culverts upstream of the industrial area east of 67th Ave--one under a 15 ft gravel road and another under the BNSF railroad--are undersized and/or prevent fish passage.
Information Sources	1995, 1999, and 2003 assessments, Project 4; City staff

Problem No.:	**26**	**Basin ID:**	**P-UP-3**
Primary Issue(s)	Flood mitigation and prevention		
Problem Description	Limited flood storage within levees along Portage and Kruger Creeks north of Safeway near S. Village Apts resulting from fill above design elevations.		
Information Sources	City staff		

Problem No.:	**27**	**Basin ID:**	**P-UP-4**
Primary Issue(s)	Local flooding, fish passage		
Problem Description	Four undersized and failing culverts at 186th Street NE result in street flooding and restrict fish passage. Location is outside City limits, and street is a one lane, unimproved gravel road which is not maintained by the County (per the sign at 91st Avenue NE). 186th Street is included in the City's long range transportation plan as a three lane arterial.		
Information Sources	1995, 1999, and 2003 assessments, Project 6; City staff		

Problem No.:	**28a**	**Basin ID:**	**P-UP-5a**
Primary Issue(s)	Flood mitigation and prevention, water quality		
Problem Description	This reach of Portage Creek from SR9 to 67th is zoned industrial and has had long term industrial use, including current ownership by Oso Lumber and cabinet shops. Other areas are in an inactive or abandoned state. This site did have in-stream and riparian restoration activity around 1990. The High School Natural Resources program has visited the site occasionally in the recent past and sees opportunity for further restoration activity. Opportunities to mitigate impacts of runoff associated with future development through wetland acquisition and restoration. The geology of this parcel is a combination of Vashon Recessional and Recessional Marine. These geological formations provide good aquifer functions and allow for infiltration of treated stormwater.		
Information Sources	Former SCP Projects 101 through 105; City staff		

Problem No.:	**28b**	**Basin ID:**	**P-UP-5b**
Primary Issue(s)	Flood mitigation and prevention, water quality		
Problem Description	The Hecla wetland (204th to round barn) is also critical in the natural function of Portage Creek and the ability to equilibrate the change in gradient from a steep ravine to the flat areas of Jensen's Farm. The stream needs a storage area for the sediments that naturally deposit at		

	changes in-stream slope. There are also currently fish passage limitations in this wetland. Opportunities to mitigate impacts of runoff associated with future development through wetland acquisition and restoration. The geology is Vashon Advance which allows infiltration when the wetland floods and recharges groundwater at the perimeter. The high groundwater table combined with this geology may sustain baseflows in the stream flow during summer periods.
Information Sources	Former SCP Projects 101 through 105; City staff

Problem No.:	**28c**	**Basin ID:**	**P-UP-5c**
Primary Issue(s)	Flood mitigation and prevention, water quality		
Problem Description	Wetland #1561 is immediately south of the New High School Site. This wetland is located on Glacial Till geology which provides little to no infiltration capability. Therefore the protection of this wetland is a priority for the management of surface waters in the upper Portage Creek watershed. Opportunities to mitigate impacts of runoff associated with future development through wetland acquisition and restoration. The wetland stores water during storm events and continues releasing water throughout the summer helping to maintain base flow levels. This wetland is outside of the City limits , but in the urban growth boundaries. It has a significant impact in providing necessary function to sustain ESA listed species.		
Information Sources	Former SCP Projects 101 through 105; City staff		

Problem No.:	**28d**	**Basin ID:**	**P-UP-5d**
Primary Issue(s)	Flood mitigation and prevention, water quality		
Problem Description	Opportunities to mitigate impacts of runoff associated with future development through acquisition and restoration of Wetland #1247. This is the uppermost headwater wetland that helps to maintain historical stream flow levels. The wetland stores water during storm events and continues releasing water throughout the summer helping to maintain base flow levels. This wetland is outside of the City limits and urban growth boundaries but has a significant impact in providing necessary function to sustain ESA listed species.		
Information Sources	Former SCP Projects 101 through 105; City staff		

4.4.4 Prairie Creek 5th tier basin

Prairie Creek (Map 6) is the westernmost tributary to upper Portage Creek within the City . The Prairie Creek 5th tier basin contains at least 2.5 miles of fish-bearing streams, and supports populations of Coho salmon and native cutthroat trout. The City and its UGA occupy 889 of the basin's 1,194 acres (74%). The City has zoned 587 acres (49%) of the basin residential, including the Gleneagle neighborhood, a master planned development that contains a golf course adjacent to the stream, and including 46 acres (4%) of high density residential area. (The majority of Gleneagle is located in the Middle Quilceda 4th tier basin, described later in this section.) Another 223 acres (19%) are zoned commercial and industrial, and 60 acres (5%) are zoned as public areas such as schools. Outside of the UGA, the remaining 305 acres (26%) is entirely rural residential with land cover predominately in pasture and forest.

Flooding in Prairie Creek is caused by a combination of loss of wetlands, backwater conditions in lower reaches of the creek, and increasing peak flows discharging through the upstream reaches. Hence the problems to be resolved include both reducing the rate of flow from the creek tributaries and limiting the depth of water storage in the mainstem.

The City has made significant changes in the area, including reconstruction of Prairie Creek through the Jensen Business Park. The projects completed include stream habitat improvements, culvert replacement for fish passage, and vegetation along the stream. The City also built a 0.5-acre wetland immediately upstream of 74th Avenue in 2005 to provide flood and sediment storage, off-channel fish habitat, and other wetland functions.

Problem Areas: Problems and opportunities specific to the Prairie Creek 5th tier basin identified during the SCP process are identified below.

Problem No.:	**29**	**Basin ID:**	**P-Pr-1**
Primary Issue(s)	Flooding		
Problem Description	Undersized culvert under 67th Avenue backwaters flow, causing local flooding.		
Information Sources	1995, 1999, and 2003 assessments(??), Project 211; City staff		

Problem No.:	**30**	**Basin ID:**	**P-Pr-2**
Primary Issue(s)	Flooding		
Problem Description	Undersized culverts under BNSF railroad and ~69th Ave reduce conveyance and contributes to flooding in Jensen Business Park.		
Information Sources	1995, 1999, and 2003 assessments(??), Project 213; City staff		

Problem No.:	**31**	**Basin ID:**	**P-Pr-3**
Primary Issue(s)	Flooding		
Problem Description	Under-capacity culvert under 204th Street; replaced culvert in the ‘90s, but another utility intersecting the culvert requires the culvert to be under-sized, thus creating a bottleneck in the stream course.		
Information Sources	Project 212?; City staff		

Problem No.:	**32**	**Basin ID:**	**P-Pr-4**
Primary Issue(s)	Infrastructure, Monitoring		
Problem Description	Gaging station including structures, electronic equipment, telemetry, etc is in place but has not been maintained and is in need of refurbishing;		

	located near Newell Manufacturing upstream of 204th Street.
Information Sources	City staff

Problem No.:	**33**	**Basin ID:**	**P-Pr-5**
Primary Issue(s)	Infrastructure damage, flooding, fish passage		
Problem Description	Sidewalk is collapsing at 71st Avenue (a private road); culvert is undersized; also influenced by channel aggradation (see Problem 34); fish passage is constrained by culvert at road crossing.		
Information Sources	Project 210; City staff		

Problem No.:	**34**	**Basin ID:**	**P-Pr-6**
Primary Issue(s)	Flooding, fish passage, water quality		
Problem Description	Jensen's Business Park reach from 74th Avenue (behind Haggen's) downstream to 204th (by Newell's) is very aggraded due to deposition of large upstream sediment source (left (west) bank failure caused by constraining stream on east bank with SR 9); deposition may be up to 4 feet thick; disturbed channel also subject to dense growth of invasive vegetation (reed canary grass, nightshade); riparian plantings by earlier volunteer groups have limited survival.		
Information Sources	1995, 1999, and 2003 assessments, Projects 2, 8; City staff		

Problem No.:	**35**	**Basin ID:**	**P-Pr-7**
Primary Issue(s)	Infrastructure damage, flooding, fish passage		
Problem Description	74th Avenue culvert is undersized and is influenced by channel aggradation (see projects P-Pr-6 and P-Pr-8); fish passage is constrained by culvert.		
Information Sources	Project 210?; City staff		

Problem No.:	**36**	**Basin ID:**	**P-Pr-8**
Primary Issue(s)	Streambank stabilization, water quality		
Problem Description	Channel straightening and confinement caused by design and construction of SR9, where Prairie Cr drops from Gleneagle down to Kent Prairie, results in chronic bank erosion and sediment recruitment that is deposited in the lower reach between Haggen’s/74th and 204th St. The sediments destroy downstream fish habitat, prevent fish passage, and cause stormwater flooding.		
Information Sources	City staff		

Problem No.:	**37**	**Basin ID:**	**P-Pr-9**
Primary Issue(s)	Flood mitigation and prevention, water quality		
Problem Description	A wetland was filled during the 1980's while redirecting the West Fork Prairie Creek channel from its original southerly path to Quilceda Creek north into the Portage/Prairie Creek system. Arlington Valley Land, owner, was court-ordered to remove the fill and restore wetland vegetation. The Army Corps of Engineers supervised the restoration of the wetland during November 2000. Bank erosion associated with subsequent natural adjustments of the channel (which continues to flow north to Prairie Cr) and variable success of riparian plantings require repeated treatments in an area 3000 ft long by 50 ft wide. The geology is Vashon Advance Outwash, which provides for infiltration and also discharges groundwater as springs. Coho salmon and native cutthroat trout use the stream, preventing the use of bank armoring. The previous owner dedicated a majority of these lands to the City as they no longer had any commercial use.		
Information Sources	City staff		

Problem No.:	**38a**	**Basin ID:**	**P-Pr-10a**
Primary Issue(s)	Flood mitigation and prevention, water quality		
Problem Description	Opportunities to mitigate impacts of runoff associated with future development through wetland acquisition and restoration. Prairie Wetland #H0979 (Mid-Elevation) is still under private ownership and located directly behind Haggen foods. It is in need of hydrological and vegetative restoration. This wetland has been dedicated to restoration in exchange for buffer averaging through Jensen business park.		
Information Sources	Projects 107 through 111?; City staff		

Problem No.:	**38b**	**Basin ID:**	**P-Pr-10b**
Primary Issue(s)	Flood mitigation and prevention, water quality		
Problem Description	Opportunities to mitigate impacts of runoff associated with future development through wetland acquisition and restoration. Prairie Wetland #H1144 is the headwater wetland that occurs just south of the wooden bridge on Crown Ridge Boulevard. This wetland is key to the year around base flow support for Prairie Creek. This wetland will also be very important in protecting Prairie Creek from flashy flows as the wetland will act as a reservoir in storing storm flows and metering them out slowly. The geology of this project is Glacial Till. There is no infiltration which emphasizes the need to protect existing wetlands that help desynchronize stormwater.		
Information Sources	Projects 107 through 111?; City staff		

4.4.5 Kruger Creek 5th tier basin

The Kruger Creek 5th tier basin (Map 7) contains the easternmost tributary to upper Portage Creek within the City. Kruger Creek is about 1.2 miles in length with no known tributaries. The lower three-quarters of the stream are fish-bearing; the remaining upper reach is a perennial, nonfish-bearing stream. Upstream of Kent Prairie Elementary School, from about 207th Street to 196th Street, Kruger Creek parallels Burn Road in a narrow, deeply incised ravine as the stream flows at about a 10% gradient off the till of the Getchell Plateau. The road constrains the stream tightly against its steep west bank. There are several locations along the stream where the mass wasting of the side slopes delivers sediment to the channel. Sediment is transported downstream to the flatter gradient reaches of the basin. The City maintains a sedimentation basin in the channel at the outlet of the Burn Road culvert to excavate sediment deposited each year. A rock cascade at the lower end of this basin allows fish passage while facilitating sediment transport downstream of the basin between Burn Road and 207th Street NE.

The City and its UGA occupy 189 of the 416 acres in the basin (45%). Most of the City's area is zoned residential (137 acres, or one third of the basin), but the Kruger basin has more area in high density residential (18%) than in low to moderate density residential areas (15%). Nine acres (2%) is zoned commercial, and no parcels are zoned for industrial use. Kent Prairie Elementary School occupies the 3.2 acres of public facilities (<1%). Approximately 40 acres (nearly 10% of the basin) is part of the Brekhus-Beach annexation that is intended to eventually contain a high-density master planned development. Outside of the UGA, the remaining 227 acres (55%) is primarily rural residential with forested land cover. It is possible that residential development in the County is delivering increasing stormwater runoff to the creek, which is exacerbating the erosion described above.

Problem Areas: Problems and opportunities specific to the Kruger 5th tier basin identified during the SCP process are identified below.

Problem No.:	**39** **Basin ID:** **P-K-1**
Primary Issue(s)	Water quality, fish habitat
Problem Description	Two old farm lane crossings are obsolete and culverts should be removed and the channel bed restored. In addition, riparian plantings have occurred along the lower mainstem of Kruger Creek where residential and commercial developments on the former Jensen farm site impacted riparian vegetation. Fair to good success planting survival has created opportunities to interplant and thus improve shading to reduce stream temperatures. In addition, the listings of the Chinook Salmon and Bull Trout have made the original buffers established on the Jensen Farm development obsolete. Restoration of adjacent riparian areas is necessary to meet regulations and create properly functioning conditions necessary to facilitate salmon recovery. Buffer averaging opportunities may exist.
Information Sources	1995, 1999, and 2003 assessments, Project 120; City staff

Problem No.:	**40** **Basin ID:** **P-K-2**

Primary Issue(s)	Local flooding, sedimentation
Problem Description	The Kruger Creek culvert under Stillaguamish Ave. is reaching end of its service life. It is rusting out and needs replacement.
Information Sources	City staff

Problem No.:	**41**	**Basin ID:**	**P-K-3**
Primary Issue(s)	Stream restoration, fish habitat, water quality, flooding		
Problem Description	Kruger Creek from 207th Street (senior living) downstream parallel to Stillaguamish Ave is chronically impacted by sediment deposition from upstream sources, and is highly erosive due to its channelization with the relocation of Burn Road. Burn Road was built directly down the ravine that previously allowed for meandering and sediment storage functions. The resulting high levels of sediment fill the lower channel as the gradient moves from steep to nearly level. The current condition of the stream results in flooding of Burn Road during heavy rain events. Coho salmon and cutthroat trout habitat in the stream is also impacted. Riparian plantings along the stream and Wallace Ponds would need to be protected. Wallace Ponds (Twin Ponds) provide an opportunity for flood and sediment storage, and perhaps off-channel habitat. However, the ponds are not natural and were originally wetlands that were dredged a number of times before the existing conditions were developed. The ponds will rapidly fill with sediment and become an emergent wetland if sediment from the upland is not first stabilized. The geology is a combination of Vashon Recessional Marine and Vashon advance. Both aquifer recharge and discharge may occur.		
Information Sources	Project 112; City staff		

Problem No.:	**42**	**Basin ID:**	**P-K-4**
Primary Issue(s)	Local flooding, sedimentation		
Problem Description	The Kruger Creek culvert under 207th Street is reaching end of its service life. It is rusting out and needs replacement.		
Information Sources	City staff		

Problem No.:	**43**	**Basin ID:**	**P-K-5**
Primary Issue(s)	Local flooding, sedimentation, fish passage		
Problem Description	The culvert crossing at Burn Road at the downstream end of the Kruger Creek ravine is under capacity due to excessive deposition of sediment from upstream sources. Annual sediment removal is required. The culvert is also undersized for fish passage in this anadromous stream..		
Information Sources	City staff; SCP modeling results (see 5.3.3)		

Problem No.:	44	Basin ID: P-K-6
Primary Issue(s)	Local flooding, water quality, sedimentation	
Problem Description	Unstable side slopes (4,000 ft long x 20 ft wide) and winter road sand in the Burn Road ravine are chronic sediment sources delivered to and through the Burn Road culvert. City crews remove 20 to 30 cubic yards of debris and soil each year from sedimentation basin downstream of the Burn Road culvert in order to maintain conveyance capacity of the channel. Stabilization of the sediment sources is required.	
Information Sources	1995, 1999, and 2003 assessments, Project 3; City staff	

Problem No.:	45	Basin ID: P-K-7
Primary Issue(s)	Flood mitigation and prevention, Sediment control	
Problem Description	Opportunity to reduce downstream flooding (within City), as well as reduce sediment recruitment in the downstream ravine, by creating a 2-stage off-channel detention facility near Burn Road and 196th Street that would reduce peak flows; wetlands in this area should be protected, and perhaps enhanced and enlarged to provide additional natural hydrologic control during storm events.	
Information Sources	1995, 1999, and 2003 assessments, Project 9; City staff	

4.5 I-5 Reach 4th tier basin

The Lower Mainstem segment of the Stillaguamish River, as defined here, includes Portage Creek (above) and the residual lands along the river between the meander bend abutting SR 530 downstream to the confluence with Portage Creek(Map 1, Map 4). This 811 acres lies entirely within the County except for a small portion of the Island Crossing annexation. It is generally undissected by streams, and supports agriculture and rural residential uses. No features of known importance are identified for this 4th tier basin; its inclusion provides contiguous and comprehensive coverage of basins on the south bank of the mainstem Stillaguamish upstream of the confluence with Portage Creek.

4.6 Old Town Northeast 4th tier basin

The Old Town Northeast 4th tier basin (Map 8) includes all areas of the City that drain to the South Fork Stillaguamish River between (east of) the Old Town 4th tier basin and (west of) the Eagle Creek 4th tier basin. It includes 1.1 miles of river shoreline, but the basin is undissected by natural surface drainages, discharging to the river via groundwater or through two outfalls shown in Table 4-4.

The 189 acre basin lies entirely within the City's UGA. Nearly 144 acres (76%) is zoned residential, including 45 acres (24%) of high density residential area, much of which is not yet built. Business/commercial and public uses (Terrace Park and three schools) each occupy about 21 acres (11% each) of the basin. The South Fork floodplain that was formerly part of Country

Charm Dairy was recently purchased by the City. Although currently zoned low to moderate-density residential, the current proposal is to use it for parks, stream and wetland restoration and riparian enhancements along the river to support salmon recovery efforts.

4.6.1 Talcott 5th tier basin

The Talcott 5th tier basin discharges runoff from about 67 acres of Old Town Northeast to a 24-inch concrete pipe outfall to the South Fork Stillaguamish River under the Lincoln Bridge on SR 530 near the Seventh Day Adventist Church. The outfall is estimated to be 30 vertical feet above the river and drains through a steep riprap bank revetment, reaching the river as groundwater or perhaps dispersed overland flow. Two-thirds of the basin is zoned residential, 3% is in commercial use, and 30% of the basin is in public uses (Terrace Park and the schools).

Problem Areas: Problems and opportunities specific to the Talcott 5th tier basin identified during the SCP process are identified below.

Problem No.:	**46**	**Basin ID:**	**OTNE-T-1**
Primary Issue(s)	Water quality, TMDL, ESA		
Problem Description	Talcott outfall discharges to South Fork Stillaguamish River with little or no treatment, resulting in unquantified impacts to river water quality and the City's ability to meet its TMDL and ESA responsibilities. An opportunity exists for treatment in a constructed wetland on a former dairy.		
Information Sources	SCP inventory; City staff		

Problem No.:	**47**	**Basin ID:**	**OTNE-T-2**
Primary Issue(s)	Water quality, TMDL, ESA		
Problem Description	Opportunity to restore riparian corridor along the South Fork with benefits including: reductions in water temperature, natural recruitment of woody debris; deposition of sediment load; and habitat improvements for salmon recovery, including ESA-listed species.		
Information Sources	1995, 1999, and 2003 assessments, Project 116; City staff		

Problem No.:	**48**	**Basin ID:**	**OTNE-T-3**
Primary Issue(s)	Local flooding		
Problem Description	Catch basin at toe of cut slope on south side of Division Street at Talcott is easily covered or clogged by sediment and leaves causing local flooding.		
Information Sources	SCP inventory; City staff		

Table 4-4. Basin Delineation and Outfall Attributes within the Old Town Northeast 4th Tier Basin in the SCP Study Area

Basin Tier			n^{th} Tier Basin Area (acres)[a]	Outfall[b]					
4	5	6		ID[c]	Drainage Area (acres)[d]	Size[e]	Type	To[f]	Treatment
Old Town NE	Talcott	n/a	67	Talcott	67	24 in.	Pipe	SF River	O/W Sep
	Broadway	n/a	8.8	Broadway	8.8	18 in.	Pipe	SF River	None known
	Wrobliski	n/a	5.6	None					Infiltration
	Seventh Day	n/a	0.6	None					Infiltration
	Residual	n/a	107	None					Infiltration
4^{th} tier basin totals			189						

[a] Basin area values apply to the smallest delineated basin shown.
[b] An outfall is a point of interchange where stormwater is discharged from City infrastructure to a natural feature, whether river, stream, wetland, or ground surface.
[c] Where outfall ID is "None", no outfall as defined above is known to exist.
[d] Area draining to an outfall may be smaller than the nth tier basin that it is contained in.
[e] Size is pipe diameter in inches (in.), or ditch top width in feet (ft.), or it may be unknown.
[f] Talcott and Broadway outfalls discharge to the South Fork Stillaguamish River

Problem No.:	49	Basin ID: OTNE-T-4
Primary Issue(s)	Local flooding, conveyance limitations	
Problem Description	SCP model results indicate surcharging along 4th St near Clara, and Alcazar Ave near Division, 5th, Park Hill, and Gilman, and resulting localized flooding during intense rainfall, when flows surface from catch basins to flow down slope across roads and properties. Observations did not support model results until January 2009 storm event. Flooding also observed on Gilman near Manhattan.	
Information Sources	SCP inventory and modeling; City staff	

4.6.2 Broadway 5th tier basin

The Broadway 5th tier basin drains 8.8 acres of Old Town Northeast to an 18-inch concrete pipe outfall to the South Fork Stillaguamish River near the north end of Broadway Avenue. The outfall is estimated to be 10 vertical feet above the riverbed and 50 feet from the low flow channel. It drains via a small channel through shrubs toward the river, but generally small flow volumes have been observed to infiltrate in sandy sediments. During high river flows, the outfall is only a short distance from the water. The pipe from Broadway Avenue to the outfall is passes under a garage at the north end of the street. About 1.4 acres of the basin (15%) is zoned high density residential; the remaining 7.5 acres (85%) is in commercial use.

Problem Areas: Problems specific to the Broadway 5th tier basin identified during the SCP process are identified below.

Problem No.:	50	Basin ID: OTNE-B-1
Primary Issue(s)	Water quality, TMDL, ESA	
Problem Description	Broadway outfall discharges to South Fork Stillaguamish River with little or no treatment; impacts river water quality and City's ability to meet its TMDL and ESA responsibilities.	
Information Sources	SCP inventory; City staff	

4.7 Eagle Creek 4th tier basin

The Eagle Creek 4th tier basin (Map 9) drains northerly to the South Fork Stillaguamish River along the eastern margin of Old Town. The headwaters of Eagle Creek and its tributary, Indian Creek, drain steeply from the northern end of Burn Hill to the South Fork Stillaguamish floodplain, then flow through low gradient meanders, wetlands, and channelized reaches to its confluence with the South Fork near the northeast corner of the City. Total stream channel length is about 4.64 miles, including 3.61 miles (78%) of fish-bearing streams (Table 3-5).

Another important stream feature within this basin is the 2007 implementation of a stream restoration project on the South Fork floodplain. Objectives include habitat enhancement through meander construction, and longterm temperature reduction through riparian planting. The project was a cooperative effort between local landowners, Arlington School District, watershed groups, and the City.

The basin's 657 acres are contained within the City (374 acres, 57%), its UGA (106 acres, 16%), and Snohomish County (177 acres, 27%). The City has zoned 149 acres (23%) of the basin for residential use, including 21 acres (3%) of high density residential area. Approximately 374 acres of the 657 acres (57%) in the basin are within the City's UGA. Commercial areas (medical services) compose 7.6 acres (1%), and schools and parks 30 acres (5%).

A significant portion of the basin under City jurisdiction (294 acres, 45%) has not had zoning assigned. Much of this unzoned area is the Brekhus-Beach annexation and is intended to be a receiving area within the Transfer of Development Rights Program (TDR) instituted by the City and Snohomish County. Currently rural residential with predominately forest cover, it is intended to be a master plan neighborhood with a preliminary projection of 1,800 single family residences and some small businesses.

Outside the UGA, Snohomish County governs 177 acres (27%) of the basin in rural residential and agricultural land use generally split along Tviet Road. To the north, nearly all of the basin is in agriculture, with an emphasis on pasture. To the south, adjacent to the UGA area designated as a TDR receiving area, are a number of rural residential parcels that are predominately forested.

Two stormwater outfalls to streams are known to occur within the basin (Table 4-5). One of the outfalls is an overflow pipe from a detention pond that discharges to Eagle Creek during large storm events after storage in the pond has been fully utilized. The range of design storms for which the pond has been constructed has not been evaluated.

Problem Areas: Problems and opportunities specific to the Eagle Creek 5th tier basin identified during the SCP process are identified below.

Problem No.:	**51**	**Basin ID: E-1**
Primary Issue(s)	Water quality, TMDL, Fish habitat	
Problem Description	High density development in the Brekhus-Beach annexation (a receiving area in the City under the TDR program) and build-out in other areas in the UGA will put significant pressure on the stream, including the potential for increased runoff into Eagle Creek; many wetlands in the system still need to be delineated; steep slopes could become sediment sources; water quantity and quality control measures may be needed to reduce the potential of impacts to Eagle Creek and the South Fork.	
Information Sources	SCP inventory; City staff	

Problem No.:	**52**	**Basin ID: E-2**
Primary Issue(s)	Fish passage	
Problem Description	The Tviet Rd culvert on Indian Creek (tributary to Eagle Creek) is considered a complete barrier to fish passage (Coho salmon and trout). Area fish biologists consider this culvert a high priority for replacement. The Brekhus-Beach annexation will discharge runoff to Eagle Creek.	
Information Sources	1995, 1999, and 2003 assessments, Project 118; City staff	

Table 4-5. Basin Delineation and Outfall Attributes within the Eagle Creek 4th Tier Basin in the SCP Study Area

Basin Tier			nth Tier Basin Area (acres)[a]	Outfall[b]					
4	5	6		ID[c]	Drainage Area (acres)[d]	Size[e]	Type	To	Treatment[f]
Eagle Creek	n/a	n/a	657	215th St	n/a	n/a	Pipe	Stream	None known
	n/a	n/a		Tviet Rd	n/a	12 in.	Pipe	Stream	D-O
4th tier basin totals			657						

[a] Basin area values apply to the smallest delineated basin shown. (No 5th or 6th tier basins have been delineated within Eagle Creek.)
[b] An outfall is a point of interchange where stormwater is discharged from City infrastructure to a natural feature, whether river, stream, wetland, or ground surface.
[c] Where outfall ID is "None", no outfall as defined above is known to exist.
[d] Area draining to an outfall may be smaller than the nth tier basin that it is contained in.
[e] Size is pipe diameter in inches (in.), or ditch top width in feet (ft.), or it may be unknown.
[f] Water quality treatment BMPs can include: oil-water separators (O/W Sep); infiltration, with overflow to outfall (I-O); detention pond or vault, with overflow to outfall (D-O)

Problem No.:	53	Basin ID: E-3
Primary Issue(s)	Fish passage	
Problem Description	The Tviet Rd culvert on Eagle Creek is a fish passage barrier to Coho salmon and trout. The Brekhus-Beach annexation will discharge runoff to Eagle Creek.	
Information Sources	City staff	

Problem No.:	54a	Basin ID: E-4a
Primary Issue(s)	Fish habitat, Water quality, Flood prevention and mitigation	
Problem Description	Wetland enhancement opportunities in lower Eagle Creek (Wetland #SH0888) provide resource benefits to fish and water quality, and storage and treatment of flood flows from upstream development in the improved wetlands. This naturally occurring acre wetland immediately north of old town has partially restored to provide improved rearing habitat for salmonids. The Eagle creek stream channel below has also been partially restored by the Stillaguamish tribe. Juvenile salmonids continue to use the channelized stream but its habitat is limited. The land continues to be very wet and severely limits the use. This wetland system is located in the floodplain on Young Alluvial soils.	
Information Sources	1995, 1999, and 2003 assessments, Project 115; City staff	

Problem No.:	54b	Basin ID: E-4b
Primary Issue(s)	Fish habitat, Water quality, Flood prevention and mitigation	
Problem Description	Wetland enhancement opportunities in lower Eagle Creek (Clay Cliff Ponds #SH0860) provide resource benefits to fish and water quality, and storage and treatment of flood flows from upstream development in the improved wetlands. This 23-acre wetland is located in an old oxbow of the South Fork Stillaguamish. It is frequently inundated by minor river flooding events. It is located downstream from the channelized area created by the High School Agriculture department in the late 1960s (see project E-4a), and upstream of the lowest reach through the Graafstra dairy farm before its confluence with the South Fork. The open water wetland is in good condition but is occasionally impacted by poachers entering from the upstream and downstream areas. There is a variety of wildlife living in the wetland including deer, beaver, coyotes, skunk, water fowl, fish, and hawks. This wetland is located in the floodplain on young alluvial geology. The water table is very close to the surface, and the hydrology is augmented by springs.	
Information Sources	1995, 1999, and 2003 assessments, Project 117; City staff	

4.8 Burn Road Creek 4th tier basin

The west bank of the South Fork Stillaguamish River upstream of its confluence with Eagle Creek is completely outside of the City's UGA. However, because the area generally lies within the City's future planning area, and since it does influence water quality in the mainstem and South Fork Stillaguamish Rivers near the City, the City has mapped as a 3rd tier basin the Upper South Fork Stillaguamish River. It contains two 4th tier basins, an unnamed tributary to the South Fork originating along Burn Road (Map 10), and the intermediate lands along the west bank of the South Fork from this tributary down to Eagle Creek (Maps 1, 9 and 10).

In this document, the otherwise unnamed tributary stream is called Burn Road creek (Map 10). The stream discharges to the South Fork across from River Meadows Park (which is on the east bank). Total channel length is nearly 6 miles, and includes 4.7 miles (79%) of fish-bearing streams, 0.3 miles (5%) of perennial nonfish-bearing streams, and 0.9 miles of intermittent nonfish-bearing streams (Table 3-5).

This rural residential 4th tier basin is 1,633 acres in size and is dominated by forest and small farm pastures under Snohomish County jurisdiction. Because most of the basin is situated on glacial till or has a shallow depth to bedrock, all of the soils have a moderate to high potential to generate runoff during storms (Tables 4-2; 4-4).

No stormwater inventories are known to exist in this basin, but most outfalls are likely to be ditches draining roads and small roadside areas.

4.9 Tviet Loop Reach 4th tier basin

This 4th tier basin contains lands draining to the South Fork Stillaguamish River between the unnamed Burn Road creek (see previous section) and Eagle Creek (Maps 1, 9, and 10). The basin's 683 acres lie entirely within Snohomish County, are generally undissected by streams, and support rural residential and agricultural uses. The area is likely to be evaluated for development by the City during future planning efforts, and is included to provide evaluation of contiguous basins in and adjacent to the City.

No stormwater inventories are known to exist in the Tviet Loop Reach 4th tier basin, but most outfalls are likely to be ditches draining roads and small roadside areas.

4.10 Middle Fork Quilceda Creek 4th tier basin

The previous nine 4th tier basins, totaling 17,756 acres, or 70% of the 25,448 acre SCP study area, are all within the Stillaguamish basin (a 1st tier basin as per Section 3.1.3). These basins include about 4,009 acres within the City and its UGA, or more than 62% of the 6,425 acres under City jurisdiction.

