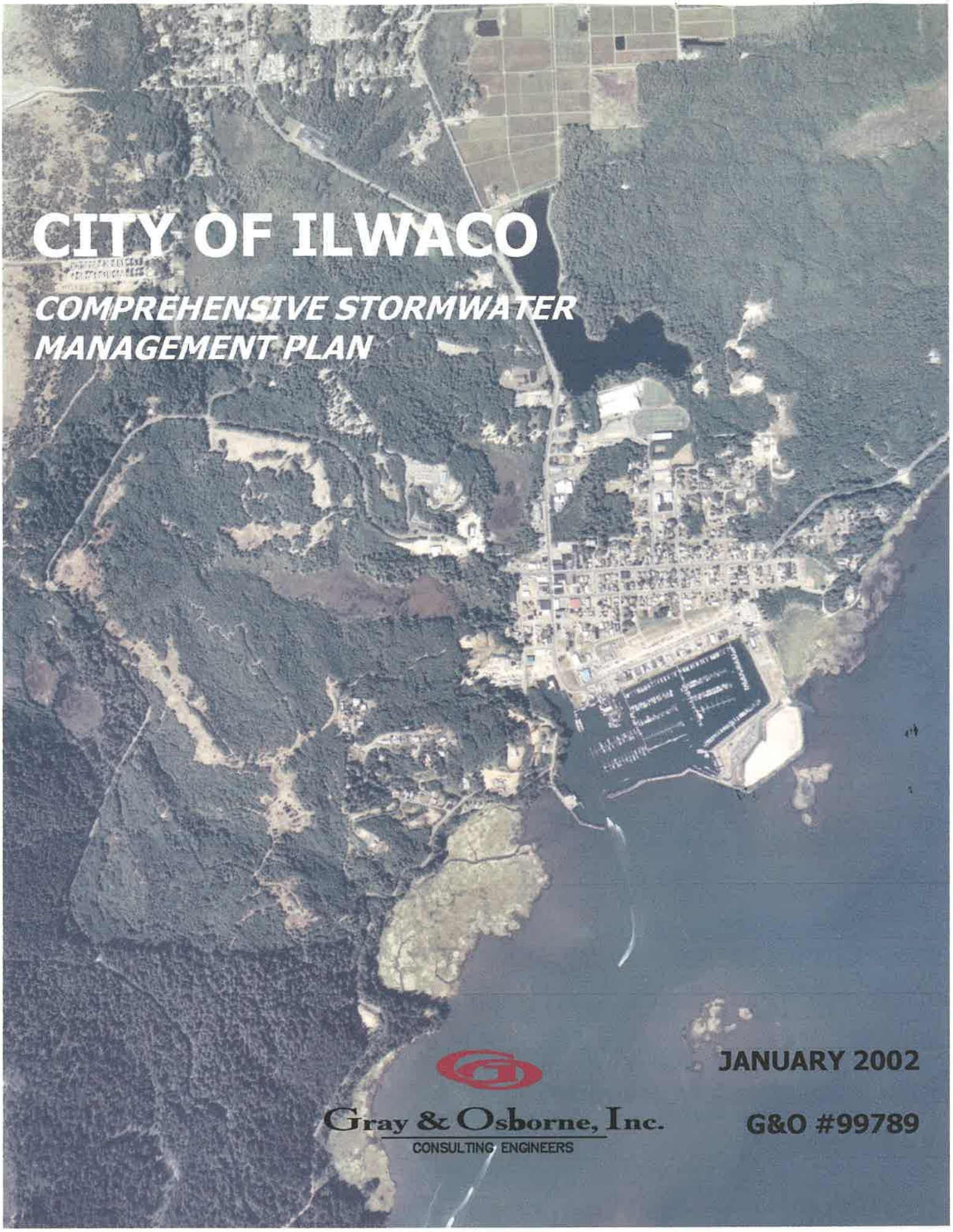


CITY OF ILWACO

COMPREHENSIVE STORMWATER MANAGEMENT PLAN

JANUARY 2002

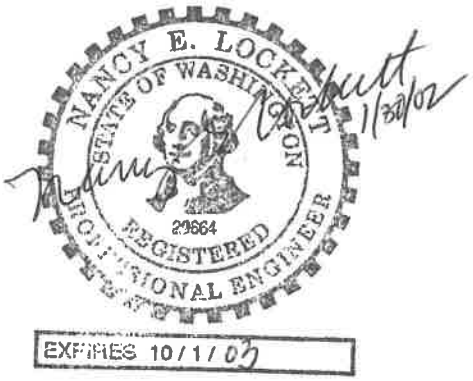
Gray & Osborne, Inc.
CONSULTING ENGINEERS

G&O #99789

CITY OF ILWACO

COMPREHENSIVE STORMWATER MANAGEMENT PLAN

January 2001



Gray & Osborne, Inc.
CONSULTING ENGINEERS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

For many years stormwater management has meant controlling water quantity and the inundating effects of large storm events. However, more recently, the cumulative effects of smaller storms have been recognized as a major contributor to water quality degradation.

Stormwater runoff carries excessive amounts of sediment from exposed construction sites and pollutants from residential, commercial, and industrial developments. Pollutants in stormwater runoff include metals such as lead, cadmium, and copper; oil and grease; pesticides and fertilizers; and harmful bacteria. In addition, the high rates of urbanization have increased the amount of impervious surfaces such as rooftops, streets, and parking areas. Impervious surfaces directly relate to an increase in runoff volumes and peak rate flows. The pollutant loads and increased volumes of stormwater runoff results in negative impacts to downstream properties, downstream water bodies such as local streams and the Columbia River, and reduced infiltration to groundwater. Due to regulations required under the Clean Water Act as well as the current and potential future listing of salmonid species under the Endangered Species Act, it has become increasingly more important for municipalities to implement stormwater control measures.

PURPOSE

The purpose of the City of Ilwaco's Comprehensive Stormwater Plan (Plan) is to provide the City with a stormwater planning document that includes ordinances and programs necessary to fulfill the requirements of a comprehensive stormwater program. The plan will additionally identify specific structural and non-structural solutions to known flooding and water quality problems that currently exist within the City. The Comprehensive Stormwater Plan will meet local, state, and federal stormwater requirements; identify water quality and quantity problems associated with surface water runoff that may endanger the environment; and provide recommendations for improvements including a cost analysis and an implementation schedule.

This plan will meet the stormwater provisions recommended by the Washington State Department of Ecology (Ecology). Other important elements of a stormwater program include operation and maintenance ordinances and a technical manual for structural and non-structural control measures. To meet the technical manual requirement, we recommend that the City of Ilwaco formally adopt the latest version of Ecology's *Stormwater Management Manual for Western Washington* and all subsequent updates relating to this manual.

WATER QUALITY AND QUANTITY GOALS

The primary goal of the City's Stormwater Comprehensive Plan is to preserve and protect water quality and the hydraulic regime within the City's drainage basins including sub-basins of Black Lake, Ilwaco Marina and Baker Bay.

The City of Ilwaco currently experiences flooding during larger storm events. During the wet season, the City generally experiences nuisance flooding in yards, streets, and residences. The main reason for the flooding is due to the flat topography and minimal natural grade within the City to convey surface water runoff. In addition, in certain areas of the City the groundwater level is high, thus preventing infiltration of surface water. As additional development occurs within the city limits, the amount of impervious surfaces will increase which will ultimately increase peak surface water runoff rates.