One 4th tier basin, Middle Fork Quilceda Creek, contains 7,692 acres, or 30% of the SCP study area, and is the only basin in the study area to drain to the 3rd tier Quilceda Creek, part of the Snohomish River 1st tier basin (Map 1). The City occupies about 2,416 acres of the Middle Fork

Quilceda, or about 38% of the City's jurisdiction. Within the study area, this 4th tier basin is second in total area to Portage Creek (12,362 acres).

Three 5th tier basins have been delineated within the Middle Fork Quilceda Creek 4th tier basin: Edgecomb Creek, Heyho Creek, and Mainstem Middle Fork Quilceda Creek (Table 4-6). Most of the City and its UGA within this 4th tier basin are contained within the Edgecomb Creek and Heyho Creek 5th tier basins (1,135 and 1,266 acres, respectively). Only about 16.2 acres under City jurisdiction within the Mainstem Middle Fork Quilceda Creek basin.

Total stream length in the basin, including tributaries, is approximately 21.6 miles (Table 3-5). About 12.9 miles (60%) are known to bear fish or provide fish habitat. Another 1.6 miles (7%) are perennial nonfish-bearing streams, and 5.6 miles (26%) are intermittent nonfish-bearing streams. Just over 1.5 miles of streams (7%) have not yet been classified (Table 3-5).

Both Edgecomb Creek and Heyho Creek have their headwaters within the City. Large areas of the basin within the City, such as the airport and the Smokey Point neighborhood are undissected by streams.

Less than one-third of the 4th tier basin is under City jurisdiction and is zoned as follows: residential (649 acres, 8% of the basin); commercial (543 acres, 7%); industrial (567 acres, 7%); public (576 acres, 7%), and not zoned (81 acres, 1%) (Table 3-12). The City's public uses include Aviation Flightline open space and one school. Snohomish County and the City of Marysville share jurisdiction for the remaining 5,276 acres (69% of the 4th tier basin). This area has been in rural residential and agricultural land use, but is generally developing quite rapidly.

Numerous stormwater outfalls to streams occur within the basin as shown in Table 4-6. Many of the outfalls are overflow pipes from detention facilities that discharge to streams during large storm events after storage in detention ponds or the soil has been fully utilized. The range of design storms for which these facilities has been constructed has not been evaluated. The City also relies heavily on infiltration systems for stormwater management on private parcels in this 4th tier basin. Shallow depths to groundwater associated with a groundwater divide that parallels 172nd Street are frequently problematic in designing stormwater control for development activities in the southern portion of this vicinity.

continued

Table 4-6. Basin Delineation and Outfall Attributes within the Middle Fork Quilceda 4th Tier Basin in the SCP Study Area

Basin Tier			n^{th} Tier Basin Area (acres)[a]	Outfall[b]					
4	5	6		ID[c]	Drainage Area (acres)[d]	Size[e]	Type	To	Treatment[f]
MF Quilceda	Edgecomb	Mainstem Edgecomb	718	Crown	n/a	n/a	Pipe	Stream	D-O
				Gale	n/a	n/a	Pipe	Stream	D-O
		Gleneagle Branch	400	Gleneagle 1	n/a	16	Pipe	Stream	O/W Sep
				Gleneagle 2	n/a	12	Pipe	Stream	O/W Sep
				Gleneagle 3	n/a	12	Pipe	Stream	O/W Sep
				Gleneagle 4	n/a	12	Pipe	Stream	O/W Sep
				Gleneagle 5	n/a	18	Pipe	Stream	Wetland overflow
				Gleneagle 6	n/a	12	Pipe	Stream	O/W Sep
				Gleneagle 7	n/a	12	Pipe	Stream	O/W Sep
				Gleneagle 8	n/a	24	Pipe	Stream	D-O
				Gleneagle 9	n/a	12	Pipe	Stream	O/W Sep
				Gleneagle 10	n/a	15	Pipe	Stream	O/W Sep
				Gleneagle 11	n/a	15	Pipe	Stream	O/W Sep
				Gleneagle 12	n/a	30	Pipe	Stream	D-O
				Gleneagle 13a	n/a	12	Pipe	Stream	O/W Sep
				Gleneagle 13b	n/a	12	Pipe	Stream	O/W Sep
				Gleneagle 14	n/a	18	Pipe	Stream	D-O
				Gleneagle 15	n/a	16	Pipe	Stream	None
				Gleneagle 16	n/a	16	Pipe	Stream	O/W Sep
				Gleneagle 17	n/a	6	Pipe	Stream	None
				Gleneagle 18	n/a	18	Pipe	Stream	None
				Gleneagle 19	n/a	12	Pipe	Stream	None
				Gleneagle 20	n/a	12	Pipe	Stream	None
				Gleneagle 21	n/a	30	Pipe	Stream	D-O
				67^{th} Ave 1	n/a	24	Pipe	Stream	D-O
				67^{th} Ave 2	n/a	24	Pipe	Stream	D-O
				67^{th} Ave 3	n/a	18	Pipe	Stream	O/W Sep

				BNSF	n/a	20	Pipe	Stream	D-O
				172nd St 1	n/a	18 ft	Ditch	Stream	None
				172nd St 2	n/a	8 ft	Ditch	Stream	None
				172nd St 3	n/a	11 ft	Ditch	Stream	None
		McPherson Branch	300	Gleneagle 22	n/a	18	Pipe	Stream	D-O
				Incline	n/a	NA	Pipe	Stream	D-O
				172nd St 4	n/a	8 ft	Ditch	Stream	None
				67th Ave 4	n/a	12	Pipe	Stream	None
		Shoultes Channel	358	51st 1	n/a	12	Pipe	Stream	None
				Turf	n/a	20 ft	Ditch	Stream	None
	Heyho	Lower Heyho	1,461	Country 1	n/a	22 ft	Ditch	Stream	None
				Country 2	n/a	12 ft	Ditch	Stream	None
				Country 3	n/a	14	Pipe	Stream	D-O
		Upper Heyho	1,063	None					Infiltration
	Mainstem MF Quilceda	n/a	3,392	None in City[g]					
4th tier basin totals			7,692						

[a] Basin area values apply to the smallest delineated basin shown.
[b] An outfall is a point of interchange where stormwater is discharged from City infrastructure to a natural feature, whether river, stream, wetland, or ground surface.
[c] Where outfall ID is "None", no outfall as defined above is known to exist.
[d] Area draining to an outfall may be smaller than the nth tier basin that it is contained in.
[e] Size is pipe diameter in inches (in.), or ditch top width in feet (ft.), or it may be unknown.
[f] Water quality treatment BMPs can include: oil-water separators (O/W Sep); infiltration, with overflow to outfall (I-O); detention pond or vault, with overflow to outfall (D-O)
[g] Only about 16 acres of this area are within the City or its UGA and there are no known outfalls. Most of this area is within Snohomish County, or the City of Marysville or its UGA.

4.10.1 Edgecomb Creek 5th tier basin

Edgecomb Creek begins as two branches within ravines in the Getchell Plateau, both of which drop steeply to the low relief of the Marysville Trough where they join (Map 11). The northern channel, called the Gleneagle Branch in this assessment, drains much of the Gleneagle subdivision north to near 188th Street, where it turns south, paralleling the BNSF railroad south to 172nd Street. The low gradient segment along the railroad is intermittent for much of its length, including its crossing under 172nd Street near 63rd Avenue. The southern channel, called the McPherson Branch in this assessment, drains the Gleneagle (Wedgewood area), Eaglecrest View, and The Crossing at Edgecomb subdivisions, 172nd Street, and areas within the UGA and the County south of 172nd Street, west to 67th Avenue. It is a perennial channel for its length along 172nd Street and extending downstream under 67th Avenue and the BNSF railroad. Both branches meet in the existing pasture south of 172nd and west of 67th Avenue, and then continue s along lot lines to the south and west, leaving the City as a perennial stream south of Crown Distributing near 59th Avenue.

The 5th tier basin includes about 5.6 miles of stream, including 3.1 miles of fish bearing streams, 1.1 miles of perennial nonfish-bearing streams, 1.4 miles of intermittent nonfish-bearing streams. Within the low gradient reaches in the Marysville Trough, Edgecomb Creek was historically extensively channelized along property boundaries to promote drainage.

The City and its UGA occupy 1,135 of the basin's 1,776 acres (64%). The City has zoned 387 acres (22%) of the basin residential, including a majority of the Gleneagle neighborhood, a master planned development that contains a golf course adjacent to the stream. Another 542 acres (30%) are zoned commercial and industrial, and 125 acres (7%) are zoned as public areas such as schools. About 80.5 acres (under 5%) of recently annexed area south of 172nd Street along the McPherson Branch have not yet been zoned. Outside of the UGA, the remaining 641 acres (36%) is entirely rural residential with land cover predominately in pasture; the area is anticipated to include residential, commercial, and industrial development in the foreseeable future.

Problem Areas: Problems and opportunities specific to the Edgecomb Creek 5th tier basin identified during the SCP process are identified below.

Problem No.:	**55**	**Basin ID: MFQ-E-1**
Primary Issue(s)	Flooding, conveyance
Problem Description	Flooding in the vicinity of 67th Avenue and 188th Street (e.g., HCI Steel) associated with the Gleneagle Branch of Edgecomb Creek has been a problem since construction in the Gleneagle neighborhood began. Drainage improvements, including construction of an overflow-to-infiltration pond circa 2000, appear to have mitigated many of these problems. Conveyance issues persist, however, including flooding of 67th Avenue and HCI Steel in the January 2009 storm. A number of issues may contribute to the flooding, including, but not limited to: restrictions from undersized culverts at 182nd St, a BNSF RR siding, an unmaintained ROW at ~177th, Lumberman's, and 172nd Street; an

	unmaintained and aggrading channel almost entirely within BNSF RR ROW; various unmaintained private storm facilities along the channel south (downstream) of 188th St; reduction in infiltration pond efficiency through time NW of 67th Ave and 188th St; and possible flow increases associated with development and/or loss of stormwater storage due to a lack of storm structure maintenance in the Gleneagle neighborhood. This problem statement addresses the culvert at 182nd St.
Information Sources	1995, 1999, and 2003 assessments Project 13; SCP inventory; City staff

Problem No.:	**56**	**Basin ID:**	**MFQ-E-2**
Primary Issue(s)	Flooding, conveyance		
Problem Description	See Prob No 55 (Basin ID MFQ-E-1). This problem statement addresses the culvert under the BNSF siding.		
Information Sources	1995, 1999, and 2003 assessments Project 13; SCP inventory; City staff		

Problem No.:	**57**	**Basin ID:**	**MFQ-E-3**
Primary Issue(s)	Flooding, conveyance		
Problem Description	See Prob No 55 (Basin ID MFQ-E-1). This problem statement addresses the culvert in the unmaintained ROW at about 177th, just downstream of the BNSF siding.		
Information Sources	1995, 1999, and 2003 assessments Project 13; SCP inventory; City staff		

Problem No.:	**58**	**Basin ID:**	**MFQ-E-4**
Primary Issue(s)	Flooding, conveyance		
Problem Description	See Prob No 55 (Basin ID MFQ-E-1). This problem statement addresses the maintenance of the channel adjacent to the railroad.		
Information Sources	1995, 1999, and 2003 assessments Project 13; SCP inventory; City staff		

Problem No.:	**59a**	**Basin ID:**	**MFQ-E-5a**
Primary Issue(s)	Flooding, conveyance		
Problem Description	See Prob No 55 (Basin ID MFQ-E-1). This problem statement addresses the conveyance of flows under Lumberman's and 172nd Street. One possibility may be to abandon the existing Lumberman's route and re-direct the channel due south under 172nd St at a new location.		
Information Sources	1995, 1999, and 2003 assessments Project 13; SCP inventory; City staff		

Problem No.:	**59b**	**Basin ID:**	**MFQ-E-5b**
Primary Issue(s)	Flooding, conveyance		
Problem Description	See Prob No 55 (Basin ID MFQ-E-1). This problem statement addresses the conveyance of flows under Lumberman's and 172nd Street. Another possibility may be to upsize the crossings under Lumberman's and 172nd		

	St at their existing locations.
Information Sources	1995, 1999, and 2003 assessments Project 13; SCP inventory; City staff

Problem No.:	**60**	**Basin ID:**	**MFQ-E-6**
Primary Issue(s)	Flooding, conveyance, fish passage		
Problem Description	The culvert on the McPherson Branch of Edgecomb Creek under the BNSF railroad is undersized and contributes to flooding southeast of 67th Avenue and 172nd Street, causing overflow along 67th Ave south to 152nd St. The culvert is also a partial barrier to fish passage during these events.		
Information Sources	City staff		

Problem No.:	**61**	**Basin ID:**	**MFQ-E-7**
Primary Issue(s)	Flooding, conveyance, fish passage		
Problem Description	Culvert under 67th Ave near McPherson Road has inadequate conveyance, or inadequate downstream conveyance, contributing to overflow along 67th Ave south to 152nd St. The culvert is also a partial barrier to fish passage during these events.		
Information Sources	City staff		

Problem No.:	**62**	**Basin ID:**	**MFQ-E-8**
Primary Issue(s)	Fish habitat, stormwater impact mitigation, aquifer protection		
Problem Description	Opportunity to relocate Edgecomb Creek downstream of confluence on Crown Development property in order to accommodate industrial development while improving channel conditions, water quality and riparian habitat. Current proposal is a stream corridor paralleling the BNSF railroad. This large area was annexed into the City of Arlington and zoned industrial in the early 2000s. Over 90% of this site is made up of hydric soils and historically experienced frequent periods of flooding. The conversion to agriculture over the last century partially drained the wetland by ditching the site and channelizing Quilceda Creek, resulting in poor habitat conditions. The landowners wish to develop the site which will require mitigation and presents restoration opportunities. The geology is Vashon Recessional, but the high groundwater table does not allow for infiltration. This is a recharge area of the Marysville trough aquifer up-gradient of city wells at the airport.		
Information Sources	1995, 1999, and 2003 assessments, Projects 114; City staff		

Problem No.:	63	Basin ID: MFQ-E-9
Primary Issue(s)	Water quality, Fish habitat, aquifer protection	
Problem Description	The turf farm and other commercial facilities south of the airport generates excessive sediment and perhaps other water quality impacts when the turf is removed in large quantities. These releases have potential to violate water quality standards in the intermittent-then-perennial channel (ditch) on the east side of 51st Avenue (Shoultes Road)--a tributary to Edgecomb Creek, which contains Coho and chum salmon--and are regulated under an NPDES General Industrial permit for the Arlington Municipal Airport (landowner).	
Information Sources	SCP inventory; City staff	

Problem No.:	64	Basin ID: MFQ-E-10
Primary Issue(s)	Flooding, water quality, aquifer protection	
Problem Description	The area along 172nd Street NE between SR9 and Smokey Pt Blvd is experiencing significant development. Runoff in this area infiltrates when groundwater levels are low; however, the groundwater is shallow during winter months and limits the ability to dispose of surface water through infiltration. Depths to water table of less than 5 ft limit soil treatment for water quality and increases risk of groundwater contamination in the aquifer and municipal wells serving Arlington. Runoff that cannot percolate into the ground instead flows overland to the south and east to Edgecomb Creek, Shoultes Road channel, or Heyho Creek. A regional approach to stormwater management for lands outside of the WSDOT ROW may be warranted. City of Marysville has prepared an assessment for industrial properties located within Marysville city limits near Smokey Pt that may affect Arlington. Arlington should evaluate its interests in advance of regional transportation improvements.	
Information Sources	1995, 1999, and 2003 assessments Project 14; City staff	

4.10.2 Heyho Creek 5th tier basin

The Heyho Creek (formerly Smokey Point Channel) basin occupies the southwest corner of the City, including the Smokey Point neighborhood annexed by the City in 1999 (Map 12). Heyho Creek initiates in the outwash soils of Marysville Trough and flows intermittently as it crosses the City boundary (dry for at least two months from August to October). The basin includes about 5.8 miles of stream, including 2.6 miles of fish bearing streams, 1.7 miles of intermittent nonfish-bearing streams, and another 1.5 miles of streams that have not been classified. Within the low gradient reaches in the Marysville Trough, Heyho Creek was historically extensively channelized along property boundaries to promote drainage. Only about 1/3 of a mile of an intermittent non-fish bearing reach lies within City jurisdiction. It is associated with the wetland area east of Navy housing on 168th Street, and just south of the proposed Wal-Mart site. (Note that Snohomish County GIS indicates the reach is non-fish bearing; recent reports prepared for Wal-Mart indicate it is fish bearing). Most of this 5th tier basin is largely undissected by streams.

Soils generally promote infiltration of stormwater. Some older Smokey Point neighborhoods have had infiltration systems, but this was in part due to under design of the systems. Wal-mart is building an infiltration system and a detention pond in this basin under the guidance of the 2001 Stormwater Manual (Ecology 2001). The pond overflow pipe will outfall to Heyho Creek.

The City and its UGA occupy one-half of the basin's 2,524 acres. The City has zoned 266 acres (10%) of the basin residential, 552 acres (22%) are zoned commercial and industrial, and 452 acres (18%) are zoned as public areas, including Aviation Flightline and parks. Outside of the UGA, the 1,258 acres (50%) is under the jurisdiction of the City of Marysville and Snohomish County, and includes a composite of residential, commercial, rural residential, and agricultural land uses that are rapidly being developed.

Problem Areas: Problems and opportunities specific to the Heyho Creek 5th tier basin identified during the SCP process are identified below.

Problem No.:	**65**	**Basin ID: MFQ-H-1**
Primary Issue(s)	Aquifer Protection, Infrastructure design	
Problem Description	Svrjcek (2003) indicates significant groundwater contribution to flows in Edgecomb and Heyho Creeks in an area where shallow depths to groundwater persist, and where the groundwater divide (between the Stillaguamish and Snohomish basins) is not understood; stormwater infiltrate may be inadequately treated prior to discharge to streams and wetlands, or may contaminate wells located in this vicinity.	
Information Sources	Svrjcek (2003); Pacific Groundwater Group (2007); SCP inventory, City staff	

Problem No.:	**66**	**Basin ID: MFQ-H-2**
Primary Issue(s)	Water quality	
Problem Description	Apart from basic oil-water separation, runoff from 166th Street discharges untreated to Heyho Creek (identified as impaired for fecal coliform and dissolved oxygen in the Lower Snohomish Tributaries TMDL); water quality treatment in ditched channel is not understood; impacts stream water quality and City's ability to meet its TMDL and ESA responsibilities.	
Information Sources	SCP inventory; City staff	

Problem No.:	**67**	**Basin ID: MFQ-H-3**
Primary Issue(s)	Infrastructure unknown	
Problem Description	Parts of the stormwater system in Smokey Point, annexed by the City in 1999, are without as-builts, and inventory efforts in this low-relief area did not establish adequate invert elevations, nor the location and function of one or more infiltration systems.	
Information Sources	SCP inventory; City staff	

Problem No.:	68	Basin ID:	MFQ-H-4
Primary Issue(s)	Conveyance, flooding due to beavers		
Problem Description	Beaver activity regularly disrupts storm conveyance at locations throughout the City, including Heyho Creek and most of the smaller streams (Prairie. Edgecomb, and Eagle Creeks).		
Information Sources	City staff		

5 HYDRAULIC, HYDROLOGIC, AND WATER QUALITY MODELING

Three types of hydrologic and hydraulic modeling were completed in selected areas during the preparation of the SCP. These analyses are summarized as follows and further described in this section.

- Runoff and Hydraulics: Estimation of runoff from a drainage area and flow routing through a network of drainage facilities.
- Runoff Only: Estimation of runoff from a drainage area to determine order of magnitude conveyance sizing.
- Water Quality Analysis: Pollutant load modeling to compute average annual pollutant loading based on land use in a drainage basin.

Runoff and Hydraulics modeling was used to evaluate the hydrologic process and hydraulic capacity within larger drainage basins, areas with known drainage problems, or neighborhoods where little is known about the stormwater infrastructure.

In order to efficiently predict stormwater runoff and route flows through existing conveyance networks, a simulation program was used. XP's Stormwater Management Model (XPSWMM) was selected to conduct these analyses because of its ability to:

- Calculate runoff from pervious and impervious surfaces,
- Perform dynamic flow routing, and
- Simulate backwater conditions, surcharged flow, and urban systems containing both culverts and open channels.

XPSWMM was originally based on the EPA SWMM program. Its computational accuracy and reporting capabilities have been improved, and it has been approved by the Federal Emergency Management Agency under multiple categories. Modules of the program that were used in this analysis are the RUNOFF module, which predicts the flow and volume of runoff over the course of a storm event, and the HYDRAULICS module, which models flow through drainage facilities such as culverts, ditches and storm drains.

To compute RUNOFF, the model requires the following types of information: rainfall, topography, land use (for percent impervious surface), soils (for runoff characteristics) and drainage system data. The sources of this information are described in the Hydraulic Model Technical Memorandum modeling (URS Corporation2006b). The hydrologic or runoff model for each basin was performed for a series of 24-hour design storm events, including the 2-year, 10-year, 25-year and 100-year events. A more detailed description of these modules and of the modeling assumptions is provided in the technical memorandum modeling (URS Corporation2006b).

For HYDRAULIC routing, a storm drainage network was constructed within the model which was built using rim and invert elevations for storm drains; pipe diameters for storm drains and culverts; and invert elevations and geometry for ditches. Once the model network was established, the estimated runoff flows were routed through the system. Flooding and surcharge information were noted and compared against existing or known problems. New flooding identified by the model was verified with the City knowledge and experience of the storm drainage system.

Runoff Only model analysis was performed for several drainage basins to estimate peak flows within a drainage basin. Estimated flows were then used to provide rule-of-thumb culvert sizes for road crossings.

Water Quality Modeling of pollutant loads for this SCP is based on the “Simple Method” as described by the Center for Watershed Protection (CWP). The model, also used by Ecology for pollutant load modeling, is implemented in a spreadsheet that computes average annual pollutant loading based on land use in each basin. The model uses average annual precipitation, runoff coefficients, and pollutant loading rates for various land use (zoning) categories documented in the literature to predict the water quality of stormwater runoff. A more detailed description of this modeling and assumptions is provided in the Water Quality Loads Model Technical Memorandum (URS Corporation 2006a).

5.1 Modeled Basins

Hydrologic, hydraulic, and water quality modeling was conducted for this SCP for the basins shown in Table 5-1.

Table 5-1. Modeling approaches[1] applied to City Arlington basins for this SCP

Basin[2]		Model		
4th Tier	5th Tier	HYDRAULICS and RUNOFF Modules[3]	RUNOFF Module Only[3]	Water Quality[4]
Old Town	Butler	X		X
	Haller Park			X
	Centennial Trail			X
March	West	X		X
	Other March Cr			X
Portage	Upper Portage		X	X
	Prairie		X	X
	Kruger		X	X

	Lower Portage			X
Eagle	None			X
Old Town NE	Talcott	X		X
	Broadway			X
Tviet Loop Reach[5]	None			X
Middle Fork Quilceda	Edgecomb-Gleneagle Br (6th Tier)	X		X

[1] See introductory text under Section 5 for additional information.
[2] See basin hierarchy defined in Section 3.1.3.
[3] The HYDRAULICS and RUNOFF modules are part of XP's Stormwater Management Model (XP_{SWMM}).
[4] Water quality modeling implements the Center for Watershed Protection's "Simple Method".
[5] Modeled as the "Jordan" basin

The remainder of Section 5 provides basin specific results of the hydraulic modeling (RUNOFF and HYDRAULICS modules, Section 5.2), hydrologic modeling (RUNOFF module only, Section 5.3), and water quality modeling (Section 5.4). Any problem areas identified by the modeling and existing known problem areas (Section 4) are ranked using the criteria presented in Section 8. Section 9 presents potential solutions to these problems as a number of prioritized projects.

5.2 Basin Specific Hydraulic Modeling Results

An XPSWMM model was developed to determine peak runoff, route storm water, and to evaluate the drainage network for four 5th tier basins: Butler, West, Talcott (which together compose most of "Old Town"), and Edgecomb/Gleneagle. These basins were selected by City of Arlington staff either because of known drainage problems, the size of the watershed, or because little was known about the stormwater infrastructure in some of the older neighborhoods.

The model network, a schematic of pipes and nodes, was constructed using aerial photography, City-provided GPS data, survey data, and as-built drawings (URS Corporation2006b). Hydrologic inputs to this system include peak runoff from areas within each basin delivered to nodes on the pipe network. Modeled storms include the 2-, 10-, 25-, and 100-year 24-hour return frequencies; corresponding precipitation for these storms totals 1.80, 2.75, 3.20, and 3.75 inches, respectively (URS Corporation2006b). Because the Old Town neighborhood is nearly fully developed, only one modeling scenario representing built-out conditions was modeled.

5.2.1 Butler 5th Tier Basin and West 5th Tier Basin

The Butler and West 5th tier basins were represented in one model. The Butler 5th tier basin collects stormwater for the core of Old Town and discharges it to the Stillaguamish River at the Butler property just west of the city limits at the north end of town. The West 5th tier basin collects stormwater along West Avenue between 3rd Street and Maple Street and discharges it to the ground in the headwaters of March Creek, a tributary to the middle mainstem Stillaguamish River (as per Section 3.1.3). Basin characteristics are presented in Appendix C.

Water within the drainage area is primarily conveyed within storm drain lines ranging from 12 to 36 inches in diameter. No open channels or ponds were included in the model. Culvert invert elevations, lengths and diameters were referenced from GPS data and as-built drawings provided by the City and survey data collected for the project.

Hydrology was estimated for the 2-year, 10-year, 25-year, and 100-year 24-hour storms. Peak flows were routed through the conveyance network and areas with flooding and capacity issues were identified for future stormwater drainage system upgrades.

The model results identified conveyance problems in the following locations:

- Storm drain along Lenore Avenue, near East 2nd Street (model reference: BE-09);
- Storm drain along First Street, between Gifford and Lenore Avenues (BE-10 and BE-11);
- Trunk line along SR-9 near Burke Avenue (DM-05);
- Storm drain along West Division Street, near North Dunham Avenue(DM-17);
- Storm drain along S West Avenue , south of E 3rd Street (W-09); and
- Storm drain along S Olympic Avenue, north of Maple Street (OL-22).

The duration of the flooding in minutes during the 24-hour period as well as the volume of flood water in cubic feet and acre-feet are reported in Table 5-2.

Flooding concerns at BE-09, BE-10, BE-11, and DM-05 have previously been identified in the 1995, 1999, and 2003 assessment reports and the City has planned projects to resolve these issues. The problems at BE-09, BE-10, and BE-11 are incorporated into Problem Statement 1, and the problem at DM-05 has been included in Problem Statement 2 (Section 4.1.1).

The model indicated flooding issues at DM-17 during the 10-year storm event, which is a significant event. Downstream of the DM-17 manhole, the slope becomes flatter and the pipe decreases from a 24-inch to a 21-inch diameter. These two reductions in the stormwater conveyance performance potential triggered the model to detect flooding during the 10-year storm. The City intends to monitor and record observations in this area during and following storm events to determine if additional modeling, and potentially upgrading the stormwater system, at this location is necessary. This segment has also been included in Problem Statement 2.

The model indicated a problem at W-09 due to an uphill pipe segment. It is believed that this result occurred due to incorrect elevation data. According to the model, W-09 will flood during the 2-year, 24-hour storm event. The City may monitor this segment during higher storm frequencies to determine if a problem exists.

The model estimated that OL-22 will flood during the 10-year storm event. The Olympic line is a new storm drain that was recently installed. The new line has an overflow structure near the intersection of 3rd Street and Olympic Avenue. High storm flows within the Olympic line are allowed to overflow into the existing line (model reference: BD) that runs north, down the alley between Olympic and West. Information on this structure is not well known and the model could be improved with added information. No new problems are expected nor have been reported within the Olympic storm drain line.

continued

Table 5-2. Hydraulic Model Results –Butler and West 5th Tier Basins Flooding Summary

	100-year Storm			25-year Storm			10-year Storm			2-year Storm		
	Flooded	Flood Volume		Flooded	Flood Volume		Flooded	Flood Volume		Flooded	Flood Volume	
Node	Time (min)	(cf)	(ac-ft)	Time (min)	(cf)	(ac-ft)	Time (min)	(cf)	(ac-ft)	Time (min)	(cf)	(ac-ft)
DM-05	127	169,408	3.89	96	128,582	2.95	74	98,538	2.26	40	30,966	0.71
DM-17	38	10,460	0.24	30	8,000	0.18	24	4,687	0.11	--	--	--
BE-09	50	15,207	0.35	42	9,756	0.22	35	5,769	0.13	9	145	0
BE-10	45	7,229	0.17	37	5,909	0.14	30	4,000	0.09	--	--	--
BE-11	26	1,872	0.04	19	708	0.02	--	--	--	--	--	--

5.2.2 Talcott 5th Tier Basin

Although the storm drain network consists of small diameter pipes (6–10 inches), a hydraulic model of the 5th tier Talcott basin was constructed, because the basin is moderately large (approximately 70 acres). A schematic of the Talcott network and detailed basin characteristics are presented in Appendix D. Hydrology was estimated for the 2-year, 10-year, 25-year, and 100-year 24-hour storms and peak flows were routed through the conveyance network.

Initial model results show flooding throughout the basin for all storm events. The flooding in the model is caused by negative slope (uphill) pipe segments at the upper end of the drainage basin as well as small pipe diameters.

The model results identified flooding in the following locations:

- Storm drain along N. Alcazar Avenue, between E. Gilman Street and Park Hill Drive (model reference T-06 & T-07);
- Storm drain along N. Alcazar Avenue, near E. 5th Street (model reference T-09); and
- Storm drain along E. 4th Street, near N. Clara Street (model reference T-12).

During the 2-year event, the model indicated flooding issues at T-06, T-07, T-09, and T-12. Downstream of the T-06 and T-07 manholes, the slopes become flatter while the diameter remains the same. The flatter downstream slope reduces the stormwater conveyance capacity and triggered the model to detect flooding during the 2-year storm. Downstream of T-09, starting at T-07, the slopes become significantly less steep which triggered the model to detect flooding at T-09. The flooding duration estimated for the 100-year storm at T-06, T-07, and T-09 is small compared to the magnitude of the storm event. The flooding detected by the model at T-12 was triggered by the uphill section downstream of that inlet. See Table 5.3 for a summary of model results within the Talcott Basin.

Modeled flood conditions initially did not correlate with the City's observations. Within the last 20 years, the City has no reports of flooding within this area, with the exception of debris clogging at T-07. However, this area did experience street flooding during January 2009 when 2.75 inches of rain fell in less than 24 hours on some residual snow, particularly on Gilman near Manhattan, and on 4th Avenue between Clara and Alcazar.

The soils in the basin are considerably porous (see Appendix D); therefore it is believed that the Talcott stormwater system is not receiving as much as water as the model predicts, particularly during smaller storm events. Several sites in this basin, such as the Immaculate Conception and Seventh Day Adventist Churches, infiltrate all stormwater on site rather than discharge to the public system. Nevertheless, the modeled problem areas above have been incorporated into Problem Statement 49 (Section 4.6.1). Anticipated future development on the former Country Charm Dairy may provide additional cause and/or opportunities for developing solutions for this area.