To this end, it is the City's intent to manage stormwater to minimize contact with contaminants, mitigate the impacts of increased runoff due to major build-out and development within the City's drainage areas, provide management of runoff from large and small construction sites, and to preserve wildlife habitat. These efforts would meet City goals to protect the health, safety, and welfare of the local citizenry and to preserve surface water resources within the City of Ilwaco.

PLANNING PERIOD

The planning period for this document has a ten-year planning horizon, which runs from 2002 through 2012.

SCOPE OF WORK

Gray & Osborne, Inc. (Engineer) will develop a Comprehensive Stormwater Plan that meets the State's recommendations and guidelines for stormwater practices as developed in the Department of Ecology's "*Stormwater Management Manual*". The scope of work for this plan includes the following agreed-upon tasks:

CITY OF ILWACO COMPREHENSIVE STORMWATER PLAN

Task 1 – Identify System Components

a) Use existing maps and as built plans to identify the drainage network and flow direction of stormwater. Verify and augment the data with field survey.
b) Generate a stormwater base map showing all publicly owned facilities.

Task 2 – Delineate Drainage Basins and Land Use

a) Using land use and topographic maps, soils surveys, geologic information, and field surveys, define the drainage sub-basins in the Black Lake, Ilwaco Marina and Baker Bay basins and the location of each in relation to the drainage network. Identify land use.
b) Transfer the above data onto the stormwater base map to be used in the analysis of the system.

Task 3 - Determine the Existing Level of Maintenance

a) Perform field surveys to gather information on the level of maintenance currently being provided by the City and Port. Assess the level of maintenance being performed by private owners of stormwater facilities.
b) Discuss with maintenance personnel the schedule and activities performed for stormwater maintenance. Assess areas of need. Discuss with City staff a desired level of maintenance.
c) Develop a maintenance schedule, procedure and costs for performing facilities maintenance.

Task 4 - Model Stormwater Flows

a) Using the information gathered above, model the existing system for the selected design storms.
b) Using information from the City's planning documents, determine runoff for future conditions. Model the system for future conditions.
c) Evaluate the impact of the tides on the discharge to the Ilwaco Marina and Baker Bay.
d) Install flow meters during dry and wet weather to obtain flow data.
e) Using actual flow data, calibrate the model and make adjustments as necessary.
f) Evaluate the conveyance performance of the system.

Task 5 - Identification of Water Quality Problems

a) Perform field surveys to identify areas that are possible sources of pollution. Specifically evaluate erosion control practices, thoroughfares, Port activities, and agricultural uses. Distinguish between point and non-point sources of pollution.
b) Identify water quality problems in Black Lake, Ilwaco Marina and Baker Bay.

Task 6 - Identify Conveyance Problems

a) Using data from the model, and information from field surveys and interviews, identify portions of the drainage network that are not capable of conveying the design storm. Evaluate possible flood damage to life and property.
b) Evaluate the probability of water quality related problems such as erosion, sedimentation and pollutant transport due to conveyance system deficiencies.

Task 7 - Identify Possible Solutions

a) Develop design standards and policies to be implemented for water quality. Utilize information from other jurisdictions, agencies, and academic and research organizations to institute the appropriate Best Management Practices.
b) Propose facilities improvements for conveyance problems, including costs.
c) Propose facilities improvements for water quality problems, including costs.
d) Develop a public involvement plan that may involve water quality monitoring, volunteer projects for trash cleanup, storm drain stenciling and education field activities.
e) Develop a stormwater ordinance to be presented to City Council and the Port Commissioners for adoption. The stormwater ordinance will address erosion control practices, water quality control and water quantity control measures.
f) Identify means of financing a stormwater program including implementation of a stormwater utility, available grants and loans and developer financing.

Task 8 – Stormwater Utility

a) Determine an equitable method of determining participation in a stormwater utility. Determine number of equivalent residential units (ERUs) and monthly charge based on the capital improvement program and operation and maintenance.

Task 9 – Capital Improvement Plan

a) Based on the improvements recommended in Task 7 propose a schedule of capital improvements for the six-year and ten-year planning horizon. Provide funding options, rate adjustments and priorities for improvements.

Task 10 – Presentation to City Council, Port Commission and Public

a) Present the Stormwater Comprehensive Plan. Describe the methodology used to model the system. Describe the improvements necessary, how they were prioritized and the alternatives for scheduling improvements. Discuss funding for each project.
b) Prepare a SEPA checklist

c) Conduct two (2) public workshops. Revise plan as necessary based on public comment.

Task 11 - Stormwater Management Plan

a) Prepare final version of plan based on public comment and City Council and Port Commission direction.
b) Present to City Council and Port Commission for adoption.

LIST OF PREVIOUS REPORTS

The following documents were used to provide background information for the development of the City of Ilwaco's Stormwater Comprehensive Plan:

Alternative Outfall Site Environmental Analysis, City of Ilwaco, Washington, prepared for Gray & Osborne Engineers by Beak Consultants Incorporated, Kirkland, Washington, August 1992.

City of Ilwaco, Wastewater Facility Plan, Gray & Osborne, Inc., April 1994.

City of Ilwaco Wastewater Treatment Plant Outfall Environmental Analysis, prepared for Gray & Osborne Engineers by Beak Consultants Incorporated, Kirkland, Washington, December 1992.

City of Ilwaco Wastewater Treatment Plant Outfall Environmental Analysis, Supplemental Modeling, prepared for Gray & Osborne Engineers by Beak Consultants Incorporated, Kirkland, Washington, May 1993.

City of Long Beach, Stormwater Management Plan, Gray & Osborne, Inc., March 1998.

City of Ilwaco Comprehensive Plan, Mark R. Barnes, August 26, 1994.

City of Ilwaco Comprehensive Plan, Bucher, Willis & Ratliff, July 14, 1997.

Effluent Dilution and Concentration Limit Analysis for a Combined Wastewater Outfall in Pacific County, Washington, prepared for Pacific County, City of Ilwaco, City of Long Beach and the Port of Ilwaco under the direction of Gray & Osborne Engineers by Beak Consultants Incorporated, Kirkland, Washington, November 1995.

Geotechnical Report, Sanitary Sewer Replacement Project, Ilwaco, Washington, Hong West & Associates, July 1996.

Ground-Water Resources of the North Beach Peninsula, Pacific County, Washington, U.S. Geological Survey Open-File Report 77-647, prepared in cooperation with the Pacific County Board of Commissioners and the State of Washington Department of Ecology by the US Department of the Interior Geological Survey, Tacoma, Washington 1978.

Screening Level Evaluation for a Regional Wastewater Outfall in Pacific County, Washington, prepared for Pacific County, City of Ilwaco, City of Long Beach and the Port of Ilwaco under the direction of Gray & Osborne Engineers by Beak Consultants Incorporated, Kirkland, Washington, April 1996.

Stormwater Management Manual for the Puget Sound Basin, Washington State Department of Ecology, February, 1992.

PROJECT CONTACTS

CITY OF ILWACO

Mr. Randy LeVold
Public Works Director
City of Ilwaco
301 Spruce St., PO Box 548
Ilwaco, WA 98624
(360) 642-3145
(360) 642-3155, FAX

GRAY & OSBORNE, INC.