Table 5-3. Hydraulic Model Results –Talcott 5th Tier Basin Flooding Summary

	100-year Storm			25-year Storm			10-year Storm			2-year Storm		
	Flooded	Flood Volume		Flooded	Flood Volume		Flooded	Flood Volume		Flooded	Flood Volume	
Node	Time (min)	(cf)	(ac-ft)	Time (min)	(cf)	(ac-ft)	Time (min)	(cf)	(ac-ft)	Time (min)	(cf)	(ac-ft)
T-06	437	30,365	0.70	349	21207	0.49	244	14,885	0.34	88	5,846	0.13
T-07	137	5,088	0.12	104	3,692	0.08	76	2,743	0.06	40	1,709	0.04
T-09	50	8,105	0.19	42	5,510	0.13	36	3,594	0.08	19	357	0.01
T-12	1,378	119,364	2.74	1,370	91,484	2.10	1,274	69,076	1.59	687	27,441	0.63

5.2.3 Gleneagle 6th Tier Basin within the Edgecomb 5th Tier Basin

The Gleneagle Branch 6th tier basin (a subbasin within the Edgecomb Creek 5th tier basin) collects stormwater for 400 acres in Gleneagle neighborhood in the south central portion of the city, draining south along the BNSF railroad for much of its lower segment within the city limits. A schematic of the Gleneagle Branch network and basin characteristics are presented in Appendix E.

The basin was evaluated to determine the capacity of the existing storm drainage network under fully developed conditions. The storm drainage network is not a continuous diameter storm drain; it includes a network of pipes with diameters ranging from 12- to 48-inch pipe diameters, channels, and ponds.

Hydrology was developed for the 2-year, 10-year, 25-year, and 100-year 24-hour storms. The focus of this evaluation was to locate potential problems within the existing stormwater system. Previously reported problems were limited to the west side of the basin (downstream of Woodlands Pond), therefore, this section of the basin was analyzed in detail to identify existing culverts that may be undersized.

Stormwater hydraulic problems identified in 1995, 1999, and 2003 assessment memos include: conveyance issues and backwater along 67th Avenue NE (between 182nd Street and 172nd Street), and flooding within the two wetlands located south of 172nd Street NE during the winter months.

Located at the intersection of 67th Avenue and Woodlands Way, Woodlands Pond is a large detention pond that receives flow from the natural headwaters stream (Gleneagle Branch of Edgecomb Creek), and stormwater from the Gleneagle subdivision. Woodlands Pond discharges flow through two outlet pipes: one 36-inch diameter pipe conveys water north to an infiltration pond northwest of the intersection of 188th Street NE and 67th Avenue NE; and a second outlet pipe, 30-inches in diameter, conveys water west to the ditched and straightened stream channel which flows south parallel to the railroad and within BNSF right-of-way. Prior to the January 2009 rain-on-snow flood event, City staff had very seldom observed any water accumulating in the northern infiltration pond, so the modeling effort addressed flow to the south only. Water within the channel is conveyed through series of culverts 18-inches to 36-inches in diameter prior to crossing 172nd Street. The channel also receives flow from a 30-inch diameter culvert located under 67th Avenue NE near Highland View Drive.

The Gleneagle Branch is an intermittent stream not passable by fish in this reach (the upstream limit is a weir located north of 172nd Street). The design storm to evaluate conveyance capacity was therefore the 10-year, 24-hour event. The modeling results (Table 5.4) confirmed flow restrictions at several culverts during 10-year flow conditions that were previously identified in individual problem statements in Section 4.10.1. Culvert numbers refer to a site survey and the hydraulic model system described in Appendix E.

- Culvert near 182nd Street NE (model reference 783) in Problem No. 55;
- Culvert under rail road spur in Problem 56, and an adjacent plugged culvert in Problem 57;

- Storm drains under lumber yard (model references 2330 to 2337) in Problem 59A/B

In addition, the need for maintenance of the ditched stream within the BNSF ROW was identified in Problem No. 58. Removal of debris, sediment, and invasive vegetation would improve conveyance in between the above structures.

The winter time flooding the City has identified south of 67th Avenue was not included in the hydraulic modeling. Flooding concerns were incorporated into Problem No. 62 (also see Problems 60 and 61, in Section 4.10.1).

continued

Table 5-4. Hydraulic Model Results –Gleneagle Branch 6th Tier Basin Flooding Summary

Structure No. [a]	Description / Location	Existing Structure Size (in)	Conveyance Adequate Relative to Depth of Upstream Storage [b]	Proposed Structure Size (in)
1	270 ft. CMP from 67th Ave to railroad (RR) near HCI Steel	24 x 33	Yes	N/A
2A	42 ft. steel pipe from east to west under RR; southern of 2 pipes at this location	36	Yes	N/A
2B	37 ft. concrete pipe from east to west under RR; northern of 2 pipes at this location	24	Yes	N/A
3	40 ft. CMP from north to south under driveway at ~180th St (ID # 783, Appendix E)	18	No	24
4	150 ft. CMP from north to south under RR spur near grain elevator	24	No	27
5	51 ft. Concrete pipe from east detention under RR west to channel near lumber yard	21	Yes	N/A
6	940 ft. of concrete pipe in 8 segments east from channel near RR west to channel near 63rd Ave	18	No	36
Weir	Concrete weir located 130 ft north of 172nd St; 15.5 ft top width by ~5 ft total height with trapezoidal notch ~4 ft wide by ~1 ft deep, flow gate through 1.75 ft square orifice beneath notch is missing	See description	Not evaluated, Effect on Structure No. 6 also not evaluated	N/A
731	Squashed CMP from north to south under 172nd St	24 x 36	Not evaluated	N/A

[a] Strucuture number referenced in Appendix E Attachments 5 and 6

[b] "No" indicates headwater depth is greater than the depth of the channel upstream of the structure, resulting in elevated risk of flooding.

[c] Staff observations indicate existing configuration is adequate with regard to local flooding. The effect of the weir on the hydraulics of Structure No. 6 have not been evaluated.

5.3 Basin Specific Hydrologic Modeling Results

Hydrologic modeling or Runoff only was estimated for Upper Portage Creek, Prairie Creek, and Kruger Creek for the purpose of conceptually sizing culverts at several road crossings. Runoff estimates, drainage basin characteristics and model results are presented in Appendix F.

Peak flows were estimated for the 2-year, 10-year, 25-year, and 100-year 24-hour storms. Each stream was assumed to be fish bearing, and requiring passage of the 100-year storm. During design of culvert improvements or replacements it will be important to consider low flows to provide fish passage. This was not evaluated for the SCP.

The culverts within each subbasin, where flooding has been reported by City staff, are all located at the downstream end of each basin. It was assumed that the entire subbasin would act as the contributing basin area to each culvert. Due to the close proximity of the culvert(s) within each basin, the same design parameters (i.e. flow) were applied globally, therefore one culvert size was estimated for each subbasin.

For the purpose of conceptually sizing a culvert to provide passage of the 100-year storm, the following assumptions were made:

- The culvert is smooth interior;
- There is no tailwater or backwater condition; and
- There is no headwater or surcharging upstream of the culvert.

5.3.1 Upper Portage Creek 5th Tier Basin

The contributing drainage area for Upper Portage Creek is approximately 1,340 acres. Estimated peak flows at the basin outlet for the modeled storm events are shown in Table 5-5.

Table 5-5. Hydrologic Model Results –Upper Portage Creek 5th Tier Basin Design Storms

Design Storm Return Interval	Peak Runoff Rate (cfs)
2-year	60
10-year	139
25-year	184
100-year	243

The two Portage Creek culverts just upstream of 67th Avenue—under the BNSF railroad and the road immediately to the west (69th Ave NE)—have been observed by City staff as barriers to fish passage and contributing to flooding upstream of the railroad (Problem No. 25, Section

4.4.3). Based on this brief analysis, culverts with a minimum diameter of 84-inches (or 7-feet) are recommended for conveyance. Actual design would need to assure fish passage consistent with state regulations. For planning and costing purposes, 8-foot diameter culverts are appropriate.

5.3.2 Prairie Creek 5th Tier Basin

The contributing drainage area for Upper Portage Creek is approximately 1,100 acres. Estimated peak flows at the basin outlet for the modeled storm events are shown in Table 5-6.

Table 5-6. Hydrologic Model Results –Prairie Creek 5th Tier Basin Design Storms

Design Storm Return Interval	Peak Runoff Rate (cfs)
2-year	75
10-year	146
25-year	184
100-year	231

For the Prairie Creek 5th Tier Basin, the following problems have previously been identified (Section 4.4.4):

- 67th Ave NE culvert crossing upstream of Pioneer Museum (Problem No. 29);
- Culverts under BNSF railroad and small road (69th) upstream of 67th Ave NE (Problem 30);
- 204th Street culvert crossing near Newell Machine (Problem No. 31);
- 71st Ave culvert crossing, south of 204th St NE (Problem No. 33); and
- 74th Ave culvert crossing, south of Haggen's grocery store (Problem No. 35).

Based on this brief analysis, culverts with a minimum diameter of 84-inches (or 7-feet) are recommended for conveyance. Actual design would need to assure fish passage consistent with state regulations. For planning and costing purposes, 8-foot diameter culverts are appropriate.

5.3.3 Kruger Creek 5th Tier Basin

The contributing drainage area for Kruger Creek is approximately 356 acres. Estimated peak flows at the basin outlet for the modeled storm events are shown in Table 5-7.

Table 5-7. Hydrologic Model Results –Kruger Creek 5th Tier Basin Design Storms

Design Storm Return Interval	Peak Runoff Rate (cfs)
2-year	21
10-year	54
25-year	72
100-year	96

For the Kruger Creek 5th Tier Basin, the following problems have previously been identified (Section 4.4.5):

- Stillaguamish Avenue culvert crossing downstream of Twin Ponds (Problem No. 40);
- 207th Street culvert crossing near retirement facility and Kent Prairie elementary school (Problem No. 42); and
- Burn Rd culvert crossing downstream of ravine (Problem No.43).

Based on this brief analysis, a new culvert with a minimum diameter of 60-inches (or 5-feet) is recommended. Prior cost estimates for this project that indicate an 8-foot diameter culvert is needed. For planning and costing purposes, an 8-foot diameter culvert is adequate. Detailed hydrologic and hydraulic modeling would be needed during the design of this replacement.

Based on this brief analysis, culverts with a minimum diameter of 60-inches (or 5-feet) are recommended for conveyance. Actual design would need to assure fish passage consistent with state regulations. An 8-foot diameter culvert for the Burn Rd crossing had previously been suggested to assure anadromous fish passage at that location. For planning and costing purposes, 8-foot diameter culverts are proposed for all three culvert replacements.

5.4 Water Quality Loads Modeling Results

Water quality loads modeling was conducted for existing and future conditions as described in the Water Quality Loads Model technical memorandum (URS Corporation 2006a). A comparison was made with waste load allocations established in TMDLs promulgated by Ecology, to assess where in the various basins in Arlington water quality protection measures might be focused. This section summarizes these comparisons.

5.4.1 Upper Mainstem Stillaguamish River 3rd Tier Basin

The model showed a land-use based fecal coliform load of 8.7 E+12 cfu/year. The TMDL for Stillaguamish River recommends a wasteload allocation for the Arlington WWTP of 3.0 E+09 cfu/day (1.1 E+12 cfu/year). This result indicates the potential that the Old Town 4th tier basin discharging at the Butler outfall may be contributing significant quantities of fecal coliform bacteria to the mainstem Stillaguamish River. It validates Problem No. 4, identified previously in section 4.1.1.

5.4.2 March Creek 4th Tier Basin

Total fecal coliform load for the March Creek basin was computed by Ecology as 3.41 E+13 cfu/year. Arlington's current contribution to this load was computed as 2.94 E+12 cfu/year, or 8.6 percent of the Ecology computed load. This load also represents the estimated future load, because Arlington areas draining to March Creek are already mostly built out. This load, however, is two orders of magnitude greater than the Ecology computed WLA for Arlington of 1.35 E+10 cfu/year. Similarly, the computed BOD load (1,250 kg/year) is significantly greater than the 116 kg/year WLA established for Arlington by Ecology.

These results indicate that the City may be contributing to bacteria and dissolved oxygen impairments in March Creek. Results validate Problem statement 13, identified previously in section 4.2.4 for the Stuller 5th tier basin within March Creek. Problem statement 12 is elaborated on below.

5.4.3 Portage Creek 4th Tier Basin

The total fecal coliform load to Portage Creek was computed by Ecology as 1.35 E+14 cfu/year. Arlington's current contribution to this load was computed as 6.71 E+13 cfu/year, or 50 percent of the Ecology computed load. The estimated future load, reflecting planned development in all four basins of the Portage Creek basin with the UGA, of 7.24 E+13 cfu/year is 450% of the Ecology computed WLA for Arlington of 1.62 E+13 cfu/year. Similarly, the computed current BOD load (73,100 kg/year) and future BOD load (75,000 kg/year) are significantly greater than the 23,560 kg/year WLA established for Arlington by Ecology.

These results indicate that the City may be contributing to bacteria and dissolved oxygen impairments in Portage Creek. This concern was summarized previously as Problem No. 20 (Section 4.4.2

5.4.4 South Fork Stillaguamish River 3rd Tier Basin

Total fecal coliform load for the South Fork Stillaguamish River was computed by Ecology as 8.18 E+14 cfu/year. Arlington's current contribution to this load was computed as 4.1 E+12 cfu/year, or 0.1 percent of the Ecology computed load. The estimated future load, reflecting planned development of the Eagle Creek basin within the UGA, of 6.56 E+12 cfu/year is 15.5% of the Ecology computed WLA for Arlington of 4.23 E+13 cfu/year. These results suggest that the Arlington basins discharging to the SF Stillaguamish River may be contributing a relatively small portion of the fecal coliform load to the river, but that proportion may increase somewhat as development proceeds in the basin.

5.4.5 Edgecomb Creek 5th Tier Basin

The computed annual fecal coliform load for the Edgecomb Creek basin of 1.01 E+13 cfu/year equates to an average concentration of 1800 cfu/100 mL, based on the computed annual runoff of 6.07 E+8 L. This value is much higher than the target fecal coliform bacteria concentrations established by Ecology for the Edgecomb Creek sampling location QCLU (35 and 63 cfu/100 mL, for wet and dry seasons, respectively).

These results indicate that the City may be contributing to bacteria impairment in Middle Fork Quilceda Creek through its tributaries, Edgecomb and Heyho Creeks. Results typify Problem No. 66, identified previously in Section 4.10.2 for the Heyho Creek 5th tier basin

6 EVALUATING REGULATORY COMPLANCE AND THE POLICIES AND PROCEDURES OF THE STORMWATER UTILITY

6.1 NPDES Phase II Municipal Stormwater Permit Conditions

This section provides a brief overview of the elements of municipal stormwater management programs and policies that are relevant to the NPDES Phase II municipal stormwater permit. More detail regarding permit conditions, responsibilities, and an annual work plan is found in the City's Stormwater Management Program (SWMP) required by the permit. The current version of the SWMP during development of this SCP is 2010-1.

Problem statements used earlier in this SCP to document capital improvement needs are also used here to identify programmatic solutions necessary for the City to achieve permit compliance. The problem descriptions will also include an indication of the program to be developed.

6.1.1 NPDES Stormwater Management Program (SWMP) Administration

The NPDES Permit requires the development of a formal program, called the SWMP, that administers the numerous other permit conditions. The SWMP conveys permit conditions into detailed annual work plans that affect staff in most city departments. In addition, program efforts, costs, public involvement, and outcomes from all departments need to be tracked and reported, with records maintained for at least 5 years.

Problem No.:	**NPDES-1** | **Program ID: SWMP-1**
Primary Issue(s)	NPDES Conditions: Stormwater Management Program Development
Problem Description	Assess permit conditions. Evaluate city inter- and intra-departmental processes and staffing in light of permit conditions. Create annual work plans with assigned responsibility throughout many city departments. Development of databases, tracking protocol, and public presentations is required. Coordination with other permittees is required. Efforts are expected to be extensive during earlier years of the first permit cycle, with declining costs as the program is established.
Information Sources	Permit requirement S5.A, S5.B, S9

Problem No.:	**NPDES-2** | **Program ID: SWMP-2**
Primary Issue(s)	NPDES Conditions: Annual Reporting
Problem Description	Permit compliance is self-reported in an extensive annual report format with reference to numerous attachments for the various program areas. Involves extensive file management, public notification, maintenance of web page, and similar administrative functions.
Information Sources	Permit requirement S9, various conditions within S5.C

6.1.2 NPDES Public Education and Outreach (PEO)

The City has performed a variety of public education and outreach activities relevant to stormwater management. Examples include:

- **Storm Drain Marking.** The City coordinates and funds storm inlet marking and supports Snohomish County and other watershed groups who do the same. The objective is to create awareness that wastes mishandled on the street do indeed reach streams, groundwater and aquatic life.

- **Streamside Signs.** Placement and maintenance of signs along streams, stream buffers, wetlands and wetland buffers, and at watershed boundaries.

- **School Curriculum.** The City's Natural Resources Manager has coordinated with the Arlington School District to include ecological studies as part of its curriculum. Frequency of instruction has been limited due to City staffing constraints.

- **City Newsletter.** The City publishes stormwater-related articles in each issue of the City newsletter, usually three or four issues per year.

- **Brochure Distribution.** The City distributes educational materials developed by others (e.g. stream protection and pet waste management) through information centers at City Hall, street fairs, and other public events.

- **Permit Applicants.** The City provides all available information on streams and stormwater systems to permit applicants in order to educate them on existing and desired conditions.

- **Industrial Source Control.** In 2003, the City implemented an award-winning program to coordinate pretreatment with industries discharging wastewater to the wastewater treatment plant via the sanitary sewer system. The effort also included general education regarding Best Management Practices for stormwater and wellhead protection. The process should be repeated and include routine inspections for illicit (non-stormwater) industrial discharges and coordination to provide guidance on maintaining private stormwater infiltration facilities.

NPDES permit conditions require development of a much more detailed public education and outreach program, however, including identifying target audiences, addressing specific stormwater issues, and gaging program effectiveness in changing behaviors of the targeted audiences. Specific program needs are identified in the problem statements below.

Problem No.:	**NPDES-3** | **Program ID: PEO-1**
Primary Issue(s)	NPDES Conditions: PEO Program Development and Administration
Problem Description	Develop comprehensive PEO programs targeting specific audiences with specific influences on stormwater. Create a management structure that includes staff from various city departments, schools, watershed groups,

	industries, and other distribution networks. Coordinate with natural resources and utilities operations (e.g., wellhead protection) to assure a comprehensive but streamlined message. Develop a theme, logo, and/or recognizable program identity. Expand or fully utilize web site capabilities as a PEO medium. Develop a database for tracking PEO efforts
Information Sources	Permit requirement S5.C.1

Problem No.:	**NPDES-4 | Program ID: PEO-2**
Primary Issue(s)	NPDES Conditions: Evaluation of PEO Program Effectiveness
Problem Description	Permit conditions require means whereby the permit objectives for understanding and adoption of targeted behaviors in targeted audiences may be measured. This information is used to evaluate program effectiveness in achieving desired behavior changes and to direct education and outreach resources in the future. Implement or commission public surveys of utility customers that are repeatable over time to gage the influences of PEO efforts.
Information Sources	Permit requirement S5.C.1.b

Problem No.:	**NPDES-5 | Program ID: PEO-3**
Primary Issue(s)	NPDES Conditions: PEO for General Public
Problem Description	Subject areas for the general public target population include general stormwater impacts on streams, effects of impervious surfaces, source control BMPs for individuals, and environmental stewardship. Program needs include: brochures for distribution in utility bills, at city facilities, and public events; portable display(s) for daily use at city and public facilities and at public events; additional and replacement signage for streams and basin boundaries; stenciling kits; pet waste stations; etc. The City also intends to participate in and build upon the pet waste and streamside landowner programs established by Snohomish County.
Information Sources	Permit requirement S5.C.1.a

Problem No.:	**NPDES-6 | Program ID: PEO-4**
Primary Issue(s)	NPDES Conditions: PEO for the Public and Businesses
Problem Description	Subject areas for this target population, which includes (not limited to) home-based and mobile businesses include BMPs for hazardous chemicals and carwash soaps, and identification and reporting of illicit discharges. The City intends to make available aids and alternatives for charity car washes; develop and distribute brochures regarding chemical storage and disposal and the impacts of illicit discharges; and provide non-binding audits of conventional stormwater facilities and practices. The City will revise its 2003 industrial source control efforts into a regular program that provides guidance on maintaining private

	stormwater treatment and/or infiltration facilities, and includes routine inspections for illicit industrial discharges.
Information Sources	Permit requirement S5.C.1.a

Problem No.:	**NPDES-7** | **Program ID: PEO-5**
Primary Issue(s)	NPDES Conditions: PEO for Homeowners, Landscapers, Property Managers
Problem Description	Subject areas for these target populations include yard care techniques, pesticide and fertilizer use, carpet cleaning, auto repair, low impact development (LID), and maintenance of private stormwater detention ponds. The City intends to make available aids and alternatives for the inspection and maintenance of private conventional stormwater facilities, including the stormwater detention ponds in common areas managed by homeowners' associations and apartments; and to develop and distribute brochures regarding yard care techniques protective of water quality; and BMPs for apartment and facility managers. The City also intends to participate in and build upon the natural yard care and septic tanks programs established by Snohomish County (the latter would evaluate individual septic tanks and drain fields within the City for potential fecal coliform loading to area streams). The City will also purchase inexpensive water quality monitoring tools they can provide to volunteer landowners to perform their own monitoring to understand their impacts
Information Sources	Permit requirement S5.C.1.a

Problem No.:	**NPDES-8** | **Program ID: PEO-6**
Primary Issue(s)	NPDES Conditions: PEO for Engineers, Contractors, Developers, Permit Staff, Planners
Problem Description	Subject areas for these target audiences include stormwater treatment and flow control BMPs for site plans, erosion control on construction sites, and implementation of LID techniques. The city intends development of an LID display for its permit center; education regarding its evaluation and revision of its stormwater standards and specifications; and preparation of stormwater design guidelines for handing to landowners and developers at development pre-application meetings.
Information Sources	Permit requirement S5.C.1.a

6.1.3 NPDES Public Involvement and Participation

During the formative years of the Stormwater Utility—just prior to and just after its inception in 2001—the City maintained a volunteer stormwater advisory council (Arlington Watershed Action Committee) and engaged the public through regular meetings. Such public participation in the process of addressing stormwater and other environmental solutions has waned in recent years due to a lack of staffing. Remaining existing opportunities for public participation are generally limited to assisting the volunteer efforts of Scouts and other youth and stewardship organizations. NPDES Phase II permit conditions call for a return to greater facilitation by the City of Arlington to increase public involvement and participation in activities which reduce urban impacts on natural resources.

Problem No.:	**NPDES-9 | Program ID: PIP-1**
Primary Issue(s)	NPDES Conditions: Public Involvement and Participation
Problem Description	The City is required to provide opportunities for the public to participate in decision making processes involving stormwater issues, including the development, implementation, and regular update of their Stormwater Management Program. The City anticipates hosting multiple public "coffee houses" as a forum for engaging the public over its SWMP and Stormwater Comprehensive Plan. In addition, invitations and advertisements for public participation in regular meetings of area watershed groups may be published.
Information Sources	Permit requirement S5.C.2 and former project number 24

6.1.4 NPDES Illicit Discharge Detection and Elimination (IDDE)

Illicit connection and illegal dumping is generally prohibited under current City stormwater regulations. Other IDDE efforts by the City have included the inventory and inspection of a significant portion of its stormwater infrastructure in dry weather conditions during stormwater mapping efforts in 2005 and 2007.

NPDES permit conditions include the City's adoption of an ordinance which significantly expands the definition and corrective enforcement of illicit discharges. The permit also requires creation and routine maintenance of a detailed stormwater infrastructure database, and implementation of a program which actively looks for and corrects illicit discharges.

Problem No.:	**NPDES-10 | Program ID: IDDE-1**
Primary Issue(s)	NPDES Conditions: Stormwater Inventory
Problem Description	The City's current inventory is indeed thorough and extensive, with numerous attributes recorded for the more than 3,253 catch basins and manholes, 48 miles of pipe, 18 miles of ditches and swales, and 2.9 miles of culverts (see Section 3.2.2). However, the inventory is incomplete with regard to outfalls, detention and infiltration facilities, and impervious areas. It also lacks procedures to assure its routine maintenance and meet other permit requirements. The City anticipates that improving its inventory to meet permit conditions will require: the use of a seasonal field employee; additional GPS equipment (portable base station) to improve the accuracy of X,Y,Z positions; video equipment; an interdepartmental QA/QC effort involving utilities,

	engineering, streets and GIS staff; and development of map products for internal and regulatory use.
Information Sources	Permit requirement S5.C.3.a

Problem No.:	**NPDES-11 | Program ID: IDDE-2**
Primary Issue(s)	NPDES Conditions: IDDE Ordinance and Regulation
Problem Description	Permit conditions include adoption of an ordinance which prohibits discharges from: potable water sources such as water main flushing from hydrants; lawn watering and irrigation runoff; swimming pool discharges; street, sidewalk, and exterior building wash water; and other non-stormwater discharges. Enforcement procedures are required. Further, the City's SWMP must practically address each of the above illicit discharges and other discharges of significant pollutants in annual work plans. The City proposes use of a public relations consultant for the development of this and other ordinances required by the permit, and the expanded use of existing code enforcement and stormwater staff for enforcement.
Information Sources	Permit requirement S5.C.3.b

Problem No.:	**NPDES-12 | Program ID: IDDE-3**
Primary Issue(s)	NPDES Conditions: Prepare and Implement IDDE Plan
Problem Description	The permit requires implementation of an IDDE identification program, including: prioritizing sites; field assessment and screenings; source characterization; and corrective procedures. In addition, public education, public reporting mechanisms, an IDDE tracking database, and trainings for all city employees are required. The City anticipates utilizing existing stormwater staff and budgeting for: detection equipment (sampling and analyses); telephone, web site, publishing, and related IDDE reporting; education and outreach program for IDDE; and contracting or purchasing IDDE training curricula.
Information Sources	Permit requirements S5.C.3.c,d,e,f

Problem No.:	**NPDES-13 | Program ID: IDDE-3C**
Primary Issue(s)	NPDES Conditions: IDDE Capital Equipment Expense
Problem Description	Capital equipment necessary to meet permit conditions may include: vactor truck (shared); sewer video camera (shared); trash pump and hose; tripod, winch, gas monitor for confined space entry; safety signs, GPS, etc.
Information Sources	Permit requirements S5.C.3.c,d,e,f

6.1.5 NPDES Construction, Development, and Redevelopment

Under the NPDES II permit conditions, the City's development standards need to reference the most recent version of the Ecology stormwater guidelines, the 2005 *Stormwater Management Manual for Western Washington* (Ecology 2005). The City adopted the 2005 manual, with revisions, with a 2010 update of AMC 13.28 (Appendix G). In addition, the City has developed design standards to guide engineers in developing drainage systems to manage the quantity and quality of stormwater from new development and redevelopment (City of Arlington 2008).

Problem No.:	**NPDES-14** | **Program ID: RUNOFF-1**
Primary Issue(s)	NPDES Conditions: Development and Construction Runoff Ordinance and Modification of Permit Process
Problem Description	Permit conditions include adoption of an ordinance addressing runoff during development and construction projects, including specified minimum technical requirements. The plan review, inspection, and enforcement components of the City's permit process will need to be evaluated and modified, as necessary, to meet the standards specified in the permit. The City proposes development of this ordinance in-house, followed by use of an engineering consultant to conduct an independent evaluation of the ordinance and the permit process. The inspection requirements are more stringent than the City's current operation, but it is anticipated that permit conditions can be met with two existing public works and stormwater staff.
Information Sources	Permit requirements S5.C.4.a,b

Problem No.:	**NPDES-15** | **Program ID: RUNOFF-2**
Primary Issue(s)	NPDES Conditions: Operations and Maintenance Ordinance and Adoption of Stormwater Standards
Problem Description	Permit conditions include adoption of an ordinance to enforce maintenance responsibilities to assure adequate long-term function of stormwater facilities after construction. Significantly, the conditions apply not only to public facilities, but private facilities permitted by the City and constructed after the effective date for this NPDES permit condition. The City proposes development of this ordinance in-house, followed by use of engineering and public relations consultants to conduct independent evaluations of the ordinance and the City's maintenance standards.
Information Sources	Permit requirements S5.C.4.c.i,ii

Problem No.:	**NPDES-16** | **Program ID: RUNOFF-3**
Primary Issue(s)	NPDES Conditions: Develop and Implement Inspection Program and Other Runoff Controls
Problem Description	Permit conditions require annual inspections of all stormwater treatment

	and flow control facilities (except catch basins) permitted by the City, and inspections of the same facilities and catch basins twice annually during and immediately after periods of heavy construction. Record keeping regarding runoff control activities, including documenting inspections and enforcement actions, and training and education of City staff and education of applicants for permits is also required under the permit. The inspection requirements are more stringent than the City's current operation, but it is anticipated that permit conditions can be met with two existing public works and stormwater staff. Stormwater wetlands with habitat functions will require assistance from the Natural Resources Manager.
Information Sources	Permit requirements S5.C.4.c,d,e,f

Problem No.:	**NPDES-17 | Program ID: RUNOFF-3C**
Primary Issue(s)	NPDES Conditions: Runoff Control Capital Equipment Expense
Problem Description	Permit conditions require annual inspections of all stormwater treatment and flow control facilities (except catch basins) permitted by the City, and inspections of the same facilities and catch basins twice annually during and immediately after periods of heavy construction. Capital equipment necessary to meet permit conditions may include: vactor truck (shared); sewer video camera (shared); laptop for field inspections, etc.
Information Sources	Permit requirements S5.C.4.c,d,e,f

6.1.6 NPDES Municipal Operations and Maintenance

The City has responsibilities under the NPDES permit to prevent or minimize pollution from municipal operations and maintenance activities. Existing exemplary efforts such as sweeping all streets within the City twice each month are required to be extended to frequent inspections and maintenance of the stormwater infrastructure on all municipal properties, easements, and rights-of-way.

The City currently conducts or contracts for maintenance on the storm sewer pipes, catch basins, inlets, ditches, and infiltration swales, and is also responsible for the various stormwater outfalls. Funding for maintenance historically came from the current expense (general) fund. Funding through the new stormwater utility began with the collection of assessments in September 2006.

The current inspection intervals and frequencies for maintenance of the storm drainage system have been established in order to more frequently service those parts of the system which routinely cause problems. However, permit conditions require more complete coverage of the stormwater infrastructure at more frequent intervals.

Written plans establishing policies and good housekeeping practices for streets, parking areas, storage yards, and parks and open spaces need to be adopted and implemented.