Nancy Lockett, P.E.
Project Manager
Gray & Osborne, Inc.
701 Dexter Avenue N, Ste. 200
Seattle, Washington 98109
(206) 284-0860
(206) 283-3206, FAX
e-mail: stormwater@g-o.com

CHAPTER 2

REGULATORY CONSIDERATIONS

INTRODUCTION

Stormwater drainage planning and construction has historically been provided for the purposes of keeping stormwater away from structures and property so that the property can be drained and protected from damage due to stormwater runoff. Local and state governments have installed the majority of existing stormwater facilities to drain roadways. Private property owners have installed facilities to drain their property, which discharge into the public drainage system associated with the roadways. However, over the last thirty years many new regulations have come forth to protect the natural environment from the increasing flows and pollution contained in stormwater runoff. Chapter 6 describes many of the water quality and quantity problems associated with today's urban stormwater runoff.

Through the Clean Water Act and other legislation, the federal government has delegated to Washington State the authority to implement rules and regulations within the state that meet the goals of this legislation. Subsequently, the State has delegated some of this authority to the local agencies. Local agencies, in turn, enact development regulations to enforce the rules sent down by the state. Local agencies are free to enact and enforce rules and policies that are more stringent than those of the state, but cannot enact any that are less stringent. Permits may be issued by all three levels of government depending on the type of project and the impacts it may have on the natural drainage systems, which may include streams (intermittent or year-around flows), wetlands, lakes, ponds, rivers, estuaries, marine waters, and groundwater.

The role of federal, state, and local stormwater regulations is to provide minimum standards for the drainage and discharge of stormwater runoff. Specifically, the goal of these regulations is to reduce the damaging effects of increased runoff volumes to the natural environment as the type of cover on the land surface changes and to remove the pollutants that become entrained in the runoff.

Because of changing administrations, conditions, and technology, all of these policies, rules, and regulations are subject to significant change through time.

FEDERAL REGULATIONS

The federal government regulates stormwater through several different programs. Responsibility for implementing the policies of these programs is often delegated to the state and local agencies through various rules, regulations, and permitting policies. The

federal government does, however, maintain some of the responsibilities for those activities that are of national interest.

FEDERAL WATER POLLUTION CONTROL ACT (CLEAN WATER ACT)

The Clean Water Act (CWA) is a 1977 amendment to the Federal Water Pollution Control Act of 1972, which set the basic structure for regulating discharges of pollutants to waters of the United States. The law gave the Environmental Protection Agency (EPA) the authority to set effluent standards on an industry basis (technology-based) and continued the requirements of the original act to set water quality standards for all contaminants in surface waters. The CWA makes it unlawful for any person to discharge any pollutant from a point source into waters of the United States unless a Nationwide Pollutant Discharge Elimination System (NPDES) permit is obtained under the Act.

The CWA provisions for the delegation by EPA of many permitting, administrative, and enforcement aspects of the law to state governments. In states with the authority to implement CWA programs, EPA still retains oversight responsibilities.

Provisions of the CWA directly apply to the purpose and creation of the non-point source management program. Under the CWA, stormwater control was established as part of the NPDES permit program (Section 402 of CWA).

Phase I NPDES Stormwater Permits

In 1990, the United States Environmental Protection Agency (EPA) set out regulations for Phase I stormwater permits for large and medium municipalities as well as industries and construction sites. Section 402 of the Clean Water Act, establishes this regulatory program for point sources of pollution but exempts most agricultural activities. The NPDES permit program draws its power from this section and was originally designed to reduce pollution from point sources such as domestic and industrial wastewater discharges. The program now includes certain runoff discharges from specific industrial activities, including construction sites that disturb more than five acres of land, and runoff discharges operated by local governments with a population over 100,000. To obtain a NPDES permit, a plan must be developed and implemented to reduce the discharge of pollutants to the "Maximum Extent Practicable," protect water quality, and satisfy the appropriate water quality requirements of the Clean Water Act.

Phase II NPDES Stormwater Permits

The United States Environmental Protection Agency (EPA) issued draft regulations for Phase II NPDES stormwater permits in January 1998 and issued final Phase II regulations on December 8, 1999. The EPA proposes to cover all urban areas, not initially covered

by Phase I regulations under a general Phase II permit. The regulations call for the development of the following stormwater management measures:

- Public Education and Outreach Program,
- Public Involvement and Participation Program,
- Elicit Discharge Detection and Elimination Program,
- Erosion and Sediment Control Program for Construction,
- New Development and Redevelopment Runoff Program, and
- Pollution Prevention (Good Housekeeping) Program.

The above stormwater management measures must include quantitative goals and a description of how these goals will be met. Therefore, monitoring will be an important part of the Elicit Discharge Detection and Elimination Program. Elicit discharges to storm drains are any discharges that are not considered stormwater. Examples include spills, illegal dumping and cross connections with the sanitary sewer. Spill control is required under the Elicit Discharge Detection and Elimination Program.

The proposed regulations specify minimum requirements for the stormwater programs developed to comply with the Phase II permits. One of those requirements is the adoption of a program for "post-construction stormwater management in new development and redevelopment". Another is a program for "construction site stormwater runoff control."

The EPA will issue a "menu of BMPs" that will serve as the basis for the stormwater program measures listed above. In the State of Washington, the Department of Ecology is the delegated authority to issue and administer NPDES permits to municipal and industrial point and non-point source discharges. An initial estimate is that 76 municipalities will be subject to the requirements and 13 additional municipalities may be subject to the requirements, depending upon an analysis that Ecology must perform. These Phase II requirements must be issued by December 2002. The Phase II communities must submit their stormwater programs to comply and obtain permit coverage by March 2003. The state intends to require that those jurisdictions requiring a Phase II NPDES permit adopt either Ecology's manual or an equivalent manual. The statewide general permit issued by Ecology will likely emulate the Comprehensive Program for stormwater as outlined in Ecology's Technical Manual.

In the State of Washington, the Department of Ecology is the delegated authority to issue and administer NPDES permits to municipal and industrial point and non-point source discharges. The state is in the last stages of issuing a final Technical Manual to address aspects included in Phase II. For western Washington, they will be published as five volumes entitled *Stormwater Management Manual for Western Washington.*

Endangered Species Act

The purpose of the 1972 Endangered Species Act (ESA) is to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved...." In pursuit of this goal, the ESA authorizes the U.S. Fish and Wildlife Service and the National Marine Fisheries Service to list species as endangered or threatened, and to identify and protect the critical habitat of listed species. USFWS has jurisdiction over terrestrial and freshwater plants and animals such as bull trout, while NMFS is responsible for protection of marine species including anadromous salmon. Under the ESA, endangered status is conferred upon "any species which is in danger of extinction throughout all or a significant portion of its range...", while threatened status is conferred upon "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." The ESA defines critical habitat as the "geographical area containing physical and biological features essential to the conservation of the species."

Once a species is listed as endangered or threatened, the ESA makes it illegal for the government or individuals to "take" a listed species. "Take" is defined in Section 9 of the act and includes killing, hunting, trapping, or otherwise "harming" the listed species or habitat the species depends upon. "Take" has been interpreted by the federal courts to include "significant modification or degradation of critical habitat" that impairs essential behavior patterns. For species listed as endangered, the blanket prohibitions against "take" are immediate.

The ESA Section 9 "take" prohibition applies to all "persons" including local public entities. State and local governments may face twin exposures through their direct conduct and through the exercise of the regulatory authorities over activities which themselves may "take".

However, threatened species may be protected through a more flexible Section 4(d) rule describing specific activities that are likely to result in a "take". The draft of the Section 4(d) rule prepared by NMFS was published in the Federal Register on January 3, 2000 (Federal Register, Vol. 65, No. 1). The final 4(d) rule was published in June, 2000 and became effective January 8, 2001.