Problem No.:	**NPDES-18 | Program ID: PPOM-1**
Primary Issue(s)	NPDES Conditions: Pollution Prevention at O&M Facilities—Adoption of Maintenance Standards
Problem Description	Permit conditions include adoption of maintenance standards that meet or exceed the 2005 Stormwater Manual for protecting the functional integrity of stormwater facilities. These need to be incorporated into the City's standards and specifications documents for stormwater utilities. The City anticipates a structured evaluation of its existing standards against the 2005 Manual and the standards and specifications of other municipalities to assure revised and adopted standards are consistent with the Manual and can be efficiently implemented in Arlington. Existing city staff are equipped for this task with some assistance from an independent engineering consultant.
Information Sources	Permit requirements S5.C.5.a

Problem No.:	**NPDES-19 | Program ID: PPOM-2**
Primary Issue(s)	NPDES Conditions: Pollution Prevention at O&M Facilities—Inspection Program
Problem Description	Permit conditions require annual inspections and frequent maintenance of all storm water treatment and flow control facilities (except catch basins) owned by the City. Inspection frequency increases after storm events with a 10-year return interval. All catch basins and inlets owned by the City are required to be inspected and maintained at least once during the NPDES II permit cycle ending in February 2012. Inspection scheduling must include all structures and achieve at least a 95% inspection rate. The City currently does not have a regular inspection program but does maintain some catch basins each year. Full compliance is anticipated to require high costs for inspection equipment (e.g., video equipment) and for maintenance activities that are currently contracted to service providers outside the City.
Information Sources	Permit requirements S5.C.5.b,c,d,e,j

Problem No.:	**NPDES-20 | Program ID: PPOM-3**
Primary Issue(s)	NPDES Conditions: Pollution Prevention at O&M Facilities—Housekeeping Procedures and Policies
Problem Description	Permit conditions include establishing and implementing policies and practices to reduce stormwater impacts from the City's: road maintenance and deicing activities; fleet parking and maintenance operations; storage and maintenance yards and facilities; and parks and open spaces. Written plans, recordkeeping, and regular training of city staff are also required. The City proposes an in-house evaluation of its existing operations and maintenance program, and development of policies and procedures for achieving permit compliance cost effectively.

	Training costs may be reduced through cooperative efforts with other NPDES II permittees in the region
Information Sources	Permit requirements S5.C.5.f,g,h,i,j

Problem No.:	**NPDES-21 | Program ID: PPOM-3C**
Primary Issue(s)	NPDES Conditions: Good Housekeeping Capital Equipment Expense
Problem Description	Full compliance is anticipated to require high costs for inspection equipment (e.g., video equipment) and for maintenance activities that are currently contracted to service providers outside the City. Capital equipment necessary to meet permit conditions may include: vactor truck (shared); backhoe or track hoe; compressor and jack hammer; utility locator, etc.
Information Sources	Permit requirements S5.C.5.f,g,h,i,j

6.1.7 NPDES TMDL Implementation

Since the City of Arlington has been identified as a contributor to the impairment of water bodies in both the Snohomish and Stillaguamish basins, it has been delegated water clean-up responsibilities under TMDLs prepared by Ecology with assistance from the City. Only the Snohomish River Tributaries TMDL for fecal coliform has regulatory requirements defined for the City during this first permit period. The City's obligations under the Stillaguamish TMDLs for fecal coliform, dissolved oxygen, temperature, and other parameters will not be required as permit conditions until the permit renews in 2012. Nevertheless, the City intends to meet its responsibilities in the Stillaguamish basin during the current cycle as the TMDL is complete and the City's tasks are clearly defined.

Problem No.:	**NPDES-22 | Program ID: TMDL-1**
Primary Issue(s)	NPDES Conditions: TMDL Compliance—Bacterial Control Program
Problem Description	A bacterial pollution control plan (BPCP) and program is a permit condition for the Snohomish TMDL and is anticipated under the Stillaguamish TMDL. The City must identify, inspect, and enforce BMPs at bacteria sources including animal handling facilities, composting facilities, pets, and septic systems. Evaluation, modification, and adoption of pet waste and critical areas ordinances, and improved education and enforcement efforts are anticipated.
Information Sources	Permit requirements S7.A,B; and Permit Appendix 2—Part 2

Problem No.:	**NPDES-23 | Program ID: TMDL-2**
Primary Issue(s)	NPDES Conditions: TMDL Compliance—Surface Water Monitoring—Snohomish Basin
Problem Description	The City is required to conduct regular monthly and event-based

	monitoring of stormwater and receiving streams within the Snohomish basin. Anticipated fixed costs include equipment and laboratory analyses of at least four and up to eight samples per month. The City anticipates continuing use of its stormwater staff and wastewater lab to reduce costs for this ongoing effort.
Information Sources	Permit requirements S7.A,B; and Permit Appendix 2—Part 2

Problem No.:	**NPDES-24** | **Program ID: TMDL-3**
Primary Issue(s)	NPDES Conditions: TMDL Compliance—Surface Water Monitoring—Stillaguamish Basin
Problem Description	The City will conduct regular monthly and event-based monitoring of stormwater and receiving streams within the Stillaguamish basin. Anticipated fixed costs include equipment and laboratory analyses of at least twelve and up to twenty samples per month. The City anticipates use of its stormwater staff and wastewater lab to reduce costs, but this additional effort could require use of consultants or temporary, on-call staff.
Information Sources	Permit requirement S7.B; and Stillaguamish TMDLs

Problem No.:	**NPDES-25** | **Program ID: TMDL-4**
Primary Issue(s)	NPDES Conditions: TMDL Compliance—Septic System Evaluation
Problem Description	This SCP planning effort did not attempt to analyze the potential for septic systems in the vicinity of Arlington to contribute to fecal coliform loads in area streams. The Stillaguamish TMDL identifies an assessment of septic systems in Arlington and their soil characteristics and proximity to streams in order to prioritize septic systems for performance evaluations. The City intends to conduct this evaluation in-house using existing stormwater and GIS staff. A report would evaluate the potential effects of septic system maintenance on area streams.
Information Sources	New project/program re: septic systems

6.1.8 NPDES Effectiveness Monitoring

In addition to water quality monitoring, the NPDES II permit established a monitoring program to evaluate the effectiveness of the Stormwater Management Program (SWMP) developed by each permittee. The City must prepare to characterize its stormwater quality, and evaluate how effective a targeted action (BMP) or narrow suite of actions within its SWMP is in achieving a targeted environmental outcome.

Problem No.:	**NPDES-26** | **Program ID: EFFMON-1**
Primary Issue(s)	NPDES Conditions: Effectiveness (Longterm) Monitoring Program

Problem Description	This particular permit condition requires no monitoring or evaluation during this permit cycle, but preparation of a plan for monitoring under future permit cycles. The plan(s) warrant appropriate effort now as a poorly defined plan may result in inconclusive results at high costs to the City later. The City anticipates using water quality monitoring data it has collected and will collect under TMDL requirements and interdepartmental team of City staff to identify appropriate outfalls and BMPs for evaluation through monitoring. Alternatively, the City may choose to cooperate in a regional effectiveness monitoring effort.
Information Sources	Permit requirements S8.C.1,2

6.2 General Planning and Policies Related to Management of the Stormwater Utility

This section provides a brief overview of the elements of municipal stormwater management programs and policies that are relevant for sound management of the Utility, but are not necessarily a requirement of the NPDES municipal stormwater permit.

6.2.1 Ordinances and Codes

Ordinances and codes considered when developing the SCP include zoning codes, development codes and standards (including Total Impervious Area restrictions), and environmental policy regulations (e.g., Federal Emergency Management Agency flood insurance protection requirements, environmentally sensitive areas, State Environmental Policy Act requirements, and Shoreline Management Act Requirements).

The City has enacted several regulations to date that are relevant to the protection of stormwater quality. In September 2001, the City adopted Ordinance No. 1266, which amended the Arlington Municipal Code to establish the stormwater utility. In July 2006, the City approved Ordinance No. 1395 to collect monthly assessments to fund the Utility. The City has maintained its Critical Areas Regulations through regular updates to its Land Use Code in ordinances 1309 (2003), 1351 (2004), 1392 (2006), and 1411 (2007). The City adopted Resolution No. 716 in 2005 committing the City's efforts to the strategy to recover Puget Sound Chinook and bull trout. AMC 13.28, Stormwater Utility, was completely revised and approved May 17, 2010 under Ordinance 2010-010. A copy of AMC 13.28 is provided in Appendix G.

As described within Section 6.1 above, the City will also need to adopt new and/or revised ordinances required by its NPDES permit. Ordinances are required to: address IDDE activities (Section 6.1.4); control runoff from construction and development projects (Section 6.1.5); and assure maintenance of stormwater facilities on private property after construction (Section 6.1.5). A water quality ordinance, pet waste ordinance, and the critical areas ordinance will need to be evaluated and may require passage or revision under permit conditions for TMDLs (Section 6.1.7).

6.2.2 Long-Range Planning

Since 1990, Washington State's GMA has required that Arlington adopt city-wide planning policies. The City follows these policies in developing its comprehensive plan. Typical planning efforts undertaken under this process include comprehensive plans for individual utilities, land use planning, critical areas protection planning, and Endangered Species Response planning.

The NPDES Phase II municipal stormwater permit is in its first implementation cycle, from 2007 to 2012, and will change in subsequent renewals as the more fundamental requirements are implemented. Future permit conditions will respond to environmental and legal issues, and the results of water quality monitoring and effectiveness monitoring.

In addition, the City is currently within a period of rapid growth, anticipating a population of 30,500 by about 2025. With this growth and the anticipated regulatory and political changes, it is prudent to plan for re-evaluation and refinement of the City's stormwater program.

The University of Washington Climate Impacts Group reported results of an uncalibrated model of climate change impacts on the general shape of the annual hydrograph in the Stillaguamish basin (Whitely Binder 2008). Though quantities are imprecise, the model provides a good estimate of the sensitivity of the basin to projected warming. Initial results suggest winter flows could increase by 16%, and summer flows could decrease by 11%. Future updates to this SCP should consider the effects of climate change on the management of the stormwater system.

Problem No.:	**Storm-1**	**Program ID: PLANNING-1**
Primary Issue(s)	Stormwater Comprehensive Planning	
Problem Description	Updates to this SCP are anticipated to: address issues related to growth; meet changing regulatory requirements; evaluate trends in water quality and climate change; and to adaptively manage the results of implementing the City's Stormwater Management Program (SWMP). Updates should be identified and planned for in the Stormwater Utility's CIP. SCP Update on a 6-year cycle (or ~2015 next cycle) is proposed for next planning horizon since that will be after the first renewal in 2012 of the NPDES II permit. This is *staffing support* (annualized). Subsequent SCP updates could occur on a 10-year cycle.	
Information Sources	Former project number 23	

Problem No.:	**Storm-2**	**Program ID: PLANNING-1C**
Primary Issue(s)	Stormwater Comprehensive Planning Consultant	
Problem Description	SCP Update on a 6-year cycle (or ~2015 next cycle) is proposed for next planning horizon since that will be after the first renewal in 2012 of the NPDES II permit. This is *consultant costs* (annualized) (Recurring capital). Subsequent SCP updates could occur on a 10-year cycle.	
Information Sources	Former project number 23	

6.2.3 Funding the Stormwater Utility

Since September 2006, the City has collected monthly assessments to fund the Stormwater Utility at a rate of $3.45 per ERU. In a survey conducted by Snohomish County in 2008, the City's stormwater assessment ranked the lowest of 18 cities in the State of Washington surveyed (most in the Puget Sound region). Of the 29 cities and counties surveyed in the State, Arlington ranked 24th. Snohomish County ranked 25th, but recently increased their monthly rates by more than 200%, primarily to meet additional regulatory requirements under its NPDES Phase I permit. Section 11.10 provides a current comparison of stormwater utility rates in the area.

The City will revise its rates as a result of the financial analysis included in this SCP (Chapter 11). Given the youth of the utility and its limited public exposure, a significant public involvement effort in the form of a stakeholder's group may be required to arrive at acceptable rates. The City will include rates in the discussion of stormwater issues identified under the NPDES permit condition for Public Involvement and Participation in Section 6.1.3

6.2.4 Drainage Basin Planning and Analysis

As defined in this plan (Section 3), the City of Arlington encompasses 10 stormwater drainage basins. The basins include areas in Snohomish County outside the Urban Growth Boundary because changes in development or land use in County areas tributary to the City's water bodies could affect conditions in those waters. Apart from this effort, however, the City has not conducted any drainage-specific basin planning.

The City has, however, taken a lead role in salmon recovery efforts through leadership on the Stillaguamish Implementation Review Committee. It is also active in implementing the clean-up plans of the Snohomish Tributaries TMDL through active involvement in the Allen/Quilceda Watershed Action Team. Although the City did not formally adopt its 2003 draft ESA Response Plan, it is actively implementing measures developed as part of that process through participation in these multi-agency, watershed-level, and action-oriented groups.

6.2.5 Geographic Information Systems Planning and Asset Management Tools

The City is investing in the development of GIS planning tools. The GIS coverages now available include: topography with two-foot contours (developed from LIDAR data); soils (from NRCS), drainage basins (modified from Snohomish County); stormwater inventory (catch basins, pipes, ditches, swales); potential wetland restoration sites (Ecology 1997); and existing and zoned land uses. Many detention, infiltration, and other elements of the storm infrastructure remain to be digitized. Significantly, the City has inaccurate and incomplete mapping of the streams and wetlands it is seeking to protect through stormwater management. In addition, wellhead protection areas and other water and sanitary sewer system infrastructure still need to be mapped comprehensively as individual systems. Completing the development of Utilities' databases in GIS will facilitate planning activities.

The Public Works' Utilities Division has also invested in Cartegraph's asset management software as a tool for the efficient linking of the Division's work order, database management, and cost accounting functions. The start-up effort includes the completion of the GIS databases and pairing with the corresponding Cartegraph interfaces.

Problem No.:	Storm-3	Program ID: PLANNING-2
Primary Issue(s)	Hydrography Inventory	
Problem Description	Stream and wetland inventories are incomplete and commonly inaccurate within the City, and can cause delays in site planning and permit reviews and impacts on aquatic resources. A complete and current inventory is required to fully meet the intent of the City's stormwater management functions. The City anticipates a cost efficient inventory through the pairing of a contractor with City stormwater and natural resources staff. This program addresses city staff time on the inventory (annual hours to maintain inventory).	
Information Sources	City staff	

Problem No.:	Storm-4	Program ID: PLANNING-2C
Primary Issue(s)	Hydrography Inventory Consultant	
Problem Description	The City anticipates a cost efficient inventory through the pairing of a contractor with City stormwater and natural resources staff. This program addresses consultant costs (CIP) for coordinated integration of data from multiple entities with field validation and inventory of surface water network.	
Information Sources	City staff	

Problem No.:	Storm-5	Program ID: PLANNING-3
Primary Issue(s)	GIS Database and Asset Management for the Stormwater Utility	
Problem Description	Numerous detention, infiltration, outfall, and other stormwater features need to be inventoried by existing stormwater staff to complete the stormwater database. Training will be required to complete the database and link it to Cartegraph to create an effective asset management system that also supports the inspection and maintenance scheduling and record keeping requirements of the NPDES permit. The City intends to meet these objectives using existing stormwater and GIS staff.	
Information Sources	City staff	

Continued

6.2.6 Utility Administration

Administrative and program activities within the Stormwater Utility need to be staffed and funded. These tasks may include work orders, budgeting, credit program, locates, safety, staff meetings, regional stormwater meetings, etc. In addition, a dedicated vehicle is necessary to assure responsiveness to both programmatic and emergency needs for City staff and residents. The vehicle currently used by stormwater staff is funded by the Water Department.

Problem No.:	**Storm-6**	**Program ID: PLANNING-4**
Primary Issue(s)	Utility Administration	
Problem Description	Administrative and program activities within the Stormwater Utility need to be staffed. Administrative and program activities within the Stormwater Utility include work orders, budgeting, credit program, locates, safety, staff meetings, regional stormwater meetings, etc.	
Information Sources	City staff	

Problem No.:	**Storm-7**	**Program ID: PLANNING-4C**
Primary Issue(s)	Utility Administration Capital Equipment	
Problem Description	Fund new vehicle(s) (pickup truck) for the Stormwater Utility. Buy small pickup truck for stormwater utility. Additional stormwater staff use Jeep as a shared vehicle with other utilities.	
Information Sources	City staff	

6.2.7 Annual Infrastructure Upgrades

Stormwater infrastructure in the City exists across the full range of age, condition, and function characteristics. Historically, maintenance and replacement of structures has failed to keep up with the need. In order to facilitate responsiveness to future emergencies and return maintenance to an appropriate schedule, a recurring capital fund for an infrastructure replacement program is appropriate.

Problem No.:	**Storm-8**	**Program ID: PLANNING-5C**
Primary Issue(s)	Annual Stormwater Infrastructure Upgrade	
Problem Description	Failing infrastructure or inadequate capacity. Annual upgrade program to fund infrastructure replacement on a regular basis to facilitate responsiveness to future emergencies and return maintenance to an appropriate schedule.	
Information Sources	City staff	

Continued

6.2.8 Natural Resources Restoration Cache

A reserve supply of native plants, large woody debris and other restoration materials that are ready for use is a desire of the City that would benefit its objectives of stormwater management. Examples include: prompt response to needs and opportunities presented by accelerated development projects; restoration of impacts caused by unknown or inaccurately mapped aquatic features; recovery from flooding, landslides, and other natural disasters; implementing projects before land use and ownership changes prevent access to properties requiring attention; and access to auxiliary funding through grants when they are advertised or become available.

Problem No.:	**Storm-9**	**Program ID: RESTORATION-1**
Primary Issue(s)	Restoration Cache and Nursery	
Problem Description	Prepare for restoration opportunities. Acquire a supply of LWD and other restoration materials for opportunistic projects. Also, provide vegetative materials for critical areas and stormwater detention maintenance projects. The City anticipates limited expansion of its existing nursery.	
Information Sources	City staff; former project number 118	

6.2.9 Underground Injection Control (UIC) Program Evaluation

As described in Sections 2.4.3.2 (and also Sections 2.4.1 and 2.4.3.1), the benefits of stormwater infiltration for surface waters can be detrimental to groundwater and come at the cost of lower groundwater quality. This is of particular concern in the aquifer recharge and wellhead protection areas of the Marysville Trough. Federal and state regulations require the City to develop and implement a UIC program to evaluate these concerns in light of increasing pressure for growth in areas with high water tables, and with regard to 2005 Stormwater Manual requirements for spacing between stormwater infiltration facilities and the seasonal high water table.

Problem No.:	**Storm-10**	**Program ID: GROUNDWATER-1**
Primary Issue(s)	UIC and Infiltration Evaluations	
Problem Description	Existing city development regulations should be evaluated in light of current UIC regulations and the 2005 Manual. Issues with regard to development, underground injection control regulations, industrial stormwater permitting, and the City’s development permit conditions for protection of groundwater from storm water need to be identified and presented to City staff for resolution and modification of the City’s development regulations, if any. The City anticipates development of its UIC program in-house using existing stormwater and wellhead protection staff. However, use of engineering and public relations consultants may be needed to provide independent facilitation of the evaluation process.	
Information Sources	City staff; Washington state regulations (WAC 173-218)	

6.2.10 Stormwater Injection and Recovery Evaluation

The capture, treatment and injection of stormwater into groundwater storage could have benefits for stormwater management, instream flow, and municipal water supply. Some of the water that would typically contribute to winter runoff (e.g., on existing impervious areas, areas with low permeability soils, or excess stream flows) may be intercepted, treated, and conveyed to a location with increased capacity for storage as groundwater. The groundwater would then support baseflows in streams, and provide a source of municipal water supply for withdrawal at a later date.

Problem No.:	**Storm-11** | **Program ID: GROUNDWATER-2**
Primary Issue(s)	Stormwater Injection and Recovery Evaluation
Problem Description	The opportunity for stormwater storage and recovery in groundwater may provide integrated management solutions for stormwater, instream flows, and municipal water supply. Such a program requires site specific evaluation of hydrologic and hydrogeologic information and development of if-then decision critieria, and would probably fit best within a regional stormwater system that might serve an individual sector within the city. A preliminary evaluation of site conditions would be required to identify appropriate locations, conditions, and seasons where this approach would work.
Information Sources	City staff; Washington state regulations (WAC 173-218)

7 STORMWATER GENERAL CONTROL OPTIONS

The City of Arlington will address the current and anticipated future stormwater problems identified in this SCP using a combination of structural and nonstructural controls to develop and implement site-specific and programmatic solutions. Structural controls address physical changes to the stormwater conveyance system while non-structural controls address programmatic level issues, i.e. land use management, regulations, and public education.

As part of the SCP process, City staff evaluated many structural and non-structural control options both for their feasibility as potential solutions to stormwater problems that may be identified within the City and for their consistency with NPDES Phase II permit conditions. Those controls passing the screening are effectively identified here as “tools in the stormwater toolbox”.

Table 7-1 presents a list of general structural control alternatives considered feasible for Arlington. Table 7-2 identifies the feasible non-structural controls.

Table 7-1. Structural Stormwater Controls Feasible for Use in the City of Arlington

Types of Stormwater Controls
Bank and Streambed Protection
Bioengineering
Gabions
Fencing
Windrow revetment (Bole installation)
Conveyance Capacity
Off stream infiltration/detention basin
Wetland creation/restoration
Selective vegetation and debris removal
Stream channel restoration
Culvert replacement/removal
Streambed Control
Stabilizers
Increased roughness/boulder and LWD
Drop Structures
Water Quality Enhancement
Constructed wetlands
Bioretention systems
Vegetative filters
Wet ponds

Table 7-2. Non-structural Stormwater Controls Feasible for Use in the City of Arlington

Types of Stormwater Controls
Mapping and Regulations
Higher regulatory standards
Additional flood data
Flood data maintenance
Open space preservation
Interagency agreements
Ordinance consistency (LID)
Flood Damage Reduction
Drainage system maintenance
Prevention of development in flood areas
Protection of channel migration zones (CMZs)
Administration
Stormwater management plan
Increased inspection and plan review
Staff workshops
Emergency complaint response
Illicit discharge detection and enhancement program
Site development standards (LID)
Steep slope restrictions
Urban forestry program
Agriculture
Implementation of best management practices (BMPs)
Finance
Financial incentives (Stormwater credits)
Qualify for various grant programs
Interagency/Governmental Coordination
Deterrence of illegal waste disposal
Participation in regional stormwater forum
Coordination with Conservation District
Restoration and monitoring partnerships
Maintenance and Operation
Ditch system maintenance
Drainage system standards
Stream design standards
Stream system maintenance
Drainage structure cleaning
Detention basin maintenance
Swale maintenance
Roadside stream indicators
Wetland observation and maintenance

Program Monitoring
Stream walks
Drainage system survey
Stormwater monitoring plan
On-site system inventory
Aquatic and wildlife species surveys
Beaver activity and response
Public Participation and Education (non-point pollutants)
Voluntary ditch maintenance
BMP brochure & manual for residents and proprietors
Annual creek clean-up days
Citizen advocate training
Questionnaire
Contractor training/certification
Catch basin stenciling
Regulatory/Enforcement
Increased enforcement
Source control BMPs[b]
Natural yard care techniques[b]
Reduction in the use and proper management of yard care chemicals[b]
Proper management of automotive chemicals[b]
Technical standards for development[b]
Low impact development (LID)[b]
Illicit discharges[b]
Environmental stewardship[b]
Waste Control
Oil recycling program

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8 EVALUATION CRITERIA FOR STORMWATER CONTROLS

Comprehensive stormwater management emphasizes selection of a mix of stormwater control options to minimize the effects of stormwater runoff. The variety of control options available to address drainage problems includes construction, environmental protection and enhancement, maintenance and operations, and planning and regulatory measures.

In the past, drainage master plans focused almost exclusively on capital projects that addressed flood control. Selecting and ranking these projects was a fairly straightforward process, using computed cost estimates compared to level of flood protection provided. With the addition of non-physical goals (i.e., inter-agency coordination) and non-structural solutions (i.e., habitat protection, water quality protection), more qualitative evaluations must be performed. Qualitative scoring combines interpretation of analyses (reduction in stormwater flooding or pollutant reduction performance estimates) with subjective judgments based on experience and local knowledge, applied in a systematic manner.

Using the goals described in Section 1.2 as guidance, seven evaluation criteria for ranking of each control option were developed. The seven criteria, phrased as questions, are:

Does a control option (or project containing one or more control options)….

- Address an identified capacity problem?
- Provide water quality benefits?
- Provide natural resource benefits to aquatic species?
- Provide maintenance benefits (is it sustainable)?
- Require property acquisition?
- Have special considerations? And,

For each control option (or project)….

- What are the capital costs?

8.1 Use of Evaluation Criteria

The evaluation criteria developed provide a method for rating the projects and assigning a priority within the capital improvement program, reflecting the City's goals for stormwater management. Subjectively, some criteria were more significant to the City than others. To address this, the criteria were weighted using values from one to three, reflecting the general importance of each criterion to the City. A Special Considerations criterion carried the most weight with a factor of three (3), allowing for recognition of high profile projects and other preferential matters (Table 8-1). Projects and controls which require less maintenance and can be implemented at a lower capital cost without requiring property acquisition were of secondary importance with a factor of two (2). Projects and controls which solve capacity issues and provide water quality and other natural resources benefits carried the least weight with a factor of one (1).

Regardless of the weight of each criterion, each option was scored by City staff from 0 to 5, where 5 applies to projects best satisfying the individual criterion. For example, if a criterion were multi-use projects on a site, a regional detention pond might rate a 4 or 5, whereas culvert-upsizing would rate a zero. Conversely, culvert-upsizing might rate a 5 on fish passage improvement, while a detention pond would rate 0 or 1 on this criterion. The possible scores are shown in the third column of Table 8-1.

When evaluating a project or control, the score for each criterion is simply the product of its score and its weighting factor. An option's total rating is computed by summing the alternative's scores for all the criteria. Projects and/or controls receiving the higher total scores would be the higher priority projects. This prioritization is used to aid scheduling (distribution of projects over the planning period).

Table 8-1. Project Scoring Criteria

Weight	Control Option Evaluation Criteria	Score Effectiveness at Meeting Criteria
3	Special Considerations (most important)	**(5 pts)** Established high profile project **(3 pts)** Established medium profile project **(1 pt)** Established low profile project **(0 pts)** No special consideration applies to project
2	Provide Maintenance Benefits (secondary importance)	**(5 pts)** Will reduce existing maintenance requirements or provide increased capacity OR Has predicted maintenance costs of less than $1,000 per year **(3 pts)** Will improve or facilitate existing maintenance activities (i.e., provide access) OR Has predicted maintenance costs of >$1,000 and <$5,000 per year **(1 pt)** Will not affect maintenance workload or annual costs OR Has predicted maintenance costs of >$2,000 per year **(0 pts)** Will add to the existing maintenance work load or costs OR Has predicted maintenance costs of >$5,000 per year
2	Requires Property Acquisition (secondary importance)	**(5 pts)** Is located on public property or an acquisition is not required **(3 pts)** Is located both on public and private property

Weight	Control Option Evaluation Criteria	Score Effectiveness at Meeting Criteria
		(1 pt) Is located on private property requiring acquisition
2	Capital Costs (secondary importance)	**(5 pts)** Low cost (less than $100,000) such as trash rack retrofits, outfall protection, structural water quality facilities (e.g., compost filter) **(3 pts)** Costs between $100,000 and $500,000 **(1 pt)** Costs more than $500,000
1	Provide Water Quality Benefits (tertiary importance)	**(5 pts)** Is a water quality facility that is located in an industrial/commercial/transportation OR Is a facility with an upstream drainage area of >200 acres OR Is a program affecting the entire city **(3 pts)** Is an open waterway enhancement (i.e., revegetation, buffer, shading) OR Is a facility with an upstream drainage area of <200 acres OR Is a program affecting only a particular segment of the city **(1 pt)** Provides limited water quality benefits or affects only a limited area **(0 pts)** Provides no water quality benefits.
1	Address an Identified Capacity Problem (tertiary importance)	**(5 pts)** Addresses a flooding problem predicted under existing conditions or a problem which has been observed OR Addresses a flooding problem on public streets and properties OR Reduces frequency or magnitude of flooding **(3 pts)** Addresses a flooding problem predicted only to occur under future build-out conditions OR Addresses a flooding problem on private streets and properties **(1 pt)** May provide some flood control benefits, but it does not address an identified flooding problem
1	Provide Natural Resource Benefits (tertiary importance)	**(5 pts)** Protects and or enhances an existing natural resource; corrects limiting factors affecting ESA populations **(3 pts)** Creates new natural resources **(1 pt)** Provides limited natural resource benefits or affects only a limited area **(0 pts)** Provides no natural resource benefits

Each of the problem statements identified in Chapter 5 and the regulatory and program requirements identified in Chapter 6 were considered individually and one or more solutions (usually one) were developed into “projects” using the controls identified in Chapter 7. When all projects were identified, they were evaluated using the process described above. Chapter 9 presents a summary of all projects developed during this SCP, including the results of the ranking process and an estimated cost of implementation.

An important consideration in the application of evaluation criteria is the need to effectively evaluate and compare regional projects that address large-scale problems to smaller, more localized or neighborhood-scale projects. Using the range of scores and criterion weighting described above provides this balance.

The evaluation process considered the importance of projects that meet only a single objective (such as flooding or water quality) as well as multi-objective solutions. It was necessary to evaluate these separately, since a single objective project may be a high priority, but did not necessarily rate that way against multi-objective projects. The “special consideration” criteria was used to identify these instances and add points to a project that has an elevated local priority, such as high visibility, public safety, political importance, etc.

No scoring process can completely and accurately compare and rank all the benefits and costs associated with each capital improvement project. Therefore, city staff provided thorough subjective analysis and review to assess the final list of selected stormwater projects for the capital improvement program in Chapter 10. .

9 PROJECT SUMMARIES

Each of the problem statements identified in Chapter 5 and the regulatory compliance and operating requirements identified in Chapter 6 were considered individually and one or more solutions (usually one) were developed into "projects" using the controls identified in Chapter 7. When all projects were identified, they were evaluated using the process described in Chapter 8. Detailed descriptions and estimated costs for each project are presented in the cost estimate work sheets in Appendix H. Costs are planning level estimates; actual costs could be lower or higher than estimated. Labor and materials efficiencies (e.g., city staff rather than contracted work; negotiating for supplies) could result in some projects being done for far less than that estimated.

This chapter presents a summary of all projects developed during this SCP, including the results of the ranking process and an estimated cost of implementation. Projects are generally categorized as either operating or capital projects. These categories are further distinguished into six project types as shown below:

- Operating Projects
  - RegCom— regulatory compliance efforts needed to satisfy permit conditions and other requirements of state and federal laws, including NPDES II
  - Ops— operations efforts assuring continuity and efficiency of day-to-day utility operations as well as planning for longterm goals
  - O&M—field operations and maintenance efforts; their identification in this SCP serves as selected examples of programs that may be developed and implemented on a regular basis
- Capital Projects
  - CIP—single-event capital improvement projects;
  - CapRecur—capital improvement projects which recur on a regular interval;
  - CapEquip—capital equipment purchases;

Projects are sorted and summarized by basin (or city-wide) and by project type in Sections 9.1 through 9.7 below.

9.1 Regulatory Compliance and Operating Program Areas

9.1.1 Labor Analysis for Operating Projects

Table 9-1 presents a summary of labor requirements necessary for meeting the regulatory requirements specified within NPDES II permit conditions, and for assuring smooth operation of the Stormwater Utility. This table does not include the current efforts from city engineering, streets, community development, and administrative staff that are actually stormwater utility functions.