The 4(d) rules may exempt certain activities from "take" liabilities and thereby offer an alternative mechanism by which to secure relief from potential " take" liability. The 4(d) rule approves some specific existing state and local programs, and creates a means for NMFS to approve additional programs if they meet certain standards set out in the rule. NMFS published "A Citizen's Guide to the 4(d) Rule for Threatened Salmon and Steelhead on the West Coast" in June, 2000. A copy of the guide is included in Appendix

A. The guide introduces and explains the rule. The following discussion summarizes this guide.

Section 4(d) requires NMFS to issue regulations deemed "necessary and admissible to provide for the conservation to the species." NMFS must establish protective rules for all species now listed as threatened under the ESA. The rules need not prohibit all take. There may be an "exception" from the prohibitions on take so long as the take occurs as the result of a program that adequately protects the listed species and its habitat. The 4(d) rule can "limit" the situations to which the take prohibitions apply. By providing limitation from take liability, NMFS encourages governments and private citizens to adjust their programs and activities to be "salmon safe."

One of the limitations on the take prohibitions contained in the 4(d) rule is Limit No. 12 – Municipal, Residential, Commercial and Industrial development and redevelopment (MRCI). The 4(d) rule recognizes that MRCI development and redevelopment have a significant potential to degrade habitat and injure or kill salmon and steelhead in a variety of ways. The 4(d) guide states that with appropriate safeguards, MRCI development can be specifically tailored to minimize impacts on listed fish to the extent that additional Federal protections would not be needed to conserve the listed ESU. The guide further states that NMFS would individually apply the following 12 evaluation considerations when determining whether MRCI development ordinances or plans adequately conserve listed fish.

1. An MRCI development ordinance or plan ensure that development will avoid inappropriate areas such as unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites.

2. An MRCI development ordinance or plan adequately prevents stormwater discharge impacts on water quality and quantity and stream flow patterns in the watershed – including peak and base flows in perennial streams.

3. An MRCI development ordinance or plan protects riparian areas well enough to attain or maintain Proper Functioning Condition (PFC), habitat that provided for the biological requirements of the fish, around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams.

4. An MRCI development ordinance or plan avoids stream crossings – whether by roads, utilities, or other linear development – wherever possible and, where crossings must be provided, minimize impacts.

5. An MRCI development ordinance or plan adequately protects historic stream meander patterns and channel migration zones and avoids

hardening stream banks and shorelines.

6. An MRCI development ordinance or plan adequately protects wetlands, wetland buffers and wetland function – including isolated wetlands.

7. An MRCI development ordinance adequately preserves permanent and intermittent streams' ability to pass peak flows.

8. An MRCI development ordinance or plan stresses landscaping with native vegetation to reduce the need to water and apply herbicides, pesticides, and fertilizer.

9. An MRCI development ordinance or plan contains provisions to prevent erosion and sediment run-off during (and after) construction and thus prevent sediment and pollutant discharge to streams, wetlands and other water bodies that support listed fish.

10. An MRCI development ordinance or plan ensures that demands on the water supply can be met without affecting either directly or through groundwater withdrawals – the flows salmon need.

11. An MRCI development ordinance or plans provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program.

12. An MRCI development ordinance or plan complies with all other state and Federal environmental and natural resource laws and permits.

The National Marine Fisheries Service (NMFS) has listed a number of salmonid species which use the Columbia River as part of their habitat. The Upper Columbia River Spring Chinook, Snake River Sockeye, and Upper Columbia River Steelhead are listed as "Endangered". The Lower Columbia River Chinook, Snake River Fall Chinook, Snake River Spring/Summer Chinook, and Upper Willamette River Chinook Salmon; Columbia River Chum Salmon; and Lower Columbia River Steelhead, Middle Columbia River Steelhead, Snake River Basin Steelhead, and Upper Willamette Steelhead are listed as "threatened" under the Endangered Species Act (ESA). In addition, the United States Fish and Wildlife Service (USFWS) listed the Bull Trout as "threatened" during the summer of 1999. ESA listings are expected to significantly impact activities that affect salmon and trout habitat, such as water use, land use, construction activities, and wastewater disposal. Impacts to the City may include revised waste load allocations developed under Section 303 of the Clean Water Act, longer timelines for permit applications, and more stringent regulation of construction impacts and activities in riparian corridors.

In response to existing and proposed ESA listings of salmon, steelhead, and trout species throughout Washington State, Governor Locke established the Office of Salmon Recovery in 1997 to direct the State's salmon recovery efforts. The Office of Salmon Recovery is also supported by the Joint Natural Resources Council (composed of representatives of state natural resource agencies) in the preparation of the Statewide Strategy to Recover Salmon, entitled "Extinction is Not an Option" (January, 1999). The goal of the Statewide Strategy is to restore wild salmon, steelhead, and trout populations to harvestable levels. Rather than attempting to avert additional ESA listings, the Statewide Strategy intends to provide local input into, and hopefully maintain some local control over the salmon recovery regulatory processes that will inevitably effect the majority of Washington State. The Statewide Strategy was submitted to NMFS in 1999 for possible inclusion in the Section 4(d) rule. The draft of the Section 4(d) rule was published in the Federal Register on January 3, 2000 (Federal Register, Vol. 65, No. 1). The final 4(d) rule was published in June 2000 and became effective January 8, 2001. The Statewide Strategy to Recover Salmon was not included in the 4(d) rule.

In order to minimize liability under the ESA, local governments will need to demonstrate that their land use regulations will not result in a prohibited "take" of a listed species, including adverse modification of critical habitat. Possible regulatory impacts may include the following:

- Adopt model critical areas ordinances designed to protect critical habitat.
- Amend critical areas ordinances to include riparian buffers, vegetation retention, soil retention, maximum road density within a watershed, maximum impervious surface in a watershed, and limits on road crossings of streams.
- Amend GMA comprehensive plans to require an "environmental protection element."
- Adopt stormwater operation and maintenance ordinances requiring regular, frequent maintenance of stormwater facilities.
- Increase inspection and enforcement of stormwater best management practices.
- Require monitoring of best management practices.
- Provide adequate funding of stormwater infrastructure, which may include implementation of stormwater utilities.
- Amend Shoreline Master Programs to encourage greater use of conservancy and natural designations, and limit conversion of agricultural and forest land.

The National Marine Fisheries Service

Under the ESA, NMFS is responsible for the protection of marine life, including anadromous salmon such as the Columbia River, Coastal, and Puget Sound Chinook and Steelhead. When a species is listed as "endangered", the prohibitions against a "take" of the species are immediate under Section 9 of the ESA of the Act. Although NMFS may

choose to invoke the blanket prohibitions of Section 9, the "threatened" status of the Coastal River Chinook allows more flexibility to establish regulations designed to protect these species. These regulations, known collectively as a Section 4(d) rule, outline activities exempted from the "take" prohibitions of Section 9.

United States Fish and Wildlife Service

Under the ESA, USFWS is responsible for the protection of all non-marine life such as bull trout. The bull trout was proposed for ESA protection and was listed as "threatened" during the summer of 1999. Unlike the NMFS, the USFWS does not differentiate between "threatened" and "endangered" species, so a Section 4(d) rule will not contain exceptions to the Section 9 prohibition on "take".

STATE STORMWATER REGULATIONS

The principal state programs already in existence that relates to stormwater include the *Puget Sound Water Quality Management Plan*, municipal NPDES stormwater permits, the Growth Management Act, the Shorelines Management Act, and Hydraulic Project Approvals.

Governor Locke issued a *Draft Salmon Recovery Strategy* plan on September 25, 1998 in response to the listing of Puget Sound Chinook salmon as "threatened" and the potential for other listings. Once the *Final Salmon Recovery Plan* is implemented throughout the State of Washington, further stormwater flow controls will likely be required. The *Draft Recovery Plan* stormwater strategy emphasizes preservation of existing high quality habitat and restricting new development. Retrofitting of existing development is recommended only in priority habitat areas due to the high cost and limited potential for successful rehabilitation. The *Draft Recovery Plan* relies on voluntary measures and greater enforcement and monitoring of existing regulations.

Puget Sound Water Quality Management Plan

In December of 2000, the Puget Sound Water Quality Action Team adopted the 2000 *Puget Sound Water Quality Management Plan*. The plan establishes the framework for managing and protecting the Puget Sound and coordinating the roles and responsibilities of federal, state, tribal and local governments. As part of this plan, a *Water Quality Work Plan* is established every two years to identify actions in order to maintain or improve water quality in the region. The Plan is separated into 21 programs including:

- Estuary Management and Plan Implementation
- Puget Sound/Georgia Basin Shared Waters
- Aquatic Nuisance Species
- Contaminated Sediments and Dredging

- Marine and Freshwater Habitat Protection
- Municipal and Industrial Discharges
- Nonpoint Source Pollution
- Agricultural Practices
- Forest Practices
- Household Hazardous Waste
- Local Watershed Action
- Marinas and Recreational Boating
- On-Site Sewage Systems
- Pest Management
- Shellfish Protection
- Spill Prevention and Response
- Stormwater and Combined Sewer Overflows
- Education and Public Involvement
- Laboratory Support
- Monitoring
- Research

Per RCW 90.71.070, local governments are required to implement local elements of the work plan subject to the availability of appropriated funds or other funding sources. Although Ilwaco is not in the geographic region intended for the *Puget Sound Water Quality Management Plan*, the Plan provides valuable guidance regarding implementation of suggested actions in areas where water quality is a concern. The *Puget Sound Water Quality Management Plan* (Puget Sound Plan) consists of elements calling for counties and cities to develop and implement local stormwater management programs.

The Puget Sound Plan directed Ecology to develop stormwater guidance for local programs, including a technical manual (SW-2) and model ordinances (SW-3.2) for stormwater management, operation and maintenance. Ecology recently released its latest version of a technical manual entitled, *Stormwater Management Manual for Western Washington*. The 2000 Puget Sound Plan also calls for jurisdictions to adopt a comprehensive stormwater program (SW-1). Densely populated urbanized areas, in accordance with EPA regulations, must also meet the requirements of municipal stormwater NPDES permits (SW-2.5). This 2000 Plan also suggests Ecology develop criteria for determining whether small municipalities outside of urban areas will need an NPDES phase II permit. This criteria includes evaluation of the potential to degrade water quality through discharge to sensitive waters, high growth or growth potential, high population density, and the evaluation of the effectiveness of water quality programs currently in place. Based on these criteria, some smaller communities may be required to obtain NPDES phase II permits.

The City of Ilwaco should be committed to meeting the comprehensive stormwater requirements. In the unlikely event the City is ever selected as a federally designated urbanized area, it will be required to meet Phase II NPDES stormwater regulations when they are implemented in the year 2002. By fulfilling the requirements of a comprehensive stormwater program, the City may well be in compliance with the Phase II NPDES requirements.

Local Government Planning and Stormwater Programs (SW-1)

The following are excerpts from the Puget Sound Plan regarding recommended components for local government planning and stormwater programs. The plan calls on local governments to use the tools listed here in order to protect water quality of surrounding waters.

Growth Management Planning: Every city and county required to plan under the Growth Management Act (GMA) shall review and revise, as necessary, countywide planning policies, local comprehensive plans and development regulations to ensure that development does not degrade water quality, aquatic species and habitat, and natural hydrology and processes. This review shall be completed according to GMA amendment timelines using best available science and shall include:

a. Designating urban growth management areas with appropriate densities and sufficient capital facilities to reduce sprawl;

b. Providing sufficient vegetative buffers and development setbacks in critical areas ordinances to protect riparian zones, shorelines, wetlands and other sensitive areas;

c. Assessing how full build-out according to the comprehensive plan will alter natural hydrology, water quality and aquatic species; and

d. Incorporating measures to retain natural hydrology and processes, such as establishing goals for limiting effective impervious surfaces and preserving open spaces and forests.

Comprehensive Stormwater Programs: Every city and county shall develop and implement a comprehensive stormwater management program. Cities and counties are encouraged to form intergovernmental cooperative agreements in order to pool resources and carry out program activities most efficiently. Programs shall include:

a. **Stormwater Controls for New Development and Redevelopment** – Adopt ordinances that require the use of best management practices

(BMPs) to control stormwater flow, provide treatment, and prevent erosion and sedimentation from all new development and redevelopment projects. Adopt and require the use of the Department of Ecology's stormwater technical manual (or an alternative manual developed under SW-1.3) to meet these objectives. All new development in the basin, particularly new development sited outside of urban growth areas, shall seek to achieve no net detrimental change in non-natural surface runoff and infiltration.

b. **Stormwater Site Plan Review** – Review new development and redevelopment projects to ensure that stormwater control measures are adequate and consistent with local requirements.

c. **Inspection of Construction Sites** – Regularly inspect construction sites and maintain temporary BMPs according to guidance developed under SW-2 and 3. Adopt ordinances to ensure clear authority to inspect construction sites, to require maintenance of BMPs and to enforce violations. Provide local inspectors with training under SW-3 on erosion and sediment control practices.

d. **Maintenance of Permanent Facilities** – Adopt ordinances that require that all permanent stormwater facilities be regularly maintained according to guidance developed under SW-2 and 3 to ensure performance. Develop provisions as necessary, such as agreements or maintenance contracts, to ensure that facilities on private land (e.g., residential subdivisions and commercial complexes) are maintained. Provide training under SW-3 for professionals who maintain stormwater facilities.

e. **Source Control** – Develop and implement a program to control sources of pollutants from new development and redevelopment projects and from existing developed lands, using BMPs from Ecology's stormwater technical manual. Source control activities shall include pollution from roadways and landscaping activities. Integrated pest management practices shall be used to manage roadside vegetation.

f. **Illicit Discharges and Water Quality Response** – Adopt ordinances to prohibit dumping and illicit discharges. Carry out activities to detect, eliminate and prevent illicit discharges, and respond to spills and water quality violations.

g. **Identification and Ranking of Problems** – Identify and rank existing problems that degrade water quality, aquatic species and habitat, and natural hydrologic processes. Local governments may choose to achieve

this through watershed or basin planning (SW-1.2.j) or another process. Conduct a hydrologic analysis and map stormwater drainages, outfalls and impervious surfaces by watershed. Develop plans and schedules and identify funding to fix the problems.

h. **Public Education and Involvement** – Educate and involve citizens, businesses, elected officials, site designers, developers, builders and other members of the community to build awareness and understanding of stormwater and water quality issues. Provide practical alternatives to actions that degrade water quality and biological resources.