Table 9-1. City-Wide Stormwater Operating Projects—Labor Analysis

Program No.	Project Type	Project Name	Priority	Annual Effort (Labor Hrs)
NPDES-1	RegCom	Stormwater Management Program (SWMP) Development and Administration	48, VH	110
NPDES-2	RegCom	SWMP Annual Reporting	35, H	92
NPDES-3	RegCom	Stormwater Public Education and Outreach (PEO) Program Development and Administration	56, VH	480
NPDES-4	RegCom	Evaluation of PEO Program Effectiveness	35, H	100
NPDES-5	RegCom	PEO Target Audience: General Public	56, VH	335
NPDES-6	RegCom	PEO Target Audience: Public and Businesses	56, VH	213
NPDES-7	RegCom	PEO Target Audience: Homeowners, Landscapers, Property Managers	56, VH	237
NPDES-8	RegCom	PEO Target Audience: PEO Target Audience: Engineers, Contractors, Developers, Permit Staff, Planners	56, VH	60
NPDES-9	RegCom	Public Involvement and Participation (PIP)	58, VH	48
NPDES-10	RegCom	Illicit Discharge Detection and Elimination (IDDE): Infrastructure	60, VH	120

		mapping and inventory		
NPDES-11	RegCom	IDDE: Ordinance and Regulation	56, VH	24
NPDES-12	RegCom	IDDE: Prepare and Implement IDDE Plan	56, VH	236
NPDES-14	RegCom	Runoff: Development and Construction Runoff Ordinance and Modification of Permit Process	56, VH	701
NPDES-15	RegCom	Runoff: Operations and Maintenance Ordinance and Adoption of Stormwater Standards	56, VH	46
NPDES-16	RegCom	Runoff: Develop and Implement Inspection Program and Other Runoff Controls	56, VH	614
NPDES-18	RegCom	Pollution Prevention at O&M facilities (PPOM): Adoption of Maintenance Standards	56, VH	116
NPDES-19	RegCom	PPOM: Inspection Program	56, VH	406
NPDES-20	RegCom	PPOM: Housekeeping Procedures and Policies	56, VH	188
NPDES-22	RegCom	Total Maximum Daily Load (TMDL): Bacterial Control Program	55, VH	80
NPDES-23	RegCom	TMDL: Surface Water Monitoring—Snohomish Basin	35, H	110
NPDES-24	RegCom	TMDL: Surface Water Monitoring—Stillaguamish Basin	35, H	206
NPDES-25	RegCom	TMDL: Septic System Evaluation	45, VH	100
NPDES-26	RegCom	Effectiveness (Longterm) Monitoring Program	40, H	72
Storm-1	Ops	Stormwater Comprehensive Plan Update (staffing support on 6 yr update cycle, annualized)	44, VH	20
Storm-3	Ops	Hydrography Inventory Maintenance	33, M	20

Storm-5	Ops	GIS Database and Asset Management System	36, H	120
Storm-6	Ops	Utility Administration (work orders, locates, credit program, safety, meetings, regional participation, other admin)	40, H	764
Storm-9	Ops	Stream Restoration Reserves	33, M	120
Storm-10	Ops	Underground Injection Control Program Evaluation	37, H	80
Staffing effort required to implement tasks defined above (man-hours)				5,818
Staffing effort required to implement tasks defined above (FTEs)				2.8

9.1.2 Capital Expenditures to Support Operating Projects

Table 9-2 presents a summary of capital projects necessary for meeting NPDES II permit conditions and assuring smooth operation of the Stormwater Utility.

Table 9-2. City-Wide Stormwater Capital Projects

Problem/ Project No.	Project Type	Project Name	Priority	Estimated Cost ($)
NPDES-13	CapEquip	IDDE Capital Equipment Expense	56, VH	22,000
NPDES-17	CapEquip	Runoff Control Capital Equipment Expense	56, VH	2,000
NPDES-21	CapEquip	Good Housekeeping Capital Equipment Expense	52, VH	1,200
Storm-2	CapRecur	Stormwater Comprehensive Planning Consultant, 6-year interval	40, H	55,000
Storm-4	CIP	Hydrography Inventory CIP	33, M	15,000
Storm-7	CapEquip	Utility Administration Pickup Truck	10, L	27,000
Storm-8	CapRecur	Utility Annual SW System Upgrade	39, H	180,000
Storm-11	CIP	Stormwater Injection and Recovery Evaluation	33, M	39,000

9.2 Old Town 4th Tier Basin

Table 9-3 presents a summary of project alternatives developed to address the problem statements identified throughout this SCP in the Old Town 4th Tier Basin. Project locations are approximately shown in Map 2.

Table 9-3. Projects in the Old Town 4th Tier Basin

Problem/ Project No.	Basin ID	Project Type	Project Name	Priority	Estimated Cost ($)
1	OT-B-1	CIP	Old Town Drainage System Improvements	32, M	670,000
2	OT-B-2	CIP	Haller (Butler) Trunk Line Improvements	41, H	590,000
3	OT-B-3	CIP	Haller (Butler) Outfall Improvements	38, H	230,000
4	OT-B-4	CIP	Hammer-Butler Stormwater Wetland Completion	48, VH/Reg	173,311
5	OT-B-5	RegCom	Groundwater Inflow to Storm System—See NPDES-10 (IDDE-1)	NA	NA
6	OT-B-6	RegCom	Illicit Discharge / Groundwater Investigation—See NPDES-12 (IDDE-3)	NA	NA
7	OT-CT-1	CIP	Centennial Trail Storm Re-direction	52, VH/Reg	140,000
8	OT-HP-1	CIP	Haller Park Outfall & Drainage Improvements	56, VH/Reg	27,000
9	OT-HP-2	CIP	Haller Park Bacterial Control	37, H	11,000

9.3 March Creek 4th Tier Basin

Table 9-4 presents a summary of project alternatives developed to address the problem statements identified throughout this SCP in the March Creek 4th Tier Basin. Project locations are approximately shown in Map 3.

Table 9-4. Projects in the March Creek 4th Tier Basin

Project No.	Basin ID	Project Type	Project Name	Priority (Old No)	Estimated Cost ($)
10	M-211-1	O&M	211th & SR 530 Upkeep	35, H	390
11	M-211R-1	CIP	211th & Ronning Rd Outfall	34, H	42,000
12	M-211-RH-1	CIP	67th Ave Bulkhead Infiltration	32, M	150,000
13	M-S-1	CIP	Stuller Outfall Water Quality Improvement	32, M	270,000
14	M-S-2	CIP	Stuller Property Water Table Investigation	32, M	15,000
15	M-S-3	CIP	Wetland #0961 Valley Gem – 96 acres	15, L	510,000
16	M-W-1	CIP	Stormwater Easement Database Research	22, L	25,000

Note: "Evaluate" means that the project needs to be inspected or reviewed to verify the problem, a potential solution identified, and estimated costs for the potential solution.

9.4 Portage Creek 4th Tier Basin

9.4.1 Lower Portage Creek 5th Tier Basin

Table 9-5 presents a summary of project alternatives developed to address the problem statements identified throughout this SCP in the Lower Portage Creek 5th Tier Basin. Project locations are approximately shown in Map 4.

Table 9-5. Projects in the Lower Portage Creek 5th Tier Basin

Project No.	Basin ID	Project Type	Project Name	Priority (Old No)	Estimated Cost ($)
17	P-LP-1	CIP	188th St Infiltration Replacement	41, H	130,000
18	P-LP-2	CIP	59th Ave Infiltration	32, M	200,000
19	P-LP-3	CIP	Cemetery Rd Infiltration	32, M	270,000
20	P-LP-4	CIP	Portage Creek Water Quality Investigation	31, M	13,000
21	P-LP-5	CIP	Lower Portage Flood Mitigation	24, L	15,000
22	P-LP-6	CIP	Lower Portage Wetland Restoration	17, L	1,960,000
23	P-LP-7	CIP	Island Crossing Stormwater Plan	17, L	370,000

9.4.2 Upper Portage Creek 5th Tier Basin

Table 9-6 presents a summary of project alternatives developed to address the problem statements identified throughout this SCP in the Upper Portage Creek 5th Tier Basin. Project locations are approximately shown in Map 5.

Table 9-6. Projects in the Upper Portage Creek 5th Tier Basin

Project No.	Basin ID	Project Type	Project Name	Priority (Old No)	Estimated Cost ($)
24	P-UP-1	CIP	Portage Creek Gaging & Monitoring	20, L	16,000
25	P-UP-2	CIP	Portage Creek Crossing, 69th Ave NE and BNSF Railroad	29, M	190,000
26	P-UP-3	CIP	Portage Creek S. Village Apts Flood Storage	25, M	210,000
27	P-UP-4	CIP	Portage Creek Crossing, 186th St NE	35, H	130,000
28a	P-UP-5a	CIP	Portage Creek Mill Reach, SR9 to 67th Ave	27, M	260,000
28b	P-UP-5b	CIP	Portage Hecla Wetland, 204th St to Round Barn	25, M	450,000
28c	P-UP-5c	CIP	Portage Wetland #1561	25, M	450,000
28d	P-UP-5d	CIP	Portage Wetland #1247	25, M	450,000

9.4.3 Prairie Creek 5th Tier Basin

Table 9-7 presents a summary of project alternatives developed to address the problem statements identified throughout this SCP in the Prairie Creek 5th Tier Basin. Project locations are approximately shown in Map 6.

Table 9-7. Projects in the Prairie Creek 5th Tier Basin

Project No.	Basin ID	Project Type	Project Name	Priority (Old No)	Estimated Cost ($)
29	P-Pr-1	CIP	Prairie Creek 67th Ave Culvert Replacement	46, VH/Reg	130,000
30	P-Pr-2	CIP	Prairie Creek BNSF Railroad/69th Ave Culvert Replacements	33, M	220,000
31	P-Pr-3	CIP	Prairie Creek 204th St Culvert Replacement	40, H	150,000
32	P-Pr-4	CIP	Prairie Creek Gaging & Monitoring	20, L	16,000
33	P-Pr-5	CIP	Prairie Creek 71st Ave Culvert Replacement	40, H	130,000
34	P-Pr-6	CIP	Prairie Creek Jensen Business Park Improvements	36, H	110,000
35	P-Pr-7	CIP	Prairie Creek 74th Ave Culvert Replacement	40, H	130,000
36	P-Pr-8	CIP	Prairie Creek SR9 Streambank Stabilization	41, H	340,000
37	P-Pr-9	CIP	West Prairie Creek Stabilization (Arlington Valley Land)	27, M	580,000
38a	P-Pr-10a	CIP	Prairie Wetland #H0979 Mid-Elevation	25,M	350,000
38b	P-Pr-10b	CIP	Prairie Wetland #H1144 Headwaters	21, L	150,000

9.4.4 Kruger Creek 5th Tier Basin

Table 9-8 presents a summary of project alternatives developed to address the problem statements identified throughout this SCP in the Kruger Creek 5th Tier Basin. Project locations are approximately shown in Map 7.

Table 9-8. Projects in the Kruger Creek 5th Tier Basin

Project No.	Basin ID	Project Type	Project Name	Priority (Old No)	Estimated Cost ($)
39	P-K-1	O&M	Kruger-Portage Jensen's Farm ESA	27, M	64,000
40	P-K-2	CIP	Kruger Creek Stillaguamish Ave Culvert Replacement	25, M	130,000
41	P-K-3	CIP	Kruger Creek Restoration, 207th to Portage	27, M	790,000
42	P-K-4	CIP	Kruger Creek 207th St Culvert Replacement	25, M	130,000
43	P-K-5	CIP	Kruger Creek Burn Road Culvert Replacement	39, H	130,000
44	P-K-6	CIP	Kruger Creek Bank Stabilization	39, H	290,000
45	P-K-7	CIP	Kruger Creek 196th St Detention Facility	25, M	1,110,000

9.5 Old Town Northeast 4th Tier Basin

Table 9-9 presents a summary of project alternatives developed to address the problem statements identified throughout this SCP which affect the South Fork Stillaguamish River in the Old Town Northeast 4th Tier Basin. Project locations are approximately shown in Map 8.

Table 9-9. Projects in the Old Town Northeast 4th Tier Basin

Project No.	Basin ID	Project Type	Project Name	Priority (Old No)	Estimated Cost ($)
46	OTNE-T-1	CIP	Talcott Water Quality Facility	25, M	1,440,000
47	OTNE-T-2	CIP	Graafstra Riparian Area	22, L	550,000
48	OTNE-T-3	O&M	Division Drainage Structures	24, L	500
49	OTNE-T-4	CIP	Old Town Northeast Storm Drain Improvements	32, M	710,000
50	OTNE-B-1	CIP	Broadway Water Quality Facility	25, M	48,000

9.6 Eagle Creek 4th Tier Basin

Table 9-10 presents a summary of project alternatives developed to address the problem statements identified throughout this SCP in the Eagle Creek 4th Tier Basin. Project locations are approximately shown in Map 9.

Table 9-10. Projects in the Eagle Creek 4th Tier Basin

Project No.	Basin ID	Project Type	Project Name	Priority (Old No)	Estimated Cost ($)
51	E-1	CIP	Brekhus-Beach Stormwater Evaluation & Design	30, M	37,000
52	E-2	CIP	Tveit Road Fish Passage—Indian Creek	33, M	130,000
53	E-3	CIP	Tveit Road Fish Passage—Eagle Creek	33, M	130,000
54a	E-4a	CIP	Eagle Wetland #SH0888	21, L	2,200,000
54b	E-4b	CIP	Eagle Clay Cliff Ponds Wetland #SH0860	29, M	66,000

9.7 Middle Fork Quilceda Creek 4th Tier Basin

9.7.1 Edgecomb Creek 5th Tier Basin

Table 9-11 presents a summary of project alternatives developed to address the problem statements identified throughout this SCP which affect Edgecomb Creek in the Middle Fork Quilceda 4th Tier Basin. Project locations are approximately shown in Map 11.

Table 9-11. Edgecomb Creek Projects

Project No.	Basin ID	Project Type	Project Name	Priority (Old No)	Estimated Cost ($)
55	MFQ-E-1	CIP	Edgecomb Cr. Gleneagle Branch 182nd St Culvert Replacement	38, H	Complete; see Appendix C
56	MFQ-E-2	CIP	Edgecomb Cr. Gleneagle Branch BNSF Siding Culvert Replacement	38, H	Complete; see Appendix C
57	MFQ-E-3	CIP	Edgecomb Cr. Gleneagle Branch 177th St Culvert Replacement	38, H	Complete; see Appendix C
58	MFQ-E-4	O&M	Edgecomb Cr. Gleneagle Branch BNSF Maintenance	42, H	48,000
59a	MFQ-E-5a	CIP	Edgecomb Cr. Gleneagle Branch 172nd St Culvert Alt A	34, H	480,000
59b	MFQ-E-5b	CIP	Edgecomb Cr. Gleneagle Branch 172nd St Culvert Alt B	34, H	480,000
60	MFQ-E-6	CIP	Edgecomb Cr. McPherson Branch BNSF Culvert Replacement	38, H	130,000
61	MFQ-E-7	CIP	Edgecomb Cr. McPherson Branch 67th Ave Tributary Culvert Replacement	38, H	190,000
62	MFQ-E-8	CIP	Edgecomb Creek Re-location—Crown Distributing Site	29, M	430,000
63	MFQ-E-9	CIP	Airport/Shoultes Rd Water	33, M	29,000

			Quality Improvements		
64	MFQ-E-10	CIP	172nd St Regional Drainage Improvements	36, H	960,000

9.7.2 *Heyho Creek 5th Tier Basin*

Table 9-12 presents a summary of project alternatives developed to address the problem statements identified throughout this SCP which affect Heyho Creek in the Middle Fork Quilceda 4th Tier Basin. Project locations are approximately shown in Map 12.

Table 9-12. Heyho Creek Projects

Project No.	Basin ID	Project Type	Project Name	Priority (Old No)	Estimated Cost ($)
65	MFQ-H-1	CIP	Middle Fork Quilceda Groundwater Influences Study	36, H	63,000
66	MFQ-H-2	CIP	Heyho Creek Water Quality Facility	27, M	140,000
67	MFQ-H-3	CIP	Smokey Point Inventory and Level Survey	21, L	30,000
68	MFQ-H-4	O&M	Beaver Control	21, L	12,000

10 IMPLEMENTATION PLAN

10.1 Stormwater Capital Improvement Strategy

The problem statements identified throughout this SCP have solutions prepared as presented in Appendix H and summarized in Chapter 9. Many of these solutions include capital projects that will require implementation on a one-time or recurring basis. Comprehensively, these projects present a "full" and proactive level of service to the community. Some projects ranked low or moderate, though beneficial, could be deferred until the Stormwater Utility has sufficient funding.

Accordingly, three alternative approaches to implementing capital improvements for the stormwater utility have been prepared. These alternatives are presented and evaluated in Section 10.1.2.

10.1.1 Projects Not Considered for Capital Funding

During development of the SCP financial program, the Stormwater Utility coordinated with BNSF to implement improvements along the railroad in the Gleneagle Branch of Edgecomb Creek. BNSF replaced two culverts, removed a third (to be replaced at a later date), and cleaned a significant length of the channel. As a result, Projects 55, 56, and 57 are or substantially are completed (Table 10-1). Project 58 remains since additional channel maintenance by BNSF is not guaranteed now or in the future.

Some projects were carried through the problem statement-project development process to assure they were addressed in the city's O&M process. With the recent implementation of the Cartegraph asset management system in the Utility, and the inclusion of specific tasks in the labor analysis in Section 10.2 (including NPDES II regulatory compliance requirements), some projects were able to be removed from further consideration. These include Projects 5, 6, 10, and 48 (see Table 10-1).

There are a large number of projects identified during the SCP process that would be difficult to fund solely by the Stormwater Utility using only utility funds; the development of this implementation plan considered opportunities to delay projects until they could be implemented with alternate funding or as part of separate or joint projects. Projects identified and removed from this capital funding plan include 7, 8, 9, 12, 13, 17, 29, 47, 59 a or b, 63, 66, and 67 (Table 10-1).

Also during development of the SCP financial program, the Stormwater Utility was able to purchase a used vactor truck in good condition using grant funding. It was determined that backhoes in the Water and Streets Departments and TV cameras in the Wastewater Department could be shared with the Stormwater Department. These and other efficiencies have reduced much of the capital *equipment* needed to meet NPDES II conditions, and Projects 13, 17, and 21 have been reduced accordingly.

A functional utility still requires basic equipment, including safety equipment. These residual equipment items still need funding, and Projects 13, 17, and 21 remain in the capital funding plan.

Table 10-1. Projects Removed from Consideration within the Stormwater Capital Improvement Strategy.

Problem/ Project No.	Project Name	Estimated Cost Savings($)	Rationale
5	Groundwater Inflow to Storm System	$1,400 (per event)	Included in utility O&M and regulatory compliance staffing
6	Illicit Discharge / Groundwater Investigation	$680 (per event)	Included in utility O&M and regulatory compliance staffing
7	Centennial Trail Storm Re-direction	$140,000	Funded by joint project: *Haller Park Environs*
8	Haller Park Outfall & Drainage Improvements	$27,000	Funded by joint project: *Haller Park Environs*
9	Haller Park Bacterial Control	$11,000	Funded by joint project: *Haller Park Environs*
10	211th & SR 530 Upkeep	$390 (per event)	Included in utility O&M and regulatory compliance staffing
12	67th Ave Bulkhead Infiltration	$150,000	Funded by joint project: *67th Ave Phase III*
13	Stuller Outfall Water Quality Improvement	$270,000	Funded by joint project: *67th Ave Phase III*
17	188th St Infiltration Replacement	$130,000	Funded by joint project: *188th St Trail (using stimulus funds)*
29	Prairie Creek 67th Ave Culvert Replacement	$130,000	Funded by joint project: *67th Ave Phase III*
47	Graafstra Riparian Area	$550,000	Funded by joint project: *Country Charm Conservation Area*
48	Division Drainage Structures	$500 (per event)	Included in utility O&M and regulatory compliance staffing

55	Edgecomb Cr. Gleneagle Branch 182nd St Culvert Replacement	$130,000	Completion by BNSF, January 2010
56	Edgecomb Cr. Gleneagle Branch BNSF Siding Culvert Replacement	$130,000	Completion by BNSF, January 2010
57	Edgecomb Cr. Gleneagle Branch 177th St Culvert Replacement	$130,000	Completion by BNSF, January 2010
59a, b	Edgecomb Cr. Gleneagle Branch 172nd St Culvert Alt A	$480,000	Funded by joint project: *SR 531 Improvements*
63	Airport/Shoultes Rd Water Quality Improvements	$29,000	Funded by Arlington Airport
66	Heyho Creek Water Quality Facility	$140,000	Funded by joint project: *West Arlington Master Plan*
67	Smokey Point Inventory and Level Survey	$30,000	Funded by joint project: *West Arlington Master Plan*
68	Beaver Control	$12,000	Assumes continued O&M provided by other City staff and cooperation with Tribe/agencies
Total of cost estimates removed from capital funding consideration (including single events for 5, 6, 10, 48)		$2,491,970	

10.1.2 Capital Improvement Strategy Alternatives

As described in the introduction to this section, the City developed three alternatives to implementation of the remaining projects for which capital funding is appropriate: Full Implementation; Delayed Implementation; and Build-up Implementation. These alternatives are described in Table 10-2.

Table 10-3 shows how each project is allocated or scheduled under each of the three alternatives. The number of projects and amount funded by horizon is summarized for each of the alternatives in Table 10-4.

A total of 60 projects with cost estimates totaling more than $18 million are considered under the Stormwater capital program. For the near term 6-year planning horizon, 2010 through 2015, the Full Implementation strategy would fund 28 projects totaling about $4,230,000 (Table 10-4). The Delayed Implementation strategy would defer many projects to the 7 to 20 year horizon, resulting in only 14 projects with cost estimates totaling just under $2,000,000 in the near term (Table 10-4). The Build-up Implementation strategy would dismiss some projects and fund selected projects at less than the estimated costs. For the 6-year planning horizon, the Build-up strategy would implement 12 projects totaling about $970,000 in order to postpone rate increases until better economic times (Table 10-4).

City leaders prefer the Build-up Implementation strategy and directed the development of the corresponding financial plan in Chapter 11.

Table 10-2. Capital Improvement Strategy Alternatives

Implementation Alternative	Characteristics
Full	a) All projects scheduled for funding in 6 yr, 20 yr, and >20 yr horizons b) Each project fully funded c) Greater number of projects (sooner) in 6 yr and 20 yr horizons
Delayed	a) All projects scheduled for funding in 6 yr, 20 yr, and >20 yr horizons b) Each project fully funded c) Increased number of projects postponed (later) into the 20 yr horizon
Build-up	a) Projects scheduled for funding in 6 yr, 20 yr, and >20 yr horizons b) Selected projects dropped from funding consideration c) Projects are fully funded, or partially funded anticipating later efficiencies or supplemental funding or inclusion d) Greater number of projects postponed (later) into the 20 yr horizon

Table 10-3. Allocation of Projects under the Capital Improvement Strategy Alternatives

Problem/ Project No.	Basin ID	Project Name	Full Implementation		Delayed Implementation		Build-up Implementation	
			Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)
3	OT-B-3	Haller (Butler) Outfall Improvements	1 to 6	230,000	7 to 20	230,000	7 to20	230,000
4	OT-B-4	Hammer-Butler Stormwater Wetland Completion (2010)	1	173,311	1	173,311	1	173,311
14	M-S-2	Stuller Property Water Table Investigation	1 to 6	15,000	7 to 20	15,000	NA	0
16	M-W-1	Stormwater Easement Database Research	1 to 6	25,000	7 to 20	25,000	NA	0
20	P-LP-4	Portage Creek Water Quality Investigation	1 to 6	13,000	1 to 6	13,000	NA	0
23	P-LP-7	Island Crossing Stormwater Plan	1 to 6	370,000	1 to 6	370,000	1 to 6	35,000
24	P-UP-1	Portage Creek Gaging & Monitoring	1 to 6	16,000	1 to 6	16,000	1 to 6	16,000
25	P-UP-2	Portage Creek Crossing, 69th Ave NE and BNSF Railroad	1 to 6	190,000	7 to 20	190,000	NA	0
30	P-Pr-2	Prairie Creek BNSF Railroad/69th Ave Culvert Replacements	1 to 6	220,000	7 to 20	220,000	1 to 6	220,000
32	P-Pr-4	Prairie Creek Gaging & Monitoring	1 to 6	16,000	1 to 6	16,000	1 to 6	16,000

Problem/ Project No.	Basin ID	Project Name	Full Implementation		Delayed Implementation		Build-up Implementation	
			Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)
40	P-K-2	Kruger Creek Stillaguamish Ave Culvert Replacement	1 to 6	130,000	7 to 20	130,000	NA	0
42	P-K-4	Kruger Creek 207th St Culvert Replacement	1 to 6	130,000	7 to 20	130,000	NA	0
43	P-K-5	Kruger Creek Burn Road Culvert Replacement	1 to 6	130,000	1 to 6	130,000	1 to 6	130,000
49	OTNE-T-4	Old Town Northeast Storm Drain Improvements	1 to 6	710,000	7 to 20	710,000	NA	0
51	E-1	Brekhus-Beach Stormwater Evaluation & Design	1 to 6	37,000	7 to 20	37,000	1 to 6	37,000
52	E-2	Tveit Road Fish Passage—Indian Creek	1 to 6	130,000	7 to 20	130,000	NA	0
58	MFQ-E-4	Edgecomb Cr. Gleneagle Branch BNSF Maintenance	1 to 6	48,000	7 to 20	48,000	NA	0
60	MFQ-E-6	Edgecomb Cr. McPherson Branch BNSF Culvert Replacement	1 to 6	130,000	7 to 20	130,000	1 to 6	130,000
61	MFQ-E-7	Edgecomb Cr. McPherson Branch 67th Ave Tributary Culvert Replacement	1 to 6	190,000	7 to 20	190,000	NA	0
64	MFQ-E-10	172nd St Regional Drainage	1 to 6	960,000	1 to 6	960,000	NA	0

Problem/ Project No.	Basin ID	Project Name	Full Implementation		Delayed Implementation		Build-up Implementation	
			Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)
		Improvements						
65	MFQ-H-1	Middle Fork Quilceda Groundwater Influences Study	1 to 6	63,000	1 to 6	63,000	NA	0
NPDES-13	IDDE-3C	IDDE Capital Equipment Expense	1 to 6	22,000	1 to 6	22,000	NA	0
NPDES-17	RUNOFF-3C	Runoff Control Capital Equipment Expense	1 to 6	2,000	1 to 6	2,000	NA	0
NPDES-21	PPOM-3C	Good Housekeeping Capital Equipment Expense	1 to 6	1,200	1 to 6	1,200	NA	0
Storm-2	PLANNING-1C	Stormwater Comprehensive Planning Consultant, 6-year interval	1 to 6	55,000	7 to 20	55,000	1 to 6	20,000
Storm-4	PLANNING-2C	Hydrography Inventory CIP	1 to 6	15,000	1 to 6	15,000	1 to 6	15,000
Storm-7	PLANNING-4C	Utility Administration Pickup Truck	1 to 6	27,000	1 to 6	27,000	2 to 6	27,500
Storm-8	PLANNING-5C	Utility Annual SW System Upgrade (2011-2015)	2 to 6	180,000	2 to 6	180,000	2 to 6	150,000
Storm-11	GROUND-WATER-2	Stormwater Injection and Recovery Evaluation	1 to 6	39,000	7 to 20	39,000	NA	0

Problem/ Project No.	Basin ID	Project Name	Full Implementation		Delayed Implementation		Build-up Implementation	
			Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)
1	OT-B-1	Old Town Drainage System Improvements	7 to 20	670,000	>=21	670,000	7 to 20	670,000
2	OT-B-2	Haller (Butler) Trunk Line Improvements	7 to 20	590,000	>=21	590,000	7 to 20	590,000
18	P-LP-2	59th Ave Infiltration	7 to 20	200,000	>=21	200,000	7 to 20	200,000
19	P-LP-3	Cemetery Rd Infiltration	7 to 20	270,000	>=21	270,000	7 to 20	270,000
21	P-LP-5	Lower Portage Flood Mitigation	7 to 20	15,000	>=21	15,000	7 to 20	15,000
26	P-UP-3	Portage Creek S. Village Apts Flood Storage	7 to 20	210,000	7 to 20	210,000	7 to 20	210,000
27	P-UP-4	Portage Creek Crossing, 186th St NE	7 to 20	130,000	7 to 20	130,000	7 to 20	130,000
28a	P-UP-5a	Portage Creek Mill Reach, SR9 to 67th Ave	7 to 20	260,000	7 to 20	260,000	7 to 20	260,000
28b	P-UP-5b	Portage Hecla Wetland, 204th St to Round Barn	7 to 20	450,000	7 to 20	450,000	7 to 20	450,000
31	P-Pr-3	Prairie Creek 204th St Culvert Replacement	7 to 20	150,000	7 to 20	150,000	7 to 20	150,000
33	P-Pr-5	Prairie Creek 71st Ave Culvert Replacement	7 to 20	130,000	7 to 20	130,000	7 to 20	130,000

Problem/ Project No.	Basin ID	Project Name	Full Implementation		Delayed Implementation		Build-up Implementation	
			Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)
34	P-Pr-6	Prairie Creek Jensen Business Park Improvements	7 to 20	110,000	7 to 20	110,000	7 to 20	110,000
35	P-Pr-7	Prairie Creek 74th Ave Culvert Replacement	7 to 20	130,000	7 to 20	130,000	7 to 20	130,000
38a	P-Pr-10a	Prairie Wetland #H0979 Mid-Elevation	7 to 20	350,000	>=21	350,000	7 to 20	350,000
39	P-K-1	Kruger-Portage Jensen’s Farm ESA	7 to 20	64,000	>=21	64,000	>=21	64,000
41	P-K-3	Kruger Creek Restoration, 207th to Portage	7 to 20	790,000	7 to 20	790,000	7 to 20	790,000
44	P-K-6	Kruger Creek Bank Stabilization	7 to 20	290,000	7 to 20	290,000	7 to 20	290,000
45	P-K-7	Kruger Creek 196th St Detention Facility	7 to 20	1,110,000	7 to 20	1,110,000	7 to 20	1,110,000
46	OTNE-T-1	Talcott Water Quality Facility	7 to 20	1,440,000	>=21	1,440,000	7 to 20	1,440,000
50	OTNE-B-1	Broadway Water Quality Facility	7 to 20	48,000	>=21	48,000	7 to 20	48,000
53	E-3	Tveit Road Fish Passage—Eagle Creek	7 to 20	130,000	>=21	130,000	7 to 20	130,000
62	MFQ-E-8	Edgecomb Creek Re-location—	7 to 20	430,000	7 to 20	430,000	7 to 20	430,000

Problem/ Project No.	Basin ID	Project Name	Full Implementation		Delayed Implementation		Build-up Implementation	
			Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)	Horizon (yrs)	Estimated Cost ($)
		Crown Distributing Site						
11	M-211R-1	211th & Ronning Rd Outfall	>=21	42,000	>=21	42,000	>=21	42,000
15	M-S-3	Wetland #0961 Valley Gem – 96 acres	>=21	510,000	>=21	510,000	>=21	510,000
22	P-LP-6	Lower Portage Wetland Restoration	>=21	1,960,000	>=21	1,960,000	>=21	1,960,000
28c	P-UP-5c	Portage Wetland #1561	>=21	450,000	>=21	450,000	>=21	450,000
28d	P-UP-5d	Portage Wetland #1247	>=21	450,000	>=21	450,000	>=21	450,000
36	P-Pr-8	Prairie Creek SR9 Streambank Stabilization	>=21	340,000	>=21	340,000	>=21	340,000
37	P-Pr-9	West Prairie Creek Stabilization (Arlington Valley Land)	>=21	580,000	>=21	580,000	>=21	580,000
38b	P-Pr-10b	Prairie Wetland #H1144 Headwaters	>=21	150,000	>=21	150,000	>=21	150,000
54a	E-4a	Eagle Wetland #SH0888	>=21	2,200,000	>=21	2,200,000	>=21	2,200,000
54b	E-4b	Eagle Clay Cliff Ponds Wetland #SH0860	>=21	66,000	>=21	66,000	>=21	66,000

Table 10-4. Project Summary for the Capital Improvement Strategy Alternatives

Horizon (years)	Parameters	Full Implementation	Delayed Implementation	Build-up Implementation
1 to 6	No. Projects	29	14	12
	Total Est. Cost ($)	$4,267,511	$1,988,511	$969,811
7 to 20	No. Projects	22	27	21
	Total Est. Cost ($)	$7,967,000	$6,469,000	$7,903,000
>=21	No. Projects	10	20	11
	Total Est. Cost ($)	$6,748,000	$10,525,000	$6,812,000
All Projects	No. Projects	61	61	44
	Total Est. Cost ($)	$18,982,511	$18,982,511	$15,684,811

10.2 Stormwater Utility Staffing Plan

10.2.1 Staffing History

Although the City commissioned a Comprehensive Stormwater Plan in the mid-1990s (Barrett Consulting Group 1995), the Stormwater Utility itself was not created until Ordinance 1266 was adopted September 4, 2001. The Stormwater Department existed only on paper, however, with utility functions performed by numerous other City departments. In September 2006, the Stormwater Utility began collection of a basic assessment from ratepayers to finance operations and maintenance of the Stormwater Utility. The utility continued unstaffed through the issuance of the NPDES II Stormwater Permit in January 2007. In March 2008, the Department hired its first employee, a Stormwater Technician, to help implement and assure permit compliance.