i. **Low Impact Development Practices** – Adopt ordinances that allow and encourage low impact development practices. These are practices that infiltrate stormwater (using proper safeguards to protect groundwater) on-site rather than collecting, conveying and discharging stormwater off site. The goals of low impact development practices are to enhance overall habitat functions, reduce runoff, recharge aquifers, maintain historic in-stream flows and reduce maintenance costs. Low impact development provides a variety of benefits, including cost savings and added market appeal, additional green space for recreational uses and greater esthetic appeal than traditional facilities. Low impact development practices may not be appropriate for all sites. Low impact principles include:

    i. Maintain the pre-developed, undisturbed stormwater flows and water quality;

    ii. Retain native vegetation and soils to intercept, evaporate and transpire stormwater on the site (rather than using traditional ponds and conveyances);

    iii. Emphasize a higher standard of soil quality in disturbed soils (by using compost and other methods) to improve infiltration, reduce runoff and protect water quality;

    iv. Cluster development and roads on the site and retain natural features that promote infiltration; and

    v. Reduce impervious surface area an use permeable surfaces instead.

j. **Watershed or Basin Planning** – Participate in watershed or basin planning processes, such as planning under Chapter 400-12 WAC or Chapter 90.82 RCW, in order to coordinate efforts, pool resources, ensure consistent methodologies and standards, maintain and restore watershed

health, and protect and enhance natural hydrology and processes, including natural surface runoff, infiltration and evapotranspiration. Progress in achieving this goal shall include biological monitoring. Cities and counties may choose watershed or basin planning processes to identify and rank existing stormwater problems, develop a plan and schedule to fix the problems, and set goals for limiting effective impervious surfaces and preserving open spaces and forests. Basin planning should use continuous runoff modeling to simulate existing and potential impacts of land use and water management on natural hydrology. Basin plans shall address water quality, aquatic habitat, groundwater recharge and water re-use. Basin plans may prescribe stronger stormwater management measures to protect sensitive resources in a certain basin or sub-basin. Stormwater management measures in all basins shall at least meet the minimum requirements of ecology's technical manual. Cities and counties shall incorporate recommendations from watershed or basin plans and specific requirements from Total Maximum Daily Load (TMDL) Water Cleanup Plan processes into their stormwater programs, land use comprehensive plans and site development ordinances.

k. **Funding** – Create local funding capacity, such as a utility, to ensure adequate, ongoing funding for program activities and to provide funding to contribute to regional stormwater projects.

l. **Monitoring** – Monitor program implementation and environmental conditions and trends over time (according to guidance developed under SW-2 and 3) to measure the effectiveness of program activities. Periodically share monitoring results with local and state agencies, citizens and others.

m. **Schedule for Implementation** – Develop an implementation schedule with specific target dates and funding sources to help plan program activities.

Stormwater Technical Manual (SW-2)

The Puget Sound Plan states that Ecology shall maintain a stormwater technical manual for new development and redevelopment with overall goals of protecting and restoring aquatic species and habitat, water quality and natural hydrology and processes, including achieving no net detrimental change in natural infiltration and surface runoff, particularly for new development sited outside of urban growth areas.

It is recommended that the City of Ilwaco adopt the latest version of the Department of Ecology's *Stormwater Management Manual for Western Washington* by adopting the

model stormwater ordinance located in Appendix B. The *Stormwater Management Manual for Western Washington* establishes the minimum requirements for stormwater control and site development requirements for all new development and redevelopment. This manual outlines water quantity design criteria, water quality controls, erosion and sediment control practices, and site development.

The intent and purpose of the manual is to provide for the following elements:

- Establish criteria for review and analysis of all development,
- Manage stormwater to minimize contact with contaminants,
- Mitigate the impacts of increased runoff due to urbanization,
- Manage runoff from developed property and that being developed, and
- Protect the health, safety, and welfare of the public.

STATE OF WASHINGTON SHORELINE MANAGEMENT ACT

On November 29, 2000, the Department of Ecology adopted new shoreline master program guidelines (Chapter 173-26 WAC), ending a five-year effort to review and update the state regulations. However, the Shoreline Hearing Board (SHB) has stated that the new shoreline guidelines are invalid and Ecology must revise them. At this time all parties have appealed the SHB decision.

A key feature of the final guidelines is a two-path approach that gives cities and counties a choice in how they write and implement their shoreline master programs. "Path A" allows local governments flexibility in meeting the Shoreline Management Act standards, while "Path B" contains specific measures for protecting shoreline functions designed to provide protection to local governments from penalties and citizen law suits under the ESA "take provisions".

The City of Ilwaco is currently completing an update of its Shoreline Master Program. All development within the designated shoreline areas must comply with the City's Shoreline Master Program.

CITY OF ILWACO STORMWATER MANAGEMENT PROGRAM

Local jurisdictions are typically responsible for implementing and enforcing regulations passed down from the State and Federal governments and for enacting additional policies, procedures and regulations based on local conditions and desires of the citizens. A proposed stormwater ordinance is provided in Appendix B. Adoption of this ordinance is a necessary step in creating a complete set of policies and regulations with respect to stormwater drainage in the City of Ilwaco.

The City currently follows the requirements of Chapter 15.78 of the Unified Development Ordinance (UDO) and the City of Ilwaco Conditions and Standards for Utility and Roadway Construction when designing or reviewing storm drainage projects. The UDO regulates the following aspects of storm drainage for new and redevelopment within the City:

- Maintenance of existing drainage patterns,
- Proper drainage of all developments,
- Prevention of discharge of storm water into the sanitary sewer,
- Stormwater management to prevent impact on adjacent and downstream properties and facilities,
- Erosion and sediment control,
- Stormwater system design criteria, and
- Prevention of illicit discharge in to the storm drain system.

The existing requirements in the UDO and the Conditions and Standards for Utility and Roadway Construction are not as stringent as the requirements set forth in the Stormwater Management Manual for Western Washington. It is recommended that the City of Ilwaco adopt Ecology's *Stormwater Management Manual for Western Washington* and ordinances for stormwater runoff management and operation and maintenance. In addition, the City may want to implement a stormwater utility to establish a reliable and dedicated source of funding for the program.

City of Ilwaco Comprehensive Land Use Plan

The City of Ilwaco adopted its Comprehensive Land Use Plan in 1994 and updated it in 1997. The Comprehensive Plan is a planning document with goals and objectives enforced by City codes. The Land Use Element contains goals and policies related to stormwater management as explained below.

Land Use

The Land Use element of the Comprehensive Land Use Plan does not directly impact stormwater policies of the City. However the way that land is developed, specifically density, open space requirements, and impervious surface coverage, have a direct impact on the water quantity and quality of runoff from a particular area. An effective way to control stormwater is to preserve the natural environment and the natural hydrologic functions of land as much as possible.

The Land Use Element contains a policy for preserving the natural environment. It states that the City will "Include greenbelts and open space areas within Urban Growth Areas." This element also contains a policy stating that the City will "...develop and adopt a

stormwater management program designed to minimize the risk of flooding and avoid degradation of Baker Bay, Black Lake, and other water bodies with polluted stormwater."

Development Regulations

The policies and goals contained in the Comprehensive Plan are intended to be implemented through the adoption of development regulations and performance standards enforced by the City. The following guidelines pertain specifically to the development of standards with respect to stormwater.