Table 9-1 presents a summary of estimated labor requirements necessary for meeting the regulatory requirements specified within the NPDES II permit conditions, and for assuring smooth operation of the Stormwater Utility. Most of the NPDES II permit conditions are required to be fully implemented by February 2011; Ecology is scheduled to issue the second cycle of NPDES II permits, with additional conditions for the subsequent 5 year cycle, in February 2012.

Table 9-1 does not include the current or recent efforts from city engineering, streets, community development, and administrative staff that are actually stormwater utility functions. Some of these functions are included in this staffing plan to the extent that they have already begun to be consolidated under utility staff. Vacation, sick leave, staff meetings, etc are also not considered in Table 9-1.

10.2.2 Staffing Plan

Basic utility staffing and regulatory compliance requirements total 2.8 FTEs (Table 9-1). With the current Stormwater Technician at 1.0 FTE, an additional 1.8 FTEs are required to fully meet the technical, regulatory (including education), and customer service expectations of the Stormwater Utility. The City recognizes that the second staff person would likely not be hired until after the February 2011 NPDES II deadline. Until the utility is fully staffed, the City intends to meet permit conditions using existing staff in various city departments (Engineering, Natural Resources, Utilities, M&O).

Table 10-5 presents an example of how NPDES II permit conditions and selected operations might be scheduled in order to fully staff and address the required efforts.

Table 10-5. Example of How City May Address Regulatory Compliance and Operations Commitments Under the Proposed Staffing Plan

Program No.	Project Name	Annual Effort Required (Labor Hrs)	Existing Staff 1.0 FTE 2010 (Labor Hrs)	Second Hire 1.0 FTE 2011 (Labor Hrs)	Third Hire 0.8 FTE 2015 (Labor Hrs)
Regulatory Compliance Requirements					
NPDES-1	Stormwater Management Program (SWMP) Development and Administration	110	80	30	0
NPDES-2	SWMP Annual Reporting	92	50	42	0
NPDES-3	Stormwater Public Education and Outreach (PEO) Program Development and Administration	480	100	200	180
NPDES-4	Evaluation of PEO Program Effectiveness	100	100	0	0
NPDES-5	PEO Target Audience:	335	50	100	185

Program No.	Project Name	Annual Effort Required (Labor Hrs)	Existing Staff 1.0 FTE 2010 (Labor Hrs)	Second Hire 1.0 FTE 2011 (Labor Hrs)	Third Hire 0.8 FTE 2015 (Labor Hrs)
	General Public				
NPDES-6	PEO Target Audience: Public and Businesses	213	50	50	113
NPDES-7	PEO Target Audience: Homeowners, Landscapers, Property Managers	237	100	34	103
NPDES-8	PEO Target Audience: PEO Target Audience: Engineers, Contractors, Developers, Permit Staff, Planners	60	60	0	0
NPDES-9	Public Involvement and Participation (PIP)	48	48	0	0
NPDES-10	Illicit Discharge Detection and Elimination (IDDE): Infrastructure mapping and inventory	120	60	60	0
NPDES-11	IDDE: Ordinance and Regulation	24	24	0	0
NPDES-12	IDDE: Prepare and Implement IDDE Plan	236	186	50	0
NPDES-14	Runoff: Development and Construction Runoff Ordinance and Modification of Permit Process	701	100	300	301
NPDES-15	Runoff: Operations and Maintenance Ordinance and Adoption of Stormwater Standards	46	46	0	0
NPDES-16	Runoff: Develop and Implement Inspection	614	174	400	40

Program No.	Project Name	Annual Effort Required (Labor Hrs)	Existing Staff 1.0 FTE 2010 (Labor Hrs)	Second Hire 1.0 FTE 2011 (Labor Hrs)	Third Hire 0.8 FTE 2015 (Labor Hrs)
	Program and Other Runoff Controls				
NPDES-18	Pollution Prevention at O&M facilities (PPOM): Adoption of Maintenance Standards	116	50	66	0
NPDES-19	PPOM: Inspection Program	406	98	200	108
NPDES-20	PPOM: Housekeeping Procedures and Policies	188	90	98	0
NPDES-22	Total Maximum Daily Load (TMDL): Bacterial Control Program	80	0	80	0
NPDES-23	TMDL: Surface Water Monitoring—Snohomish Basin	110	40	0	70
NPDES-24	TMDL: Surface Water Monitoring—Stillaguamish Basin	206	0	0	206
NPDES-25	TMDL: Septic System Evaluation	100	0	0	100
NPDES-26	Effectiveness (Longterm) Monitoring Program	72	0	0	72
Selected Operations Requirements					
Storm-1	Stormwater Comprehensive Plan Update (staffing support on 6 yr update cycle, annualized)	20	20	0	0
Storm-3	Hydrography Inventory Maintenance	20	20	0	0

Program No.	Project Name	Annual Effort Required (Labor Hrs)	Existing Staff 1.0 FTE 2010 (Labor Hrs)	Second Hire 1.0 FTE 2011 (Labor Hrs)	Third Hire 0.8 FTE 2015 (Labor Hrs)
Storm-5	GIS Database and Asset Management System	120	110	10	0
Storm-6	Utility Administration (work orders, locates, credit program, safety, meetings, other admin)	764	424	300	40
Storm-9	Stream Restoration Reserves	120	0	60	60
Storm-10	Underground Injection Control Program Evaluation	80	0	0	80
Staffing effort required to implement assigned tasks defined above (man-hours)		5,818	2,080	2,080	1,658
Staffing effort required to implement assigned tasks defined above (FTEs)		2.8	1.0	1.0	0.8

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11 FINANCIAL PROGRAM

This Chapter was prepared by Katy Isaksen & Associates under separate contract to the City of Arlington and incorporates the stormwater funding plan. Based on the financial needs identified in this Chapter, the City will be continuing its review of Stormwater rates during 2010.

11.1 History

The City of Arlington established the Stormwater Utility with Ordinance No. 1266 in September 2001. Ordinance No. 1395 in July 2006 established Arlington Municipal Code Chapter 13.28, most recently updated in May 2010 and included in Appendix G. The City accounts for its stormwater utility with an operating and a capital improvement fund. All stormwater revenue is deposited into one of the two funds identified specific to stormwater. Table 11-1 summarizes the four-year history of the combined stormwater funds.

Table 11-1. Summary History of Storm Sources & Uses

CITY OF ARLINGTON SUMMARY STORM HISTORY	ACTUAL 2006	ACTUAL 2007	ACTUAL 2008	ACTUAL 2009
Stormwater Sources				
Stormwater Service Charges	123,794	340,374	349,683	349,144
Stormwater – Marysville Billing		52,936	77,651	81,459
Loan fr. Prog. Devel. Fund	27,293		-	-
Investment Interest	945	3,897	2,717	1,750
Grants: Dept. of Ecology			66,771	84,091
Miscellaneous			-	27,786
Total Storm Sources	152,032	397,207	496,822	544,230
Stormwater Uses				
Storm M&O Expense	96,862	285,178	310,017	364,301
Existing Loan (Util. Implementation)*	-		50,000	50,000
Stormwater Comp Plan	94,169	70,243	18,193	3,830
Stormwater Wetland Project			44,756	69,481
Capital Outlay – CIP List	-	8	-	1,192
Total Storm Uses	191,031	355,429	422,966	488,804
Annual Increase/(Use) of Reserves	***(38,999)***	***41,778***	***73,856***	***55,426***
Ending Balance Stormwater Fund				*$ 103,008*
Ending Bal Storm Capital Fund				*$ 58,958*

* Annual loan payment shown as 2009 although transfer actually made in 2010.

The Stormwater Operating Fund had a 2009 ending balance of $103,008 after including the loan payment of $50,000 that was not shown in the annual transfers. The Stormwater Capital Fund had a balance of $58,958 at the end of 2009.

Grants from the Department of Ecology have been helpful in progressing on the wetland project and meeting the bottom line. In 2010, additional grants are anticipated from two Department of Ecology Stormwater Implementation Grants: $400,000 for the wetlands project, and $50,000 for the vactor purchase and other NPDES Phase II implementation. Future grants are uncertain. The legislature has been authorizing these stormwater grants focused on implementation of NPDES Phase II requirements on a year-to-year basis.

All property within the city limits is in the Stormwater Utility. The stormwater billing for the majority of the city appears on the monthly utility bill. A portion of the city is served water/sewer by the City of Marysville and the City contracts with Marysville to bill these customers for stormwater service and transfer the receipts to Arlington.

The current stormwater charge was set in 2006 at $3.45 per Equivalent Service Unit (ESU). One ESU is equal to a single family residential property or 6,000 square feet of impervious surface area for non-residential properties. Any increase or change in Stormwater Utility revenue is primarily due to growth or change in the customer base, such as by annexation or the addition of impervious surface area.

Property owners within the city limits that are on wells or septic tanks are charged for stormwater on an annual basis. The City bills itself for city-owned property for an annual billing of approximately $19,000.

An initial grant from the Department of Ecology prior to this period assisted the City in establishing the utility. A loan from the Program Development Fund was recorded over several years of approximately $500,000 for implementation and to balance the stormwater fund before a revenue source was established. This utility implementation loan is now being repaid at $50,000 per year for 10 years.

The City was successful in competing for and receiving a $520,000 grant for the Stormwater Wetland Project to be constructed on the former Hammer property. The other grants of $75,000 and $50,000 from Department of Ecology for NPDES Phase II implementation have assisted the City in funding this Stormwater Comprehensive Plan and purchasing a vactor truck (used from the City of Bellevue). It is unclear whether any further Phase II grants will be made available from DOE, but the City is ready to make further progress toward Phase II should additional funds be available.

11.2 Outstanding Debt

The only outstanding debt to the Stormwater Utility at this time is an internal loan for implementation funding. The loan was transferred from the Program Development Fund in current expense to the Water Utility. Stormwater is currently repaying the Water Utility at $50,000 per year for 10 years.

11.3 Funding Priorities

The Stormwater service charges are the primary source of on-going revenue for the Utility. These are deposited into the Stormwater operating fund and are available to pay for operations, maintenance, administration, debt repayment and capital improvements.

The Stormwater Utility retains all surplus in its fund balance and is available for reserves, capital projects or as deemed necessary to support Stormwater Utility functions. Excess funds in the operating fund are transferred into the capital fund for use in future improvements.

With the Stormwater Utility in its early years, the reserves have been accumulating. To be consistent with the water and sewer utilities, the target minimum reserve balance in the operating fund would be two months of operating expense, or approximately $60,000 for 2010 and

$76,000 for 2011 (Table 11-2). An emergency reserve of $50,000 has been built-up. When the Stormwater Utility incurs external debt, the target reserves should be increased to reflect up to one year debt repayment.

Table 11-2. Reserve Account

Estimated Ending Balance	2010	2011	Comments
Est. Operating Fund	90,000		
Est. Improvement Fund	44,000		
Est. Ending Balance	**134,000**		
Target Minimum Reserve			
Target Operating Reserve	*57,000*	*76,000*	*2-month O&M*
Target Emergency Reserve	*50,000*	*50,000*	*Emergency*
Target Minimum Reserve	***107,000***	***126,000***	
Balance Meets Target?	***Yes***	***Yes***	

The City will continue to seek grants to fund improvements and implementation of the NPDES Phase II requirements. In the absence of grants, long-term debt may be used when appropriate to carry out capital improvements. Any future debt incurred will be repaid by Stormwater rates.

11.4 Capital Funding Sources

The City has been successful in receiving grants from the Department of Ecology to assist with utility implementation, with the Wetland Project, and in recent years with NPDES Phase II implementation grants. These have been a combination of competitive and non-competitive grants. With the State's focus on cleaning up Puget Sound, stormwater management and NPDES Phase II, additional grant funding may become available. The City should continue monitoring and position itself to receive grants.

Grants – Grant funds are a good source of capital funding because the money does not have to be repaid. Unfortunately, grants are unpredictable and typically hard to come by. Grants are typically targeted to capital improvements and offerings vary widely. Good sources on the internet to research include Washington State Department of Ecology, Puget Sound Partnership, Department of Recreation and Conservation, Department of Commerce, US Environmental Protection Agency, Association of Washington Cities and Municipal Research Services Center. Economic stimulus is primarily coming through existing programs.

Low-Interest Loans – The State of Washington also operates several low-interest loan programs for storm capital projects. The Department of Ecology operates a competitive grant/loan program for storm capital projects in the form of the State Revolving Fund, the Centennial Clean Water Fund and Section 319 funds. A combined application process for DOE Water Quality programs is run with applications typically due at the end of each October (2009 was changed to December by the legislature for one year only). There are certain approvals that are required by DOE prior to application. The low-interest loans are currently at 60% of the market rate interest for up to 20 years. A portion of these DOE Water Quality funds are also grants or a combined grant/loan.

The Public Works Trust Fund has both a Pre-Construction and a Construction program with loans with interest rates up to two percent and loan terms up to 20 years. These are competitive programs with Construction applications due each May. If successful, the funds are available the following year. The maximum for PWTF Construction is $10 million per state biennium. The Pre-Construction program is year-round, with a maximum of $1,000,000 per jurisdiction per biennium. Unfortunately, the state's budget crisis put these programs on hiatus for the current biennium. Applications were accepted in May 2010 with funding potential for July 2011. It is anticipated that the PWTF program may attempt to have the major funding cycle every other year. Planning ahead is key to be in line for the most advantageous funding package.

Bond Sales – The City has the authority to sell several types of bonds that would be appropriate for capital projects: revenue, general obligation, limited general obligation and local improvement district bonds. While some may argue that bonds can be a more costly form of financing over grants and low-interest loans, the City controls the timing of the funding and thus the schedule for completing the projects. Another benefit of using bond funding is the trade-off of locking the project cost in an earlier construction year rather than waiting to accumulate funds and allow the construction costs to escalate. For large projects, in times of rapidly rising construction costs, and in times of low interest, bonds are very appropriate.

Developer Funded Improvements – A series of projects have been identified as developer funded improvements. These projects are not intended to be funded or completed by the City and will be required to be constructed by developers, as deemed necessary to support the new development. The City typically uses Recovery Contracts to allow a developer to be reimbursed by other parties benefiting from the developer funded facilities as appropriate on a case-by-case basis.

Contributions, Joint Projects – Pursuing contributions from benefiting parties or joint projects can provide cost savings to the Stormwater fund when appropriate for the project.

Puget Sound Partnership – The Partnership is focused on cleaning up Puget Sound, and stormwater is a significant element of the solution. At this time, the Partnership does not have direct funding for jurisdictions. However, they see themselves as a funnel with attracting funding to the area and ensuring that projects funded have been prioritized in their Action Agenda. State programs are being adjusted to also reflect such prioritization. The City should continue to participate in the implementation of the Action Agenda and identify the areas where the stormwater program fits for use in future applications. The City should also review the PSP website for new and changing information on upcoming funding opportunities. It will be important that the City meets the criteria necessary to be included as a Puget Sound "Partner" as that will provide additional points when competing for grants.

Infrastructure Funding Database – The Infrastructure Assistance Coordinating Council (IACC) provides a funding database. This can be accessed directly on the web at www.infrafunding.com or through the Public Works Board website, www.pwb.wa.gov . This database is 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.

11.5 Six-Year Capital Improvements

In earlier chapters the City developed three alternatives for implementation of the Capital Improvement projects: Full Implementation; Delayed Implementation; and Build-up Implementation. For the near term 6-year planning horizon, 2011 through 2016, the Full Implementation strategy would fund 28 projects totaling about $5,000,000. The Delayed Implementation strategy would defer many projects to the 7 to 20 year horizon. The Build-up Implementation strategy would defer additional projects, dismiss other projects and fund 11 projects totaling about $1,330,000. After discussion with City leaders, it was decided that it was more prudent to move forward with the Build-up Implementation strategy.

The project costs for the Build-up Implementation Strategy were estimated in 2009 dollars in earlier chapters. The projects were scheduled over the six-year period and a total in 2009 dollars is shown in Table 11-3. The costs have also been escalated to the scheduled year using 3.5% annual construction cost escalation for a total of $1,590,000 needed to complete the six-year capital improvements.

Table 11-3. Six-Year Capital Improvements Scenario – Build-Up Program

Project #	TYPE	6-YEAR BUILD-UP IMPLEMENTATION	Est. Cost ($2009)	Year Scheduled
Exist		Stormwater Wetland (not grant-funded) *NOTE 1*	$ 65,000	2011
Storm-8	Annual	Annual SW System Upgrade (capacity/failing)	$ 750,000	2012-16
Storm-7	Capital	Storm Utility Capital Equipment	$ 27,500	20112-16
23	CIP	Island Crossing Stormwater Plan	$ 35,000	2016
24	CIP	Portage Creek Gaging & Monitoring	$ 16,000	2015
30	CIP	Prairie Creek BNSF RR / 69th Culvert Replacement	$ 220,000	2015
32	CIP	Prairie Creek Gaging & Monitoring	$ 16,000	2016
43	CIP	Kruger Creek Burn Rd Culvert Replacement	$ 130,000	2014
51	CIP	Brekhus -Beach Stormwater Evaluation & Design	$ 37,000	2016
Storm-4	Capital	Hydrography Inventory CIP	$ 15,000	2015
Storm-2	CIP	Stormwater Comp Plan Update	$ 20,000	2014
		Total 6-Year - ($2009)	$ 1,331,500	
		Total Est. Cost - Escalated to Year*	**$ 1,590,000**	

NOTE 1 - The non-grant funded portion of the existing Stormwater Wetland Project and Implementation Monitoring has been included in Table 11-3 because it has not yet been funded. The remaining cost is estimated to be $260,000 minus a $195,000 grant application that is being submitted to Dept. of Ecology.

In addition to the six-year projects identified above, there are approximately $17,674,000 of other projects scheduled as Future Capital Improvements and $2,782,000 in Joint Projects to be funded with other projects. Table 11-4 summarizes the project costs that are in addition to the six-year improvements.

Table 11-4. Future Capital Improvements

FUTURE CAPITAL IMPROVEMENTS	Est. Cost ($2009)
Delayed from 2011-2016	$ 3,023,000
Period 2017 - 2026	$ 7,903,000
Period 2027 - 2035	$ 6,748,000
Total Future CIP	**$17,674,000**
JOINT PROJECTS funded with other projects	
Period 2010-2015	$ 1,644,000
Period 2016-2025	$ 1,138,000
Total Joint - funded with other projects	**$ 2,782,000**

Any projects related to operations and maintenance, have been assumed to be included in the O&M program and are not separately accounted for as capital improvements or equipment.

11.6 Funding The Six-Year Storm Improvements

The Stormwater Utility does not have sufficient rates or reserves to fund the recommended six year capital improvements. The Utility continues to seek grants to complete eligible priority improvements.

Three funding alternatives have been developed to estimate the impact on monthly rates for each funding package: Pay-As-You-Go, 100% Bond, and 50% Bond.

- Pay-as-you-go – Improvements are funded through rates over the next six-years and completed over the same period.
- 100% Bond – Improvements are funded through a bond sale for the full six-year program, completed in the next 2 years and the debt repaid over 20 years at 5.5% interest.
- 50% Bond – Improvements will be completed over the next six-years and 50% will be funded by a bond sale to be repaid over 20 years at 5.5% interest.

Table 11-5 estimates the impact on monthly rates for each alternative.

Table 11-5. Six-Year CIP Funding

		Est. Rate Impact/Mo.		
SCENARIO: BUILD-UP PROGRAM		**Pay as Go**	**100% Bond**	**50% Bond**
Total 6-Year CIP ($2009)	$ 1,331,500	6-Yrs	20-Yrs	20-Yrs
Total 6-Year CIP – Escalated	**$ 1,590,000**			
Annual average over 6-years	$ 265,000	**$ 2.12**	**$ 1.20**	**$ 1.66**

Due to the economic times, the typical funding programs are a bit unknown. New grants have been offered by the State that the City has been a beneficiary. Federal economic stimulus funds are typically coming through existing funding program. The sure funding methods that are under City control are that the pay-as-you-go for the capital improvements each year or sell bonds to complete projects in today's dollars with low interest rates.

A bond issue to finance the six-year improvements over 20-years would reduce the impact on the monthly rate necessary to fund the improvements over 6-years. However, with the City currently incurring significant debt for the Wastewater Treatment Plant Project, it is unlikely that the City would incur additional debt in the next two years. The average annual cost of the six-year improvements of $265,000 is included in the six-year outlook for stormwater rates.

11.7 Additional Staffing To Meet NPDES Phase II

An analysis of the staffing needed to meet the NPDES Phase II requirements is included in an earlier chapter. The conclusion was that an estimated 2.8 full time equivalent (FTE) staff was required to meet the requirements of the NPDES II permit. The Stormwater Utility currently has 1.0 FTE dedicated to meeting Phase II; an additional 1.0 FTE staff is planned to be added in 2011 and is included as a separate line item in the operating expense (see Six-Year Outlook). The need for the remaining 0.8 FTE will be evaluated in 2015 and addressed as necessary at that time.

11.8 Six-Year Rate Outlook

The six-year outlook includes the operating expenses necessary to meet the NPDES Phase II requirements, and to begin paying a share of Utility Administration (currently funded by water and sewer). For 2011, this includes 1.0 FTE additional staff and an additional $30,000 as a 5% share of Utility Administration.

New residential units are estimated at the equivalent of 30 per year. This includes commercial activity in the portion of the City where the water/sewer utilities are provided by Marysville, but Stormwater services are provided by Arlington.

The existing rate of $3.45 per single family or an equivalent service unit (ESU) per month would need to increase to $5.26 by 2015 to pay for the operations, maintenance and debt repayment. This is before the capital improvements are added.

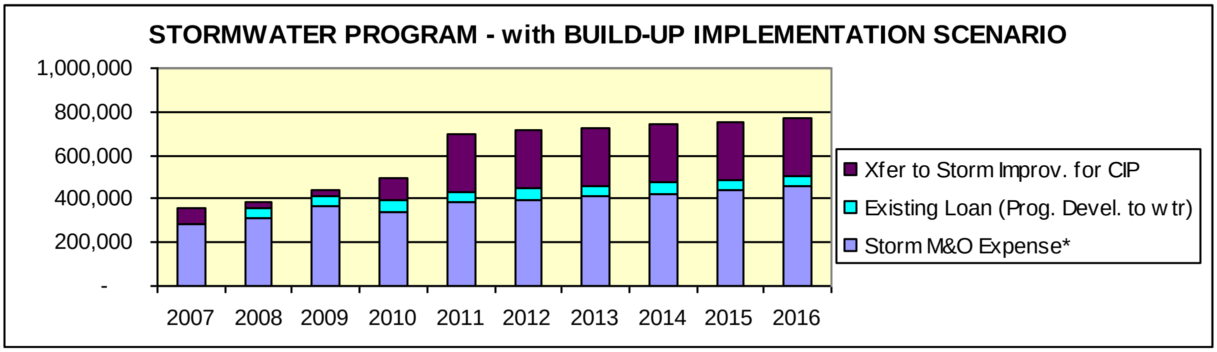
<u>Recommended Six-Year Outlook</u>

The rate scenario that includes the Build-Up Implementation Strategy for capital improvements is recommended as a reasonable alternative to make progress toward solving the stormwater issues in the City. The outlook graph and the impact on monthly rates are shown in Table 11-6.

After adding in the capital program, the Pay-as-you-Go method would result in an increase of $2.55 per month in 2011 to $6.00 per single family residence. The rates would need to increase to cover the costs of annual escalation in the remaining years through 2016 to meet the identified needs.

The outlook graph and the impact on monthly rates are shown in Table 11-6.

Table 11-6. Six-Year Rate Outlook – With Capital Build-Up Program



ESTIMATED MONTHLY SINGLE FAMILY RATE	2010	2011	2012	2013	2014	2015	2016
Build-Up Scenario: Pay as You Go	***$3.45***	*$6.00*	*$6.11*	*$6.22*	*$6.34*	*$6.46*	*$6.58*

This is the most conservative rate scenario that includes funding for the six-year improvements as an annual average. The Utility will review the improvements during each budget cycle and determine how best to complete the projects within the planned target. The rates could be reviewed and adjusted if low-interest loans or bonds were used, or if grants are obtained, some of the reduced or delayed projects should be added back into the six-year window.

With the 100% Bonds scenario, the rate would need to increase less overall than the Pay-as-you-Go method, or $1.65 increase to $5.10 per month. This scenario provides funding for anticipated bond debt repayment and would require bonds to be sold to complete the capital improvements.

The 50% Bonds scenario is the middle alternative. It recognizes that some of the improvements should be funded with rates and that a bond or low-interest loans may be used in the second half of the period after the Wastewater project is complete. This scenario would require a $2.10 increase in 2011 to $5.55.

11.9 Existing Stormwater Rates

The existing Stormwater rates were established in 2006. Single family residences pay a flat rate of $3.45 per month. Other property types pay based on the amount of impervious surface area is on their property. Impervious surface area is hardened surfaces, such as driveways, rooftops, parking lots, etc. that have resulted from some sort of clearing or development of the property.

These impervious surface areas prevent water from entering the ground and cause the runoff to be in greater quantity or flow rate than before development occurred. The properties that are not single family are charged a Stormwater rate of $3.45 per 6,000 square feet of impervious surface area. One Equivalent Service Unit (ESU) is equal to one residence or 6,000 square feet of impervious surface area.

Table 11-7 summarizes the existing Stormwater rates.

Table 11-7. Existing Stormwater Monthly Rates

Real Property Type	Equivalent Service Units (ESU)	Rate
Single-family residences, duplexes and triplexes	1 ESU[(a)] per dwelling unit	$3.45 per month
Senior Low-Income Single Family Residence	1 ESU per dwelling unit	40% reduction to $2.07 per month
All other developed real properties, including multifamily, condominiums, and mobile home parks	Divide the square footage of Impervious Area[(b)] on each property by 6,000 to get ESU's; round to the nearest whole number.	$3.45 per month per ESU calculated
Each developed parcel of property	Minimum 1 ESU	$3.45 per month minimum

(a) 1 ESU = one single family residence or 6,000 square feet of Impervious Area

(b) Impervious Area = Hard surface area which prevents or retards the entry of water into the soil mantle and/or causes water to run off the surface in greater quantities or at an increased rate of flow from that present under natural conditions prior to development.

Undeveloped properties, or those remaining in an undeveloped condition, are not subject to Stormwater service charges. In addition, City street rights-of-way, State of Washington highway rights-of-way and Snohomish County road rights-of-way are special categories exempt from Stormwater service charges. The State of Washington and Snohomish County must agree to maintain, construct and improve all drainage facilities within the rights-of-way and conform with all utility standards.

Credits are available under certain conditions for private, on-site control facilities on non-single family properties and school facilities. The credits, process and forms are described in the Stormwater Credit Manual. There is typically a maximum credit available for certain conditions.

11.10 Comparison to Other Jurisdictions

It is nice to know what other jurisdictions are charging for their Stormwater service, however it is important to remember that each jurisdiction may have other factors impacting the monthly rate, such as program scope and organization, need for major improvements, size of customer base, etc.

The monthly rates are compared in Table 11-8 and they were taken from information provided on the websites in 2010. These rates are for a single family residence and do not include any taxes that are added on the bills.

Table 11-8. Monthly Rate Comparison

Jurisdiction	Monthly Stormwater Rate
Duvall	$16.92
Stanwood	$12.25
Everett	$11.60
Monroe	$10.50
Unincorp. Sno. Co. – Arlington UGA	$10.17
Marysville	$10.00
Snohomish	$9.52
Lake Stevens	$8.67
Unincorp. Sno. Co. - Outside UGA	$7.50
Sultan	$6.75
Burlington	$6.07
Mt. Vernon	$6.05
Arlington - Proposed	**$6.00**
Arlington – Existing	**$3.45**

The Arlington proposed rate of $6.00 per month remains less than the other jurisdictions compared. This is likely due to the Build-Up Implementation strategy that makes progress on stormwater issues with less dramatic impact on the ratepayers. It is estimated that the Full Implementation strategy could be afforded within the range of rates shown above.

11.11 Detail Tables

Four tables follow to provide the detail for future monitoring and adjustment as necessary.

- Table 11-9: Detailed Stormwater Financial Outlook
- Table 11-10: Detailed Stormwater Improvement Fund Outlook
- Table 11-11: Detailed Stormwater O&M
- Table 11-12: Six-Year Stormwater Capital Improvements

Table 11-9. Detailed Stormwater Financial Outlook

Assumptions									
New Residential Units			30	30	30	30	30	30	30
Est. Revenue ESU's		10,401	10,704	10,734	10,764	10,794	10,824	10,854	10,884

CITY OF ARLINGTON – STORM SIX-YEAR PROJECTIONS	ACTUAL 2008	ACTUAL 2009	Est./Bdgt. 2010	Projected 2011	Projected 2012	Projected 2013	Projected 2014	Projected 2015	Projected 2016
Stormwater Revenue									
Storm Service Charges	349,683	349,144	361,536	362,778	364,020	365,262	366,504	367,746	368,988
Storm Service - Marysville Billing	77,651	81,459	81,600	81,600	81,600	81,600	81,600	81,600	81,600
Investment Interest	2,364	1,386	785	785	785	785	785	785	785
FEMA Storm Assistance			54,541						
Miscellaneous	-	-	155	-	-	-	-	-	-
Total Sewer Revenue	429,698	431,989	498,617	445,163	446,405	447,647	448,889	450,131	451,373
Storm Expense									
Storm M&O Expense*	310,017	364,301	341,381	383,329	396,746	410,632	425,004	439,879	455,275
Additional Staff for NPDES Ph II			-	75,000	77,625	80,342	83,154	86,064	89,076
Existing Loan (Prog. Devel. To wtr)	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Xfer to Storm Improv. for CIP	21,517	25,000	100,000	265,000	265,000	265,000	265,000	265,000	265,000
Total Sewer Expense	381,534	439,301	491,381	773,329	789,371	805,974	823,158	840,943	859,351
begin funding $30,000 of Utilities Admin. in 2011 (approx. 5%)									
Annual Increase/(Use) of Reserves	***48,164***	***(7,312)***	***7,236***	***(328,167)***	***(342,966)***	***(358,327)***	***(374,269)***	***(390,813)***	***(407,979)***
Cumulative % of Svcs Charges				***90%***	***94%***	***98%***	***102%***	***106%***	***111%***
Est. Increase/Mo.- Cumulative				*2.55*	*2.66*	*2.77*	*2.89*	*3.01*	*3.13*
Est. Increase/Mo. - Annual				***2.55***	***0.11***	***0.11***	***0.12***	***0.12***	***0.12***
Estimated Rate/ESU/Mo.		***$ 3.45***	***$ 3.45***	***$6.00***	***$6.11***	***$6.22***	***$6.34***	***$6.46***	***$6.58***
Proposed Rate/Mo.				***$6.00***	***By CPI***	***By CPI***	***By CPI***	***By CPI***	***By CPI***

Table 11-10. Detailed Stormwater Improvement Fund Outlook

Storm Improvement Revenue	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Xfer from Storm Fund for CIP	70,593	11,701	5,000	100,000	265,000	265,000	265,000	265,000	265,000	265,000
Investment Interest		353	364	134	134	134	134	134	134	134
Grant: DOE Storm Impl (2009)				50,000						
Grant: DOE Storm Impl (2008)		66,771	8,229							
Grant: DOE Storm Impl (Wetlnd)			75,862	400,000	44,043					
Reimbursements										
Total Sewer Improv. Revenue	70,593	78,825	89,455	550,134	309,177	265,134	265,134	265,134	265,134	265,134
Beginning Fund Balance	-	342	16,218	58,956	44,090	88,268	88,402	88,537	88,671	88,805
Storm Improvement Expense										
Storm Comp Plan	70,243	18,193	3,830	5,000						
Storm Wetland Project	-	44,756	41,695	475,000	incl. in cip					
Vactor Purchase (used)				45,000						
Capital Outlay - CIP List	8		1,192	40,000	265,000	265,000	265,000	265,000	265,000	265,000
Total Storm Improv. Expense	70,251	62,949	46,717	565,000	265,000	265,000	265,000	265,000	265,000	265,000
Annual Incr./(Use) of Reserves	***342***	***15,876***	***42,738***	***(14,866)***	***44,177***	***134***	***134***	***134***	***134***	***134***
End Balance - Storm Improv.	**342**	**16,218**	**58,956**	**44,090**	**88,268**	**88,402**	**88,537**	**88,671**	**88,805**	**88,940**

Target Emergency Reserve includes $50,000 + 1 year debt payment. Emergency reserve should be increased when possible.

Target Minimum Reserve Levels

Estimated Ending Balance	2010	2011	
Est. Operating Fund	90,243		
Est. Improvement Fund	44,090		
Est. Ending Balance	**134,333**		
Target Minimum Reserve			
Target Operating Fund	*56,897*	*76,388*	*2 mos oper*
Target Improvement Fund	*50,000*	*50,000*	*emergency*
Target Minimum Reserve	***106,897***	***126,388***	
Balance Meets Target?	Yes	Yes	

Table 11-11. Detailed Storm O&M

CITY OF ARLINGTON - STORM	ACTUAL 2007	ACTUAL 2008	ACTUAL 2009	BUDGET 2010	EST. 2011	EST. 2012	EST. 2013	EST. 2014	EST. 2015	EST. 2016
Storm M&O Expenses										
Salaries & Wages			45,961	49,596	51,332	53,128	54,988	56,913	58,904	60,966
Personnel Benefits			27,086	29,683	30,722	31,797	32,910	34,062	35,254	36,488
Additional Staff for NPDES Ph II					75,000	77,625	80,342	83,154	86,064	89,076
Salaries - Xfer to PW- M&O	90,000	163,439	91,759	92,700	95,945	99,303	102,778	106,375	110,099	113,952
Operating Supplies	1,611	1,108	3,960	5,000	5,175	5,356	5,544	5,738	5,938	6,146
Equipment Rental M&O (vehicle exp)				2,000	2,070	2,142	2,217	2,295	2,375	2,459
Communications	-	69	231	280	290	300	310	321	333	344
Travel & Training		250	-	250	259	268	277	287	297	307
Monitoring & Sampling Supplies	-	5,274	27	1,500	1,553	1,607	1,663	1,721	1,782	1,844
NPDES Phase II Requirements				3,000	3,105	3,214	3,326	3,443	3,563	3,688
Interlocal Agreements	2,150	4,064	1,048	4,500	4,658	4,821	4,989	5,164	5,345	5,532
Professional Services (consult/legal)			500	2,500	2,588	2,678	2,772	2,869	2,969	3,073
Vactor (contract thru 09, equip maint)	31,926	34,993	83,369	35,000	36,225	37,493	38,805	40,163	41,569	43,024
Vegetation Control	-	-	-	-	-	-	-	-	-	-
Advertising & Publishing (pub ed.)	-	675	-	1,000	1,035	1,071	1,109	1,148	1,188	1,229
DOE Phase II Discharge Fee	2,821	3,243	3,571	3,700	3,830	3,964	4,102	4,246	4,394	4,548
Water Quality Sample Analysis			140	1,500	1,553	1,607	1,663	1,721	1,782	1,844
State Tax	4,659	4,686	5,237	7,000	7,245	7,499	7,761	8,033	8,314	8,605
City of Marysville - Billing Svcs	7,959	8,287	9,611	9,700	10,040	10,391	10,755	11,131	11,521	11,924
Xfer to Street Fund	28,000	-	-	-	-	-	-	-	-	-
Xfer to Finance (Acctg & Admin)	25,000	25,000	30,000	30,600	31,671	32,779	33,927	35,114	36,343	37,615
Xfer to Utilities Admin.				-	30,000	31,050	32,137	33,262	34,426	35,631
Xfer to PW/Eng (sal,wg,bene)	90,928	58,926	61,872	61,872	64,038	66,279	68,599	71,000	73,485	76,056
Stormwater Mgmt Plan	-	-	-	-	-	-	-	-	-	-
Refunds	124	3	(71)	-	-	-	-	-	-	-
Total Storm M&O Expense	**285,178**	**310,017**	**364,301**	**341,381**	**458,329**	**474,371**	**490,974**	**508,158**	**525,943**	**544,351**
Total Without Add'l Staff Line	*96,862*	*285,178*	*310,017*	*364,301*	*341,381*	*383,329*	*396,746*	*410,632*	*425,004*	*439,879*

Table 11-12. Six-Year Storm Capital Improvements

Project #	TYPE	SCENARIO: BUILD-UP IMPLEMENTATION	Est. Cost ($2009)	Year Scheduled	2011	2012	2013	2014	2015	2016
Exist		Stormwater Wetland & Monitoring (not grant-funded)	$ 65,000	2011	65,000					
	Annual	Annual SW System Upgrade (capacity/failing)	$ 750,000	2012-16	-	150,000	150,000	150,000	150,000	150,000
	Capital	Storm Utility Capital Equipment	$ 27,500	2012-16		5,500	5,500	5,500	5,500	5,500
23	CIP	Island Crossing Stormwater Plan	$ 35,000	2016						35,000
24	CIP	Portage Creek Gaging & Monitoring	$ 16,000	2015					16,000	
30	CIP	Prairie Creek BNSF RR / 69th Culvert Replacement	$ 220,000	2015					220,000	
32	CIP	Prairie Creek Gaging & Monitoring	$ 16,000	2016						16,000
43	CIP	Kruger Creek Burn Rd Culvert Replacement	$ 130,000	2014				130,000		
51	CIP	Brekhus -Beach Stormwater Evaluation & Design	$ 37,000	2016						37,000
Storm-4	Capital	Hydrography Inventory CIP	$ 15,000	2015					15,000	
Storm-2	CIP	Stormwater Comp Plan Update	$ 20,000	2014				20,000		
		Total 6-Year - ($2009)	$ 1,331,500		65,000	155,500	155,500	305,500	406,500	243,500
		Total Est. Cost – Escalated to Year*	**$ 1,588,176**		**65,000**	**172,406**	**178,440**	**362,838**	**499,692**	**309,800**
		**Annual Construction Cost Increase*	*3.5%*		*1.017*	*1.109*	*1.148*	*1.188*	*1.229*	*1.272*
		Base Year Cost Estimate	*2009*							

Scenario: Build-up Program

Total 6-Year CIP	$ 1,331,500
Total 6-Year CIP – Escalated	**$ 1,590,000**
Annual average over 6-years	$ 265,000
Annual average over 5-years	$ 317,600

FUTURE CAPITAL IMPROVEMENTS	Est. Cost ($2009)
Delayed from 2011-2016	$ 3,023,000
Period 2017 - 2026	$ 7,903,000
Period 2027 - 2035	$ 6,748,000
Total Future CIP	$17,674,000

JOINT PROJECTS TO BE FUNDED WITH OTHER PROJECTS	
Period 2011-2016	$ 1,644,000
Period 2017-2026	$ 1,138,000
Total Joint - funded with other projects	$ 2,782,000

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APPENDIX A. ADDITIONAL INFORMATION ON TOTAL MAXIMUM DAILY LOADS

Lower Snohomish River Tributaries Fecal Coliform TMDL

As described in Section 2.3, Ecology has developed a TMDL for fecal coliform in Snohomish River tributaries, including Quilceda Creek. The Detailed Implementation Plan (Svrjcek 2003) specifies load reductions for non-point sources of fecal coliform, including a 70% reduction in dry season fecal coliform loads, and presents information from the Puget Sound area that indicates that more than 30% of fecal coliform contamination is often due to bird and wildlife sources. If this is the case for Quilceda Creek, even complete control of human and pet sources of fecal coliform would not result in a 70% reduction in coliform levels. Nevertheless, the City has been assigned clean-up responsibilities including monitoring, educational programs, and evaluation and/or adoption of critical areas, water pollution, stormwater, and pet waste ordinances.

The NPDES Phase II permit (Appendix 2 of the permit) requires the City to implement its TMDL commitments, and lists specific additional requirements as well. These requirements are identified in detail below.

- The City's illicit discharge detection and elimination program shall address commercial animal handling areas and commercial composting facilities, including source control best management practices. Arlington must compile a list of the existing facilities within 30 months of permit issuance (permit issued 17 January 2007), and begin to conduct inspections of all such facilities starting no later than 30 months following permit issuance.

- Monitoring and implementation requirements (Strategy A, Targeted Implementation Approach) include:

    - Prepare a QAPP within four months of permit issuance;

    - Develop a Bacterial Pollution Control Plan (BPCP) no later than 12 months prior to permit renewal application;

    - Conduct public review of BPCP no later than 9 months prior to permit expiration (15 February 2012); and

    - Submit final BPCP to Ecology with permit renewal application.

The City of Arlington has prepared its Quality Assurance Project Plan (QAPP) for stormwater monitoring in support of the Lower Snohomish Tributaries Fecal Coliform TMDL.

Stillaguamish River TMDLs for Fecal Coliform, Dissolved Oxygen, pH, Mercury and Temperature

The Stillaguamish River Water Quality Implementation Plan (Svrjcek and Lawrence 2007) identifies the following Wasteload Allocations (WLAs) or Load Allocations (LAs) for Arlington:

- Fecal coliform LA in March Creek (19% of the estimated load)
- Biochemical oxygen demand (BOD_5) LA in March Creek (2% of the estimated load)
- Fecal coliform LA in Portage Creek at 43rd NE (39% of the estimated load)
- BOD_5 LA in Portage Creek at 43rd NE (57% of the estimated load)
- Fecal coliform LA in South Fork Stillaguamish at mouth (5.6% of the estimated load)
- Fecal coliform WLA for the Arlington Wastewater Treatment Plant (WWTP) (3.0×10^9 cfu/day)
- Temperature WLA for the WWTP, by 2025 (estimated at 22.4 °C)

The TMDL also specifies special requirements for NPDES permit holders whose stormwater discharges have been identified as sources of loadings to the TMDL. The requirements below are anticipated to be included in the second cycle of the NPDES permit in 2013. However, the City anticipates implementation of these requirements during the current NPDES permit cycle.

- No later than two years from permit issuance, adopt and enforce an ordinance or other equivalent mechanism requiring the application of source control BMPs related to bacterial pollutants for commercial animal handling areas, commercial composting facilities, and illicit connections to storm drains.
- Prepare a TMDL Action Plan (TAP) as a subset of the Stormwater Management Plan (SWMP), to facilitate public participation in the TMDL portion of the SWMP.
- Include discussion of TMDL activity in SWMP annual report to Ecology.
- Integrate public outreach and education on TMDL issues into Phase II permit minimum measures.
- Begin water quality monitoring within 180 days of permit issuance.
- Water bodies addressed by a TMDL for bacteria are designated “high priority water bodies” and shall receive field assessments and screening prior to other water bodies.

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APPENDIX B. ADDITIONAL INFORMATION ON INSTREAM HABITAT CONDITIONS

Limiting Factors in the Portage Creek System

The Portage Creek system was rated by the Washington State Conservation Commission as a Tier II (moderate) priority stream for protection and rehabilitation of habitat functions and current fish productivity. This system provides critical habitat functions to the Stillaguamish basin with approximately 40.3 linear miles of habitat for migratory anadromous species. Historically, Portage Creek and its tributaries were reported to provide habitat for Chinook, Coho, pink, and chum salmon and steelhead (City of Arlington 1995). Currently, Portage Creek is recognized to provide habitat for resident and anadromous cutthroat trout, Coho salmon, and winter steelhead and presumed habitat for bull trout (WSCC 1999).

Several limiting factors were identified in a recent review of potential productivity of anadromous and resident fish populations in Portage Creek(WSCC 1999). These include loss of floodplain connectivity, streambed sedimentation, loss of riparian vegetation, water quality (primarily dissolved oxygen and temperature), hydrologic changes, and loss of beaver pond and wetland habitats. While many aspects of functioning habitat in the Portage Creek system may have been modified or degraded over time, the factors discussed below are considered to be the primary limiters of fish production in Portage Creek:

- **Floodplain Connectivity.** Floodplain connectivity in the Portage Creek drainage has been modified and degraded by channel modifications for agricultural, urban and industrial development.

- **Wetlands.** Portage Creek has seen a large system-wide loss in functional wetland area from its historic condition. Much of this wetland area has been permanently lost to commercial and residential development; however, some historic wetland areas are still functional and several other areas with potential for restoration of wetland functions exist. The protection and rehabilitation of functional wetlands is rated as a high priority habitat protection and restoration activity (WSCC 1999).

- **Channel Conditions.** Sedimentation impacts in the Portage Creek drainage are viewed to be improving, due in part to reduced landslide activity in the drainage. Ninety-eight percent of the volume of sediments associated with landslides was associated with logging roads or clearcuts. Limiting landslide activity and adverse sedimentation effects is rated as a high priority habitat protection measure in the Portage Creek drainage (WSCC 1999).

- **Fish Passage Blockages.** The Stillaguamish Tribe and Snohomish County have developed inventories of fish passage blockages in the Stillaguamish drainage basin and identified locations where blockages (especially culverts) occur. These blockages limit access to otherwise useful habitat.

- **Riparian Condition.** Riparian vegetation in the Portage Creek drainage is considered to be more than 90 percent degraded, including the majority of the anadromous zone. Riparian conditions are improving in some areas, but the rate and extent of improvement was rated as a low priority relative to other limiting factors in the basin (WSCC 1999).

- **Hydrology.** Modified hydrologic conditions in the Portage Creek drainage are viewed to be a limiting factor in fish production. Increased peak flows can increase sediment problems, scour spawning gravels, and disrupt juvenile rearing. Portage Creek has not been identified as experiencing problematic low summer base flows (WSCC 1999).

- **Water Quality.** Non-point source pollution in Portage Creek was found to be negatively impacting fish habitat in 49 percent of studied stream segments (WSCC 1999). Portage Creek is currently on the 303(d) list for dissolved oxygen, fecal coliform, and turbidity. Dissolved oxygen levels in lower Portage Creek range from 4 to 6 milligrams per liter (mg/l) during summer months. The applicable state water quality standard for Portage Creek is 8 mg/l, levels below which are considered stressful to salmonids. Dissolved oxygen levels of 4 mg/l in combination with high stream temperatures are potentially lethal. Portage Creek also experiences stream temperatures ranging from 13°C to 20ºC during warm weather periods. Temperatures in this range are considered stressful for migrating and rearing fish.

Limiting Factors in the Quilceda Creek System

The Quilceda Creek system is rated by Washington State Conservation Commission as a Tier 1 (high) priority for protection and restoration, with particular emphasis on maintaining high Coho production areas in the watershed (WSCC 2002). The Middle Fork Quilceda Creek system provides important rearing and spawning habitat functions to the Snohomish basin. Edgecomb Creek hosts regular spawning populations of Coho and chum salmon within the Arlington UGA. Juvenile Coho are also commonly observed. Heyho Creek with the Arlington UGA is not expected to provide significant salmonid habitat, although spawning Coho are commonly observed near the 152nd Street crossing.

Several limiting factors were identified in a recent review of potential productivity of anadromous and resident fish populations in Quilceda Creek(WSCC 2002). These include loss of floodplain connectivity, channel conditions, loss of riparian vegetation, hydrologic changes, water quality (primarily dissolved oxygen and temperature), and loss of beaver pond and wetland habitats. While many aspects of functioning habitat in the Quilceda Creek system may have been modified or degraded over time, the factors discussed below are considered to be the primary limiters of fish production:

- **Floodplain Connectivity.** Extensive ditching and channelization in the Quilceda Creek watershed has significantly reduced floodplain connectivity from historic levels. Many streams were rerouted to drain agricultural areas and to follow roadways cut through the historic floodplain. Urbanization and agricultural activities continue to limit floodplain connectivity. Some potential exists for restoration of floodplain connectivity in limited areas of the watershed, particularly the Edgecomb creek drainage. The area of the watershed lying within the city limits, primarily the upper Middle Fork, lies largely within agricultural and increasingly industrial lands with limited floodplain connectivity

- **Wetlands.** Approximately 75 to 80 percent of the historic wetland area in the Quilceda Creek drainage has been lost to agricultural, industrial, and urban development. Much of the remaining wetland acreage has been altered in some fashion by development and is at less than optimal function. A substantial headwater wetland complex on Middle Fork Quilceda Creek has been identified as functional and should be considered a high priority for habitat protection.

- **Fish Access. A**vailable information on fish passage barriers in the Quilceda Creek watershed indicates that there are no significant known barriers currently present, with the exception of a blocking culvert at SR 9 (WSCC 2002). A previously existing barrier culvert at river mile (RM) 3.8 was corrected by Snohomish County Surface Water Management in 1999. A local environmental organization has recently completed a comprehensive culvert inventory in the watershed, and this information, when available in WDFW Salmonid Screening Habitat Enhancement and Restoration database, could identify additional fish passage barriers (WSCC 2002).

- **Riparian Condition.** Portions of the Quilceda Creek watershed maintain a relatively intact riparian buffer, ranging in width from 200 to 500 feet. Riparian quality declines significantly on agricultural lands. The majority of the drainage within the city limits lies in agricultural and industrial lands with limited riparian vegetation.

- **Hydrology.** The current hydrologic regime of the Quilceda Creek watershed is protected by the significant influence of groundwater on peak and base flow levels. Rainfall is stored in the upstream areas of the watershed via aquifer recharge and moves south as groundwater before reemerging as surface water in steeper gradient reaches. Protection of aquifer recharge areas is viewed to be a high priority for maintaining habitat quality in the watershed.

- **Water Quality.** Water temperatures in Quilceda Creek in general are below the temperature ranges considered stressful to salmonids, primarily due to the strong influence of groundwater on streamflows. Under warm weather and low flow conditions, stream temperatures occasionally rise to stressful levels, but extreme events are generally limited and high water temperatures are not a major concern. Some reaches in Quilceda creek are prone to low dissolved oxygen and elevated fecal coliform levels, associated with inputs from agriculture and septic systems. Five reaches in the watershed are on the 303(d) list for exceeding standards for these two parameters. Agricultural impacts in the East Fork and Middle Fork of Quilceda Creek were viewed to be a major source of water quality impacts (WSCC 2002).

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APPENDIX C. HYDRAULIC MODEL RESULTS FOR OLD TOWN AND MARCH CREEK 4TH TIER BASINS

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APPENDIX D. HYDRAULIC MODEL RESULTS FOR TALCOTT 5TH TIER BASIN

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APPENDIX E. HYDRAULIC MODEL RESULTS FOR THE GLENEAGLE BRANCH 6TH TIER BASIN WITHIN THE EDGECOMB 5TH TIER BASIN

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APPENDIX F. HYDROLOGIC MODEL RESULTS FOR THE UPPER PORTAGE, PRAIRIE, AND KRUGER CREEK 5TH TIER BASINS

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APPENDIX G. CITY OF ARLINGTON MUNICIPAL CODE 13.28, STORMWATER UTILITY

Adopted Under Ordinance 2010-010 on May 17, 2010.

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Chapter 13.28
STORMWATER UTILITY

13.28.010 Title.

This chapter shall be known as the stormwater utility code and shall be referred to herein as the “code.”

13.28.020 Stormwater department established.

There is hereby created and established, pursuant to RCW Chapters 35A.80 and 35.67, a storm and surface water utility to be known as the "Arlington Stormwater Utility." All references to the “utility" in this chapter refer to the Arlington Stormwater Utility. The administrator of the utility shall be designated by the city administrator. Any revenues collected by the utility shall be separately accounted for and be used to provide for regulation, operations and maintenance, improvements, debt service, education, and administration of the utility. The officers and other employees shall consist of such personnel as deemed necessary for the efficient administration of the department.

13.28.030 Purpose.

The purpose of this code is to:

(a) Provide for the planning, security, design, construction, use, maintenance, repair and inspection of the public and private storm and surface water systems, and to protect the life, health, and property of the general public;
(b) Establish programs consistent with federal and state regulations which assure the quality of the water in such systems;
(c) Minimize water quality and quantity impacts causing degradation and sedimentation of creeks, streams, ponds, lakes, and other water bodies;
(d) Preserve and enhance the suitability of waters for contact recreation, fish and wildlife habitat, and aesthetics;
(e) Maintain and protect valuable groundwater quality, locations, and flow patterns including points of recharge and discharge;
(f) Minimize the chance of flooding;
(g) Ensure the safety of public roads and rights-of-way;
(h) Decrease drainage related damage to public and private property; and
(i) Provide for the enforcement of the provisions of this code.

13.28.040 Territorial application.

(a) This code shall be in effect throughout the Utility Service Area as defined in AMC 13.28.060.
(b) Where the storm and surface water system crosses jurisdictional boundaries through the physical interconnection of structures and conveyances, the utility shall coordinate with neighboring jurisdictions to clarify roles and responsibilities in stormwater management activities.

13.28.050 Intent.

It is the specific intent of this code to:

(a) Enact an exercise of the police power of the City of Arlington to protect and preserve the public health, safety and welfare; its provisions shall be liberally construed to accomplish this purpose.
(b) Provide for and to promote the health, safety and welfare of the general public and not to create or otherwise establish or designate any particular class or group of persons who will or should be especially protected or benefitted.
(c) Place the obligation of compliance upon the owner/operator. Nothing contained in this code is intended to be or shall be construed to create or form the basis for liability on the part of the city of Arlington, its utility, officers, employees or agents, for any injury or damage resulting from the failure of the owner or operator of any private system to comply with the provisions of the code, or by reason or in consequence of any act or omission in connection with the implementation or enforcement of this code by the city of Arlington, its utility, officers, employees or agents.

13.28.060 Definitions.

The following words and phrases, when used in this code, shall have the following meanings:

(a) "AMC" means Arlington Municipal Code.

(b) "As-built" means a final approved drawing of the actual installation of structures, materials and equipment that meets the requirements specified in the most recent edition of the Engineering Standards.

(c) "Best Management Practice" (BMP) means those physical, structural and/or managerial practices that, when used individually or in combination, prevent or reduce structural damage, soil erosion, and water pollution. BMPs include, but are not limited to, structural solutions covered by the terms "best available technology" (BAT) and "all known available and reasonable methods of treatment" (AKART).

(d) "City" means the city of Arlington, Washington unless otherwise specified.

(e) "Comprehensive Stormwater Plan" means the latest version of the city of Arlington Comprehensive Stormwater Plan as adopted by the city council.

(f) "Conveyance system" means that part of the drainage system that conveys storm and surface water, including pipes, storage facilities, catch basins, ditches, swales, and stream courses.

(g) "Detention facility" means an above or below ground facility, such as a pond or vault, that temporarily stores stormwater runoff and subsequently releases it at a slower rate than it is collected by the drainage facility.

(h) "Director" means the director of the Arlington Public Works Department, or designated representative.

(i) "Drainage Connection Permit" means a permit which is required to connect to an existing public drainage system, construct a new private drainage system, or modify an existing private drainage system.

(j) "Drainage system". See "storm and surface water system."

(k) "Emergency" means any natural or human-caused event or set of circumstances that disrupts or threatens to disrupt or endanger the operation, structural integrity or safety of the drainage system; or endangers the health and safety of the public; or aquatic inhabitants; or otherwise requires immediate action by the utility.

(l) "Engineering Standards" means the most recent edition of the City of Arlington Public Works Design and Construction Standards and Specifications manual, which include minimum requirements for the design and construction of storm and surface water drainage facilities.

(m) "Equivalent Service Unit" (ESU) means the measure of impervious area to be used by the utility in assessing service charges against a parcel of property. One ESU is equal to six thousand square feet of impervious area.

(n) "Illicit Discharge" means any discharge to a municipal separate storm sewer that is not composed entirely of stormwater, except discharges as allowed by this code.

(o) "Illicit Discharge Detection and Elimination (IDDE) program" means a program designed to detect and eliminate illicit discharges through education, enforcement, or other measures available to the utility under this code. The IDDE program is both reactive and proactive. The program is reactive in addressing spills and other illicit discharges to the stormwater drain systems that are found. The program is proactive in preventing and eliminating illicit discharges through education, training and enforcement

(p) "Impervious area" means the hard surface area which prevents or retards the entry of water into the soil mantle and/or causes water to run off the surface in greater quantities or at an increased rate of flow from that present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled macadam or other surfaces which similarly impede the natural infiltration of surface and stormwater runoff. Open retention/detention facilities and vegetated wetlands shall not be considered as impervious surfaces for the purposes of this section when the area of open water was incorporated in to the design. An area or property may be deemed impervious whether or not the same is occupied or inhabited.

(q) "Maintenance Standards" means City of Arlington Stormwater Utility Maintenance Standards which includes minimum requirements for maintaining drainage facilities so they function as intended and provide water quality protection and flood control, maintenance standards are identified or referenced in the Engineering Standards. Maintenance of stormwater management systems located in critical areas buffers will be required to follow an approved plan approved by the Natural Resources Manager.

(r) "Maximum Extent Practicable or MEP" means the use of best management practices that are technically and financially achievable, and are the technically sound and financially responsible, non-numeric criteria (standard of compliance) applicable to all municipal stormwater discharges through the implementation of "best management practices."

(s) "National Pollution Detection and Elimination System Phase II Municipal Stormwater Permit" (NPDES II) means the permit first issued to the City by the Washington Department of Ecology on February 16, 2007, and as may be subsequently revised and reissued, and which contains federal and state conditions to which the Utility must comply.

(t) "One Hundred (100) Year, Twenty Four (24) Hour Storm" means a storm with 24-hour duration with a 0.01 probability of exceedance in any one year.

(u) "Operations and Maintenance Manual" means a document prepared by the owner and/or operator of a private drainage system as part of the drainage connection permit application or the stormwater credit application, approved by Utility reviewers, and revised and included with the as-built submittal. The O&M Manual for a property becomes the basis for evaluation during private drainage facility inspections.

(v) "Pollution" means the contamination or other alteration of the physical, chemical, or biological properties of any natural waters including change in temperature, taste, color, turbidity, or odor of the waters, or the discharge of any liquid, gaseous, solid, radioactive, or other substance into any such waters as will, or is likely to, create a nuisance or render such waters harmful, detrimental, or injurious to the public health, safety, or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life, per RCW 90.48.20.

(w) "Procedure" means a procedure adopted by the utility, by and through the director, to implement this code, or to carry out other responsibilities as may be required by this code or other codes, ordinances, or resolutions of the City or other agencies.

(x) "Property owner" means any individual, company, partnership, joint venture, corporation, association, society or group that owns or has a contractual interest in the subject property or has been authorized by the owner to act on his/her behalf.

(y) "Private system or private drainage facility" means any element of a storm and surface water system which is not a part of the public drainage system as defined in this code.

(z) "Public storm and surface water system, or public drainage system" means those elements of the storm and surface water system:

(1) Located on property owned by the City or in public right-of-way; or

(2) Located on property on which the City has an easement, license or other right of use for utility purposes.

(aa) "Redevelopment" means, on a currently developed site, the creation or addition of impervious surfaces; structural development including construction, installation, or expansion of a building or other structure; and/or replacement of impervious surface that is not part of a routine maintenance activity; and land or vegetation disturbing activities associated with structural or impervious development.

(bb) "Runoff control BMPs" means best management practices that are intended to control or manage the rate and/or quantity of stormwater runoff.

(cc) "Service charge" means the monthly fee levied by the utility upon all real property within the boundary of the utility as authorized herein.

(dd) "Source control BMPs" means best management practices that are intended to prevent pollutants from entering storm and surface water.

(ee) "Storm and surface water system," (also referred to as the drainage system), means the entire system within the City, both public and private, naturally existing and manmade, for the drainage, conveyance, detention, treatment or storage of storm and surface waters. However, facilities directly associated with buildings or structures such as foundation drains, rockery/retaining wall drains, gutters and downspouts or groundwater are not considered parts of the storm and surface water system.

(ff) "Stormwater Credit Manual" a manual detailing procedures and requirements for receiving credit against the monthly stormwater utility bill through education, proper installation and maintenance of on-site, private stormwater systems. It is the City's intent to encourage sound technical design and maintenance practices that reduce the negative impact of development on the drainage system through a simple but effective credit system.

(gg) "Stormwater Management Program" (SWMP) is a set of actions and activities which constitute a work plan for meeting the conditions of the City's NPDES II Stormwater Discharge Permit and reduce our overall impact on the natural environment.

(hh) "Stormwater Manual" means the 2005 Washington Department of Ecology Stormwater Management Manual for Western Washington, as hereby adopted.

(ii) "Stormwater manual administrator" is the Public Works Director or their designee. This person acts on the City's behalf to interpret matters associated with the Stormwater Manual and to grant adjustments that are consistent with Stormwater Manual objectives.

(jj) "Stream" means any channels as defined in AMC 20.88.100. These include areas where surface waters flow sufficiently to produce a defined channel, bed or swale where flow may be perennial or intermittent. This definition is not meant to include ditches constructed to convey: ephemeral stormwater flows; irrigation water; or other entirely artificial watercourses, unless they are used to convey certain streams naturally occurring prior to construction.

(kk) "Unsafe condition" means any condition on any premises which is a hazard to public health or safety that does or may impair or impede the operation or functioning of any portion of the public drainage system or which may cause damage thereto.

(ll) "Utility" means the stormwater utility, within the Utilities Division of the Public Works Department of the City of Arlington.

(mm) "Utility Service Area" means that service area defined by the City of Arlington city limits and as may be expanded through subsequent inter-local agreements, annexations and special utility district assumptions.

13.28.70 Applicability of the Utility.

Any of the following actions or applications for any of the following permits and/or approvals will require submittal for approval by the utility: site plans, design drawings, and operation and maintenance plans. Submittals for the following shall be consistent with the provisions of this code, and shall comply with the Stormwater Manual and the Engineering Standards:

(a) Any modification of an existing drainage system;
(b) Creation of new or additional impervious surfaces;
(c) New development;
(d) Redevelopment that creates or alters impervious surfaces;
(e) Land disturbing activities, including construction, clearing, grubbing, grading, filling, excavation or dewatering;
(f) Subdivision approval;
(g) Short subdivision approval;
(h) Commercial, industrial or multi-family site plan approval;
(i) Planned unit development or planned residential development;
(j) Development within or adjacent to critical areas; and
(k) Substantial development permit required under RCW 90.58 (Shoreline Management Act).

13.28.080 Authority of the Utility.

The utility, by and through its director, or designee shall have the authority to:

(a) Develop, adopt and carry out procedures as needed to implement this code and to carry out other responsibilities of the utility, including, but not limited to, procedures pertaining to the billing and collection of monthly service charges and procedures for periodic adjustment of fees and charges imposed pursuant to this code and rate structure as defined in AMC 13.12.
(b) Prepare and update as needed Engineering Standards to establish minimum requirements for the design and construction of drainage facilities and requirements for protecting existing facilities during construction. The Engineering Standards shall be consistent with this code and adopted city policies.
(c) Administer and enforce this code and all procedures relating to the planning, acquisition, security, design, construction, inspection and maintenance of new storm

and surface water facilities and relating to the regulation of storm and surface water system alterations.

(d) Enter into any contract pursuant to Chapter 35.91 RCW, the Municipal Water and Sewer Facilities Act, including contracts which provide for the reimbursement of owners constructing facilities (latecomer agreements) and agreements with private property owners.

(e) Prepare, update, administer and enforce as needed, maintenance standards to establish minimum requirements for the maintenance of drainage facilities so they function as intended, protect water quality and provide flood control.

(f) Develop and implement a program that includes administration, inspection, education, and enforcement of private drainage facilities to ensure continued compliance of drainage facilities with this code.

(g) Advise the city council, city administrator and other city departments and commissions on matters relating to the utility.

(h) Prepare, revise as needed, recommend and implement a Comprehensive Stormwater Plan for adoption by the city council, and prepare basin plans and other studies that are approved in the utility's adopted budget.

(i) Develop a Stormwater Management Program, as required by state and/or federal agencies.

(j) Develop an Illicit Discharge Detection and Elimination program, as required by state and/or federal agencies.

(k) Establish and implement programs to protect and maintain water quality and to manage stormwater runoff within the storm and surface water system in order to maintain compliance to the maximum extent practicable with applicable water quality standards established by state and/or federal agencies as now or hereafter adopted.

(l) Perform or direct the performance of financial review and analysis of the utility's revenues, expenses, indebtedness, rates and accounting and recommend budgets, rates and financial policy for adoption by the city council.

(m) Carry out such other responsibilities as required by this code or other city codes, ordinances or regulations consistent with the Arlington comprehensive plan.

(n) Terminate utility service, including water and sewer service, to any utility customer who is violating any provision of this code, to the extent permitted by law.

(o) Conduct public education programs related to protection and enhancement of the drainage system.

(p) Develop an Underground Injection Control program to manage stormwater infiltration systems, as required by state and/or federal agencies.

13.28.090 Comprehensive Stormwater Plan.

A Comprehensive stormwater plan shall be developed by the utility for review and adoption by the city council. The utility shall recommend supplements or updated plans for adoption by the city council as needed.

13.28.100 Studies and basin plans.

The utility may, from time to time, conduct studies and develop basin plans. Plan recommendations which impact development or land use regulations shall be reviewed and approved by the Arlington Community Development Director, or their designee, prior to being forwarded to city council for adoption. Upon adoption, such plan recommendations shall supersede the requirements of this code; provided that the basin-specific requirements provide an equal or greater level of water quality and runoff control protection.

13.28.110 Emergency plan.

The utility will prepare and update an emergency plan, as required by state law, as part of the City's emergency operation plan.

13.28.120 Connections or modifications to the drainage system.

Connections or modifications to any public or private drainage system, including abandonment or removal of any structures, shall be allowed only if:

(a) All applicable requirements of this code have been met; and
(b) All applicable Engineering Standards have been met; and
(c) The property owner has paid all applicable fees and charges.

13.28.130 System ownership.

Utility ownership of stormwater facilities.

(a) The utility owns and maintains all elements of the stormwater drainage system in the public right-of-way and in easements or tracts dedicated to and accepted by the utility, except to the extent private ownership is otherwise indicated as a matter of record.
(b) The utility may choose to accept ownership (or other property rights) and maintenance responsibility for privately built drainage facilities when all of the following conditions are met:
    (1) Ownership of the facility by the utility would provide a public benefit; and
    (2) Necessary and appropriate property rights (easement) are offered by the property owner at no cost to the utility; and
    (3) Transfer of the facility is consistent with the land use permit issued by the city of Arlington, and
    (4) The facility meets Engineering Standards, as determined by the utility, or is brought up to Engineering Standards by the owner; and
    (5) There is access for utility maintenance in accordance with criteria provided in the Engineering Standards; and
    (6) The utility has adequate resources to maintain the facility; and
    (7) In the case of runoff control facilities, the facility serves a residential subdivision or short plat, rather than a commercial property; and
    (8) The facility is transferred to the utility by bill of sale at no cost to the city.
(c) It is unlawful for any person, except City of Arlington personnel or its authorized contractors to alter any portion of the city owned stormwater system.

13.28.140 Permits – Approvals.

Drainage Connection Permit.

(a) A drainage connection permit is required to connect to or modify the public drainage system or modify a private drainage system,

(b) The property owner shall apply for a drainage connection permit whenever new development or redevelopment involves any of the following:
   (1) Detention or other runoff control facilities; or
   (2) Runoff treatment facilities, other than spill control structures; or
   (3) Work on the public drainage system or within the right-of-way:
   (4) Culverts for driveways that can be covered under another permit such as a grading or right-of-way permit; or
   (5) Work on private drainage systems that may or may not be covered under another permit such as a building or grading permit.

(c) A drainage connection permit application must be made by the property owner or their licensed and bonded contractor.

(d) Drainage connection permit issuance date will coincide with the Site/Civil Permit approval date and shall expire 18 months from the date of issuance, or as otherwise specified in the Engineering Standards.

(e) The utility will accept constructed facilities as complete once the facilities have been constructed according to the approved plans and specifications, as confirmed by utility inspectors and as-built drawings along with a final O&M manual have been completed as specified in the Engineering Standards; and all applicable fees and charges have been paid. Ownership of newly constructed stormwater drainage systems within the public right-of-way or in easements conveyed to the city shall be transferred to the city through a bill of sale.

(f) Contractors. Contractors shall be licensed in accordance with Washington State requirements and shall be registered with the City of Arlington.

(g) The City Engineer, or their designee, shall administratively determine submittal requirements for all permits pertaining to stormwater system design and construction.

(h) When an application for drainage connection, new drainage system, or drainage modification is required, it shall be the property owner’s responsibility to design all drainage facilities required to serve the property including, but not limited to, conveyance systems, runoff treatment best management practices, detention facilities and other system components, in accordance with Engineering Standards and the requirements of this Code.

13.28.150 Engineering and design requirements.

(a) Authorities. The stormwater engineering and design requirements of the city, including but not limited to thresholds, definitions, minimum requirements, adjustment and variance criteria, and exceptions to these requirements, shall be governed by the 2005 Department of Ecology Stormwater Manual, the City of Arlington Engineering Standards, and all provisions of this code, including permits issued under 13.28.120, and including differences identified elsewhere in 13.28.130. In the event of conflicts between the various provisions, the most restrictive provision shall apply.

(b) Divergence from the Stormwater Manual. Design, construction, maintenance, and other requirements to be applied on projects within the City may differ from the Stormwater Manual, and may be modified from time to time in order to meet regulatory requirements or to take advantage of improved technology or advancements in Best Available Science. All such requirements which differ from those of the Stormwater Manual shall be clearly identified within the Engineering Standards or within permits issued by the City.

(c) Low Impact Development (LID). Nothing in this AMC 13.28 is intended to preclude the use of non-structural preventative actions and source reduction approaches as alternatives to the engineering and design requirements identified herein, and in the Stormwater Manual and the Engineering Standards. These measures include LID techniques which minimize the creation of impervious surfaces and the disturbance of native soils and vegetation. The City's LID code and procedures shall be specified in AMC Title 20 – Land Use Code and in the City of Arlington Engineering Standards.

13.28.160 Exceptions.

(a) Where physical circumstances or conditions affecting the property, and where the strict application of these provisions would deprive the applicant of all reasonable economic use of the parcel of land in question, every effort shall be made to find alternatives to meet the intent of the requirements of AMC 13.28.150.

(b) Exception Process. Exceptions to the requirements of AMC 13.28.150 may be granted by the Public Works Director, or their designee, provided that the exception address all of the following criteria:

(1) The exception provides equivalent environmental protection; is in the public interest; and the objectives of safety, function, environmental protection and facility maintenance are fully met; and

(2) The granting of the exception will not be detrimental to the public health and welfare and will not be injurious to other properties in the vicinity and/or downstream of the proposal and/or to the quality of waters of the state; and

(3) The exception provides the least possible deviation from the requirements of AMC 13.28.150.

13.28.170 Installation responsibility.

(a) Property Owner Installation. The property owner shall install all drainage facilities as required by this code and in accordance with Engineering Standards.

(b) Costs. All installation costs are the property owner's responsibility, except where:

(1) If the utility requires a property owner to upsize a drainage facility, the utility will compensate the property owner for the difference in material cost between the normally sized facility and the upsized facility, based on the lowest of three bids furnished by the property owner from reputable licensed contractors. Upsizing means the difference between the City's minimum design standards, as defined in the Engineering Standards, and the required facility size.

(2) An owner who constructs a public drainage system extension that directly benefits a property in addition to the owner's may request a latecomer agreement in order to be reimbursed from benefitting properties that connect to the extension during the agreement's duration. See AMC Chapter 13.24 regarding latecomer agreements.

(3) The city may choose to install drainage facilities to facilitate development, coordinate with other city projects, or for other utility purposes.

13.28.180 Latecomer agreements.

See AMC Chapter 13.24 Utility Reimbursement Agreements.

13.28.190 Drainage easement requirements.

(a) An easement is required whenever public drainage facilities will be constructed on private property or whenever private drainage facilities will be constructed on property owned by a third party. Evidence of the easement between the applicant and third party property owner shall be provided to the city.

(b) Requirements. All of the following requirements shall be met before the city will accept and approve any easement:

(1) Clear title in the grantor shall be demonstrated; and

(2) The proposed easement shall be compatible with utility clearance standards and setback standards and with other utilities or easements; and

(3) The easement shall provide the city with access to the facility for repair and maintenance; and

(4) The easement shall prohibit all structures within the easement except those which can readily be removed by the structure's owner at the owner's expense when access to the drainage facility is required by the utility. If such structures are within the easement area, an agreement to remove the structures on request by the utility, approved by the city, shall be recorded; and

(5) The easement shall prohibit all vegetation and landscaping that may inflict damage on the utility, or that will impede the utility from performing necessary maintenance, repair, or replacement work on the utility located within the easement. The utility may request the land owners upon whose property the easement crosses to remove select vegetation and landscape. If the land owners upon whose property the easement crosses fail to comply with the request to remove vegetation and landscaping, the utility may remove the landscaping with City employees or a licensed contractor at the owner's expense.

(6) The easement dimensions and other requirements shall conform to the Engineering Standards. The easement must be recorded prior to final approval of the project.

(7) New easements will not be granted through areas that already have a Critical Area Protection Easement, or other areas already identified as vegetated buffers.

(c) Costs. The property owner shall pay all costs of providing or obtaining and recording the easement.

(d) Relinquishment of Easement. An easement granted to the utility may be relinquished only if the utility determines it is no longer needed and the city council authorizes the relinquishment.

13.28.200 Construction requirements.

(a) General. When constructing or modifying drainage facilities, compliance is required with this code, the Engineering Standards, the approved Site/Civil Permit, plans and specifications, the terms of any drainage connection permit, the recommendations of the manufacturer of the materials or equipment used, and any applicable local, state or federal requirements.

(b) Safety Requirements. Utility staff will perform inspections only if shoring and other site conditions conform to WISHA safety standards and other safety requirements, as applicable.

(c) Failure to Complete Work or Meet Requirements.

(1) The utility may complete public drainage facility construction begun by a property owner or contractor, or take steps to restore the site (such as backfilling trenches and restoring the public right of way) if the work does not meet utility requirements, the contractor or person doing the work fails to rectify the problem following notification by the utility, and the work, in the opinion of the utility, constitutes a hazard to public safety, health or the drainage system.

(2) Utility costs incurred pursuant to subsection (c)(1) of this section shall be calculated pursuant to AMC 13.28.170 and charged to the owner or contractor in charge of such work. The permittee shall pay the utility immediately after written notification is delivered to the responsible parties or is posted at the location of the work. Such costs shall constitute a civil debt owed to the utility jointly and severally by such persons who have been given notice as herein provided. The debt shall be collectable in the same manner as any other civil debt owing the utility. In addition, if an assurance device was collected for the project, the City may collect the debt from the assurance device.

(3) If in the opinion of the director, the work being performed is not in accordance with these codes or the Engineering Standards and the permittee is unwilling to change or correct the deficiencies, the director may issue a stop work order until the deficiencies are corrected.

(d) Authorized Drainage Construction. Only the following persons are authorized to install drainage facilities:

(1) Contractors licensed in accordance with AMC 13.28.120(f).

(2) Property owners working on their own property.

(e) Posting of Drainage Connection Permit. If a drainage connection permit is required for the work, the permit shall be readily available at the job site to utility inspectors.

(f) Location of Connection. Connection to the drainage system shall be made at a point approved by the utility.

(g) As-Built Drawings and O&M Manual. An as-built plan shall be completed according to the requirements in the Engineering Standards and filed with the utility prior to the city's acceptance of the improvements or final approval by the utility inspectors. A final O&M manual shall be submitted that reflects any changes to the drainage system between permitting and final construction approval.

13.28.210 Construction and warranty inspections and tests.

(a) Construction/Installation Inspection. All projects involving construction of new drainage facilities, or connection or modification to existing drainage facilities are subject to utility inspection to ensure compliance with the code, Engineering Standards, and permit/approval conditions. As a condition of permit issuance, the applicant shall consent to inspection and testing.

(b) Warranty Inspections and Tests. Public facilities and equipment accepted by the utility under specific warranties may be re-inspected at the utility's discretion and, if necessary, retested prior to the expiration of the warranty period.

13.28.220 Maintenance of drainage facilities.

(a) Maintenance Responsibility.
  (1) The utility is responsible for maintaining, repairing, and replacing public drainage facilities.
  (2) Owners of private drainage facilities, including but not limited to detention facilities, runoff treatment facilities and conveyance facilities, are responsible for the operation, maintenance, repair, and replacement of those facilities.
  (3) In new subdivisions and short plats, maintenance responsibility for private drainage facilities shall be specified on the recorded subdivision or short plat.
  (4) If a private drainage facility serves multiple lots and the responsibility for maintenance has not been specified on the subdivision plat, short plat or other legal document, maintenance responsibility shall rest with the homeowners association, if one exists, or otherwise with the properties served by the facility, or finally, with the owners of the property on which the facilities are located.

(b) Maintenance and Inspection Standards. Drainage facilities shall be maintained so that they operate as intended. Stormwater maintenance standards shall be in accordance with the Stormwater Manual, the Engineering Standards, and in accordance with the operation and maintenance plan (O&M manual) approved for the drainage facility operation and maintenance plan.

13.28.230 Discharge of polluting matter.

(a) Discharge of Polluting Matter Prohibited. No person shall discharge, either directly or indirectly, any organic or inorganic matter into the storm and surface water system that may cause or tend to cause water pollution, including, but not limited to, the following:
  (1) Petroleum products including but not limited to oil, gasoline, grease, fuel oil and heating oil;
  (2) Trash or debris;
  (3) Pet wastes;
  (4) Chemicals;
  (5) Paints;
  (6) Steam cleaning wastes;
  (7) Washing of fresh concrete for cleaning and/or finishing purposes or to expose aggregates;
  (8) Wash water runoff from pavements and building exteriors;
  (9) Laundry wastes;
  (10) Soaps and detergents;
  (11) Pesticides, herbicides, or fertilizers;
  (12) Sanitary sewage;
  (13) Heated water;
  (14) Chlorinated water or chlorine;
  (15) Degreasers and/or solvents;
  (16) Bark and other fibrous material;
  (17) Antifreeze or other automotive products;
  (18) Lawn clippings, leaves, or branches;

(19) Non-native invasive plants or seeds
(20) Animal carcasses or aquarium pets;
(21) Sediment;
(22) Acids or alkalis;
(23) Recreational vehicle wastes;
(24) Dyes (without prior permission of the drainage utility);
(25) Construction materials;
(26) Food waste;
(27) Lawn watering and other irrigation runoff;
(28) Swimming pool discharges;
(29) Runoff from dust control efforts

(b) Swimming pool discharges shall be allowed where discharges are de-chlorinated to a concentration of 0.1 ppm, pH-adjusted and re-oxygenated, if necessary, and volumetrically and velocity controlled to prevent re-suspension of sediments in the stormwater system.

(c) Pavement Washing Prohibited. In addition to the prohibitions of subsection (a) of this section, washing of public or private streets and parking areas is not permitted unless all of the following conditions are met:
(1) No other feasible alternative exists to remove the undesirable material; and
(2) Prior written approval is obtained from the director; and
(3) Facilities are provided to collect and treat the wash water runoff and affected drainage facilities are cleaned.

(d) Discharge of Pollutants – Liability for Expenses Incurred by the Utility. Any person responsible for pollutant discharge into the storm and surface water system who fails to immediately collect, remove, contain, treat or disperse such pollutant materials at the director’s request shall be responsible for the necessary expenses incurred by the City in carrying out any pollutant abatement procedures, including the collection, removal, containment, treatment or disposal of such materials.

(e) Source Control BMPs. To prevent discharge of polluting matter into the storm and surface water system, source controls shall be applied in accordance with the Maintenance Standards for public and private systems as per AMC 13.28.230(b).

13.28.240 <u>Private facility inspections</u>.

(a) Inspection Program. As required by the NPDES II permit, the director is authorized to develop and implement an inspection program for new and existing private drainage facilities within the City.

(b) Right of Entry. An authorized representative of the City may enter private property at all reasonable times to conduct inspections, tests or to carry out other duties imposed by the code, provided the utility shall first attempt to notify the property owner or person responsible for the premises. If entry is refused or cannot be obtained, the director shall have recourse to every remedy provided by law to secure entry.

13.28.250 <u>Illicit Discharge Detection and Elimination (IDDE) and Emergency Conditions</u>

(a) IDDE Inspection Program. As required by the National Pollution Discharge Elimination System, Phase 2 permit, the director is authorized to develop and implement an IDDE program specifically designed to detect and eliminate illicit discharges.

(b) Right of Entry. Upon detection or verifiable reporting of an illicit discharge, an authorized representative of the utility may enter private property at all reasonable times to conduct inspections, tests or to carry out other duties imposed by the code, provided the utility shall first attempt to notify the property owner or person responsible for the premises. If entry is refused or cannot be obtained, the director shall have recourse to every remedy provided by law to secure entry.

(c) Emergency Conditions. Notwithstanding any other provisions of this code, whenever it appears to the director, or an authorized representative of the utility, that conditions regulated by this code exist and require immediate action to protect the public health, safety, or public resources, the director is authorized, to the extent permitted by law, to enter at all reasonable times in or upon any property, public or private, for the purpose of inspecting and investigating such emergency conditions. The director may without prior notice order the immediate discontinuance of any activity leading to the emergency condition. Failure to comply with such order shall constitute a civil violation pursuant to AMC 11.01.090.

13.28.260 Fees for permits/specific services.

(a) General.
  (1) The director shall develop for city council review and adoption a schedule of fees and charges for all permits and other specific services provided by the utility, including:
    (a) Drainage connection permits;
    (b) Site investigations beyond typical operations and maintenance that may be required by system blockages, water pollution, and other extenuating circumstances;
    (c) Disconnection charge for unauthorized connections;
    (d) The fees referenced in this section are in addition to applicable stormwater rates.

(b) Fee Schedule. The director shall adjust the schedule of fees and charges without further city council action to the extent necessary to reflect actual changes in the utility's cost of providing the service.

13.28.270 Storm and surface water rates.

(a) General. The city council shall establish service rates within AMC 13.12 for the operation and maintenance of the drainage system, for related drainage services, and for the operation of the Stormwater Utility. Shall establish classifications of customers or service and rate structures, using any method or methods authorized by law.

(b) Rate Basis. Drainage rates shall be based on revenue requirements necessary to cover all costs of the utility, as authorized by the city council, the adoption of the annual budget and subsequent amendments and shall be guided by adopted financial policies and bond covenants.

(c) Rate Adjustments. Rates shall be evaluated periodically as part of the review and adoption of the annual budget. Rate adjustments shall be recommended by the director as needed to meet revenue requirements of the utility. The recommendation shall consider equity, adequacy, costs, NPDES requirements and other factors allowed by law.

(d) Rate Relief. The city council may establish drainage rate relief measures, as authorized by state law and as detailed in the Stormwater Credit Manual, for specific customer classes where, through site design, regular system maintenance, education and other approaches, the impacts of stormwater on the drainage system are reduced.

13.28.280 Violations – Penalties.

(a) Voluntary correction. In the event a property owner or contractor violates any of the provisions of this code, the Stormwater Manual, or the Engineering Standards, City staff shall work with the violator to voluntarily correct the situation and comply with these conditions. Education and cooperative problem solving shall govern the city's response during this period,

(b) Civil Violation. Any violation of any of the provisions of this code constitutes a civil violation as provided for in the AMC Chapter 11, for which a monetary penalty may be assessed and abatement may be required as provided therein. The city shall seek compliance through the civil violations code if compliance is not achieved through this code.

(c) Destruction of Notice. It shall be unlawful for any person to remove, mutilate, destroy, or conceal any notice issued and posted by the director pursuant to this code.

APPENDIX H. PROJECT PROPOSAL DETAILS

As part of the SCP process, solutions were developed to address the stormwater-related issues, concerns, and opportunities identified throughout this SCP. Solutions are presented as proposed Projects, and Problem statement Numbers introduced in the text are matched identically with the same Project Number. Projects addressing regulatory compliance and programmatic solutions through utility staffing were summarized in Table 9-1. Table H-1 below presents in one table a summary of the many capital project proposals. It amounts to a combination of Tables 9-2 through 9-12. Individual project detail forms follow Table H-1.

Table H-0-1. Summary of All Capital Project Proposals Developed to Address the Problem Statements Introduced Throughout this Comprehensive Stormwater Plan

Problem/ Project No.	Basin ID	Project Type	Project Name	Priority	Estimated Cost ($)
1	OT-B-1	CIP	Old Town Drainage System Improvements	32, M	670,000
2	OT-B-2	CIP	Haller (Butler) Trunk Line Improvements	41, H	590,000
3	OT-B-3	CIP	Haller (Butler) Outfall Improvements	38, H	230,000
4	OT-B-4	CIP	Hammer-Butler Stormwater Wetland Completion	48, VH/Reg	173,311
5	OT-B-5	RegCom	Groundwater Inflow to Storm System—See NPDES-10 (IDDE-1)	NA	NA
6	OT-B-6	RegCom	Illicit Discharge / Groundwater Investigation—See NPDES-12 (IDDE-3)	NA	NA
7	OT-CT-1	CIP	Centennial Trail Storm Re-direction	52, VH/Reg	140,000
8	OT-HP-1	CIP	Haller Park Outfall & Drainage Improvements	56, VH/Reg	27,000
9	OT-HP-2	CIP	Haller Park Bacterial Control	37, H	11,000
10	M-211-1	O&M	211th & SR 530 Upkeep	35, H	390
11	M-211R-1	CIP	211th & Ronning Rd Outfall	34, H	42,000
12	M-211-RH-1	CIP	67th Ave Bulkhead Infiltration	32, M	150,000

Problem/ Project No.	Basin ID	Project Type	Project Name	Priority	Estimated Cost ($)
13	M-S-1	CIP	Stuller Outfall Water Quality Improvement	32, M	270,000
14	M-S-2	CIP	Stuller Property Water Table Investigation	32, M	15,000
15	M-S-3	CIP	Wetland #0961 Valley Gem – 96 acres	15, L	510,000
16	M-W-1	CIP	Stormwater Easement Database Research	22, L	25,000
17	P-LP-1	CIP	188th St Infiltration Replacement	41, H	130,000
18	P-LP-2	CIP	59th Ave Infiltration	32, M	200,000
19	P-LP-3	CIP	Cemetery Rd Infiltration	32, M	270,000
20	P-LP-4	CIP	Portage Creek Water Quality Investigation	31, M	13,000
21	P-LP-5	CIP	Lower Portage Flood Mitigation	24, L	15,000
22	P-LP-6	CIP	Lower Portage Wetland Restoration	17, L	1,960,000
23	P-LP-7	CIP	Island Crossing Stormwater Plan	17, L	370,000
24	P-UP-1	CIP	Portage Creek Gaging & Monitoring	20, L	16,000
25	P-UP-2	CIP	Portage Creek Crossing, 69th Ave NE and BNSF Railroad	29, M	190,000
26	P-UP-3	CIP	Portage Creek S. Village Apts Flood Storage	25, M	210,000
27	P-UP-4	CIP	Portage Creek Crossing, 186th St NE	35, H	130,000
28a	P-UP-5a	CIP	Portage Creek Mill Reach, SR9 to 67th Ave	27, M	260,000
28b	P-UP-5b	CIP	Portage Hecla Wetland, 204th St to Round Barn	25, M	450,000
28c	P-UP-5c	CIP	Portage Wetland #1561	25, M	450,000
28d	P-UP-5d	CIP	Portage Wetland #1247	25, M	450,000
29	P-Pr-1	CIP	Prairie Creek 67th Ave Culvert Replacement	46, VH/Reg	130,000
30	P-Pr-2	CIP	Prairie Creek BNSF Railroad/69th Ave Culvert	33, M	220,000

Problem/ Project No.	Basin ID	Project Type	Project Name	Priority	Estimated Cost ($)
			Replacements		
31	P-Pr-3	CIP	Prairie Creek 204th St Culvert Replacement	40, H	150,000
32	P-Pr-4	CIP	Prairie Creek Gaging & Monitoring	20, L	16,000
33	P-Pr-5	CIP	Prairie Creek 71st Ave Culvert Replacement	40, H	130,000
34	P-Pr-6	CIP	Prairie Creek Jensen Business Park Improvements	36, H	110,000
35	P-Pr-7	CIP	Prairie Creek 74th Ave Culvert Replacement	40, H	130,000
36	P-Pr-8	CIP	Prairie Creek SR9 Streambank Stabilization	41, H	340,000
37	P-Pr-9	CIP	West Prairie Creek Stabilization (Arlington Valley Land)	27, M	580,000
38a	P-Pr-10a	CIP	Prairie Wetland #H0979 Mid-Elevation	25,M	350,000
38b	P-Pr-10b	CIP	Prairie Wetland #H1144 Headwaters	21, L	150,000
39	P-K-1	O&M	Kruger-Portage Jensen’s Farm ESA	27, M	64,000
40	P-K-2	CIP	Kruger Creek Stillaguamish Ave Culvert Replacement	25, M	130,000
41	P-K-3	CIP	Kruger Creek Restoration, 207th to Portage	27, M	790,000
42	P-K-4	CIP	Kruger Creek 207th St Culvert Replacement	25, M	130,000
43	P-K-5	CIP	Kruger Creek Burn Road Culvert Replacement	39, H	130,000
44	P-K-6	CIP	Kruger Creek Bank Stabilization	39, H	290,000
45	P-K-7	CIP	Kruger Creek 196th St Detention Facility	25, M	1,110,000
46	OTNE-T-1	CIP	Talcott Water Quality Facility	25, M	1,440,000
47	OTNE-T-2	CIP	Graafstra Riparian Area	22, L	550,000
48	OTNE-T-3	O&M	Division Drainage Structures	24, L	500
49	OTNE-T-4	CIP	Old Town Northeast Storm Drain Improvements	32, M	710,000

Problem/ Project No.	Basin ID	Project Type	Project Name	Priority	Estimated Cost ($)
50	OTNE-B-1	CIP	Broadway Water Quality Facility	25, M	48,000
51	E-1	CIP	Brekhus-Beach Stormwater Evaluation & Design	30, M	37,000
52	E-2	CIP	Tveit Road Fish Passage—Indian Creek	33, M	130,000
53	E-3	CIP	Tveit Road Fish Passage—Eagle Creek	33, M	130,000
54a	E-4a	CIP	Eagle Wetland #SH0888	21, L	2,200,000
54b	E-4b	CIP	Eagle Clay Cliff Ponds Wetland #SH0860	29, M	66,000
55	MFQ-E-1	CIP	Edgecomb Cr. Gleneagle Branch 182nd St Culvert Replacement	38, H	130,000
56	MFQ-E-2	CIP	Edgecomb Cr. Gleneagle Branch BNSF Siding Culvert Replacement	38, H	130,000
57	MFQ-E-3	CIP	Edgecomb Cr. Gleneagle Branch 177th St Culvert Replacement	38, H	130,000
58	MFQ-E-4	O&M	Edgecomb Cr. Gleneagle Branch BNSF Maintenance	42, H	48,000
59a	MFQ-E-5a	CIP	Edgecomb Cr. Gleneagle Branch 172nd St Culvert Alt A	34, H	480,000
59b	MFQ-E-5b	CIP	Edgecomb Cr. Gleneagle Branch 172nd St Culvert Alt B	34, H	480,000
60	MFQ-E-6	CIP	Edgecomb Cr. McPherson Branch BNSF Culvert Replacement	38, H	130,000
61	MFQ-E-7	CIP	Edgecomb Cr. McPherson Branch 67th Ave Tributary Culvert Replacement	38, H	190,000
62	MFQ-E-8	CIP	Edgecomb Creek Re-location—Crown Distributing Site	29, M	430,000
63	MFQ-E-9	CIP	Airport/Shoultes Rd Water Quality Improvements	33, M	29,000
64	MFQ-E-10	CIP	172nd St Regional Drainage Improvements	36, H	960,000
65	MFQ-H-1	CIP	Middle Fork Quilceda Groundwater Influences Study	36, H	63,000

Problem/ Project No.	Basin ID	Project Type	Project Name	Priority	Estimated Cost ($)
66	MFQ-H-2	CIP	Heyho Creek Water Quality Facility	27, M	140,000
67	MFQ-H-3	CIP	Smokey Point Inventory and Level Survey	21, L	30,000
68	MFQ-H-4	O&M	Beaver Control	21, L	12,000
NPDES-13	IDDE-3C	CapEquip	IDDE Capital Equipment Expense	56, VH	22,000
NPDES-17	RUNOFF-3C	CapEquip	Runoff Control Capital Equipment Expense	56, VH	2,000
NPDES-21	PPOM-3C	CapEquip	Good Housekeeping Capital Equipment Expense	52, VH	1,200
Storm-2	PLANNING-1C	CapRecur	Stormwater Comprehensive Planning Consultant, 6-year interval	40, H	55,000
Storm-4	PLANNING-2C	CIP	Hydrography Inventory CIP	33, M	15,000
Storm-7	PLANNING-4C	CapEquip	Utility Administration Pickup Truck	10, L	27,000
Storm-8	PLANNING-5C	CapRecur	Utility Annual SW System Upgrade	39, H	180,000
Storm-11	GROUND-WATER-2	CIP	Stormwater Injection and Recovery Evaluation	33, M	39,000

MAPS

The following maps are provided in this section:

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