Design standards should include regulations on stormwater detention and conveyance systems, standard plan notes, and standard drawings/details which pertain to stormwater facilities. The City should require, through these standards, that all new development provide on-site retention/detention and water quality treatment (unless the proposed development is beneath the impervious threshold set by the Ecology manual). All projects which fall under the requirements of the manual should be required to be designed by a professional engineer or by someone who can prove that results will be met, and will be subject to approval by the City. Reference to the City's Critical Areas Ordinance, Shoreline Master Program, and SEPA would provide the City with the ability to impose more stringent runoff controls, if needed, in order to best serve the public's interest.

JURISDICTIONAL COORDINATION

The main purpose of stormwater management is to preserve or improve surface water quality, prevent or control flooding, and control the flow regime of the natural drainage systems. This purpose will be accomplished through the adoption and implementation of the capital improvements and maintenance and operations program contained in this document. In addition, the City's stormwater ordinance should be comprehensive in nature and consistent with the ordinances of surrounding jurisdictions.

The City of Ilwaco and the Port of Ilwaco have jointly prepared this planning document. The City owns and maintains the storm drainage facilities on City right-of-ways and the Port owns and maintains the storm drainage facilities on Port property. Much of the stormwater from the City drains through the Port property. This plan recommends that the City obtain easements from the Port for the storm drainage facilities on Port property so that the City can assist the Port in maintenance of the facilities. The Port is responsible for training, implementation and maintenance of pollution prevention measures for the businesses within the Port. The City is responsible for training, implementation and maintenance for pollution prevention measures regarding City facilities.

CHAPTER 3

SERVICE AREA CHARACTERISTICS

LOCATION

The City of Ilwaco is located in Pacific County in southwest Washington at the base of the Long Beach Peninsula. To the north of the City is the incorporated City of Long Beach. Ilwaco is bounded by the Pacific Ocean on the west, Pacific County on the east and north and Baker Bay on the south. State Route Highway 101 passes through the City.

SERVICE AREA AND URBAN GROWTH AREA

The service area for the City's Stormwater Comprehensive Plan will essentially consist of the City's corporate limits. However, the stormwater drainage basins reviewed and developed in this report extend slightly beyond the borders into the unincorporated areas of Pacific County.

Figure 3-1 shows the City of Ilwaco corporate limits as well as the City's urban growth boundary. The urban growth area (UGA) shown in the City of Ilwaco's 1997 *Comprehensive Plan* encompasses approximately 1,000 acres and consists of residential, commercial, industrial and resort zoning areas as shown in Figure 3-2. The UGA was established to contain the population growth within the City up to the year 2020.

LAND USE AND ZONING

Land use within the City of Ilwaco has generally developed in a non-aggressive manner. Throughout this development, drainage has been accomplished along the streets through a number of open ditches, culverts, small-sized pipes, and natural drainage ways.

The primary document for growth and land use decisions in Ilwaco is the July 1997 *City of Ilwaco Comprehensive Plan*. Among the land use goals presented in the 1997 Plan, are as follows:

- Encourage development in urban areas where adequate public facilities and services exist or can be provided in an efficient manner.
- Include greenbelts and open space areas within Urban Growth Areas

- Adopt a stormwater management program designed to minimize the risk of flooding and avoid degradation of Baker Bay, Black Lake and other water bodies with polluted stormwater.

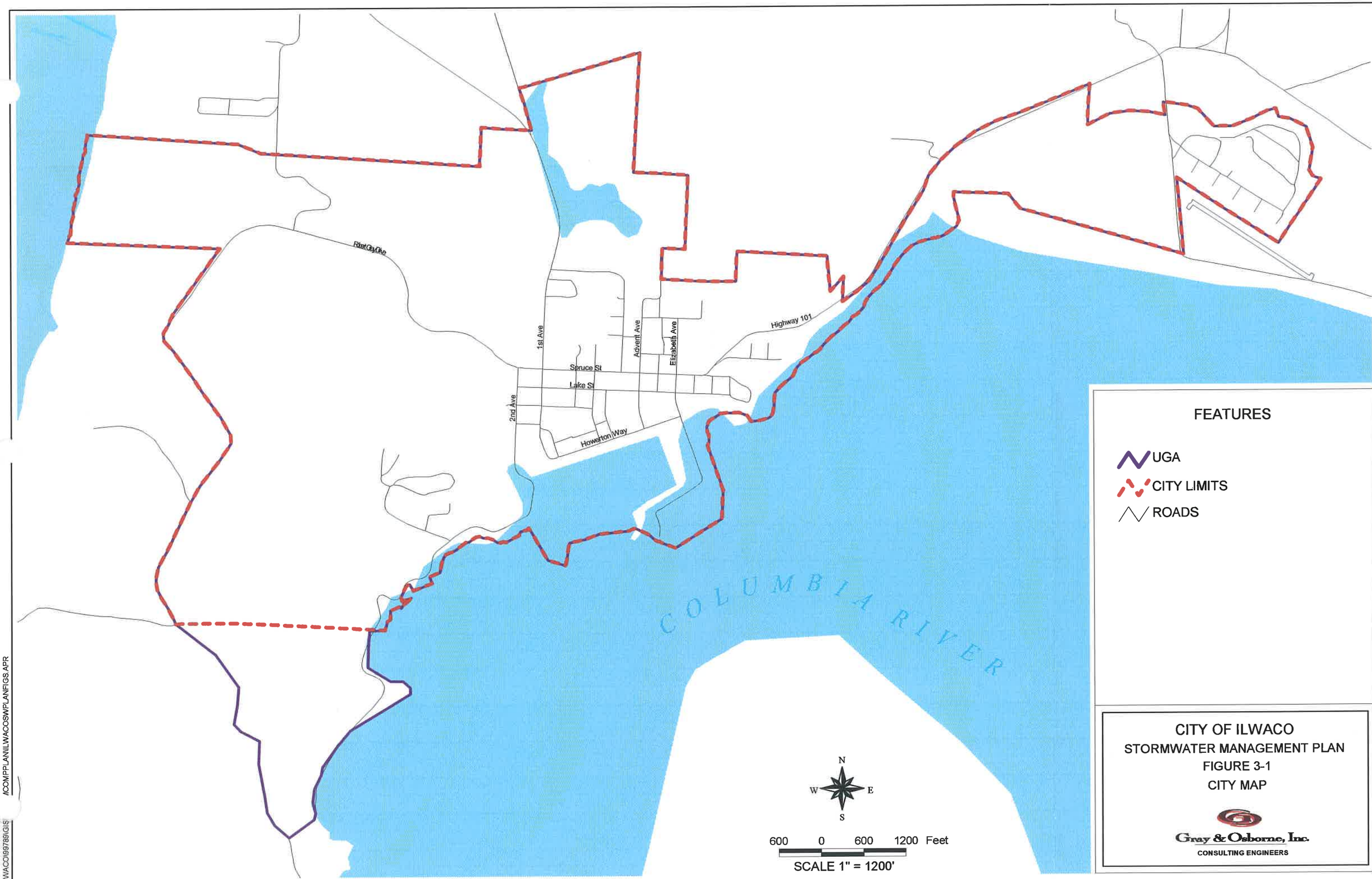
The 1997 Plan addresses the problems associated with residential and recreational subdivisions and the ability to maintain a rural lifestyle that is valued by Ilwaco residents. A rural lifestyle is characterized by a variety of low-density neighborhoods and developments, concentrations of residential buildings surrounded by open space, as in planned unit developments, and commercial development, which is generally, limited to growth areas and convenience centers. With this objective in mind, zoning for the City of Ilwaco was implemented through the City's Zoning Ordinance, which was originally adopted in 1972 and later revised on February 8, 1999. The zoning for the City of Ilwaco (see Figure 3-2) was separated into the classifications shown in Table 3-1:

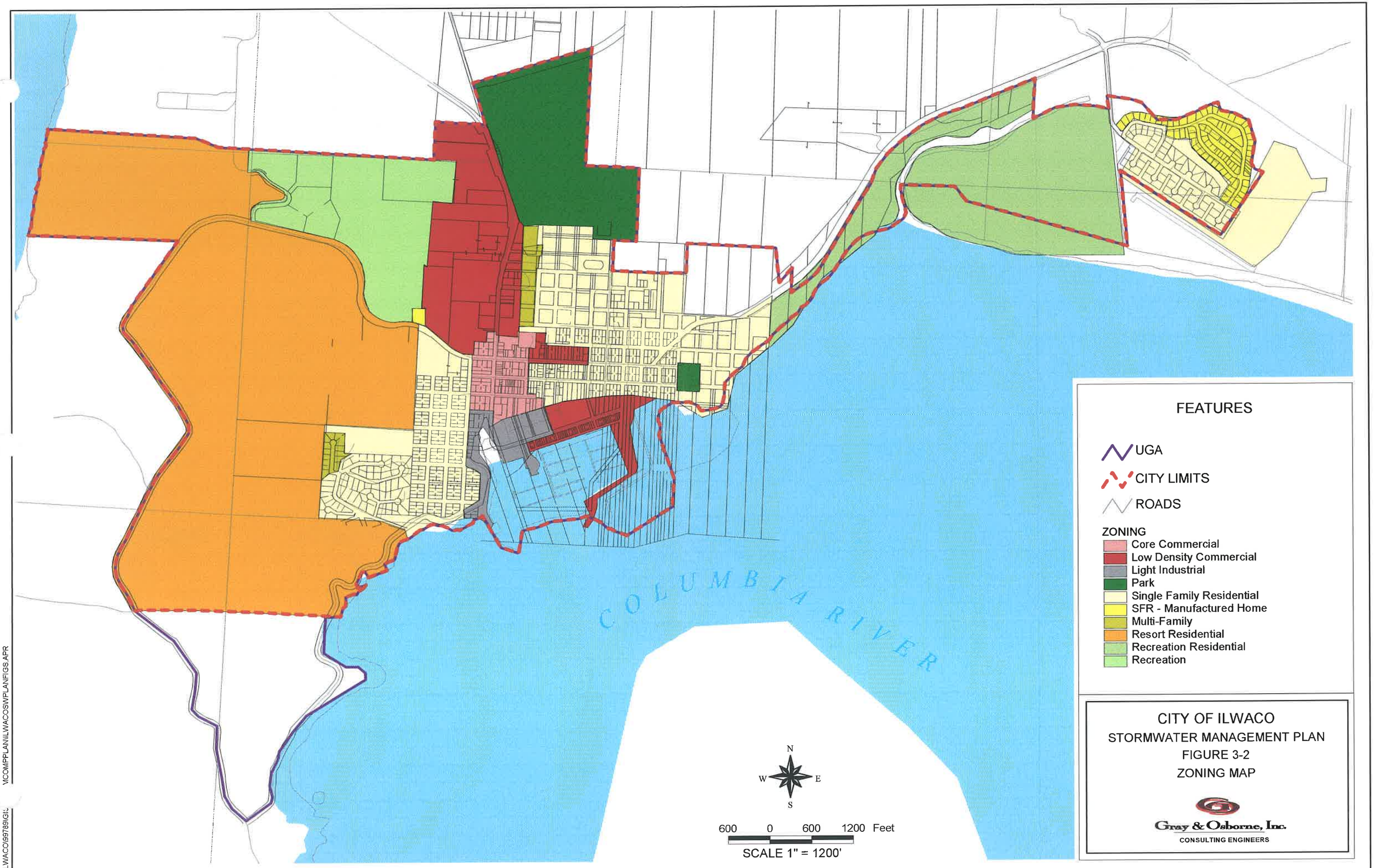
TABLE 3-1

City of Ilwaco Land Use Classifications

Land Use Category	Acres
Single Family Residential, R-1	291
Single Family Residential, Manufactured Home R-1S	25
Multi Family Residential, R-2	11
Resort Residential, R-3	406
Recreation Residential, R-4	158
Recreation, R-5	91
Core Commercial, C-1	23
Low-Density Commercial, C-2	120
Light Industrial, M-1	8
Park, P	92
TOTALS:	**1225**

The intent of the 1989 Plan was to focus growth where utilities already exist as opposed to extending utility service to currently undeveloped areas of the Peninsula. Innovative land development techniques such as planned unit developments, or clustering of units, will be encouraged where possible to more efficiently utilize land resources and public services. These techniques will also be used to preserve unique or sensitive areas as open space, for this is an important aspect to preserving water quality within the area. It should be noted that the City's 1997 Comprehensive Plan echoes these land use objectives and will enforce them in the years to come.


Ridgeway Dr
1st Ave
2nd Ave
Advent Ave
Elizabeth Ave
Spruce St
Lake St
Howerton Way
Highway 101
COLUMBIA RIVER
N
W
E
S
600 0 600 1200 Feet
SCALE 1" = 1200'
FEATURES
UGA
CITY LIMITS
ROADS
CITY OF ILWACO
STORMWATER MANAGEMENT PLAN
FIGURE 3-1
CITY MAP
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\ILWACO\99789\GIS\COMPPLAN\ILWACOSWPLANFIGS.APR



CITY OF ILWACO
STORMWATER MANAGEMENT PLAN
FIGURE 3-2
ZONING MAP

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\ILWACO\99789\GIS\COMPPLAN\ILWACOSWPLANFIGS.APR

EXISTING POPULATION

The Washington State Office of Financial Management (OFM) is the state agency that develops official state population figures. Table 3-2 lists the City of Ilwaco's population for the years 1990 through 1999 as listed from OFM's Forecasting Division and the population estimate for 2000 from the U.S. Census Bureau.

TABLE 3-2

City of Ilwaco Population 1990 through 2000

Year	City of Ilwaco
1990	838[1]
1991	856
1992	880
1993	890
1994	870
1995	875
1996	864
1997	874
1998	876
1999	860
2000	950[2]
2001	950[3]

(1) Special Count
(2) 2000 Federal Census Count
(3) OFM 2001 Estimate

FUTURE POPULATION

The planning period for this document has a ten-year planning horizon from 2000 through 2010. As determined from Table 3-3, the average annual growth rate from 1990-2000 was 1.3%. The July 1991 OFM Forecasting Report predicted a population increase of 2.88% from 2000 to 2005 and 2.96% for every five years thereafter. In Table 3-3, the City's future population was estimated using the OFM predicted growth rates in five-year increments to the year 2020.

TABLE 3-3

City of Ilwaco Projected Population to the Year 2020, OFM

Year	City of Ilwaco	Growth Rate
2000	950	--
2005	977	2.88%
2010	1006	2.96%
2015	1035	2.96%
2020	1065	2.96%

The City of Ilwaco's 1997 Comprehensive Plan forecasts population through 2015 with an annual growth rate of 2%. The numbers resulting from this prediction is listed below in Table 3-4.

TABLE 3-4

City of Ilwaco Projected Population to the Year 2015, Comp. Plan

	2000	2005	2010	2015
City Population	1,047	1,167	1,286	1,406

EQUIVALENT RESIDENTIAL UNITS

The use of Equivalent Residential Units (ERUs) is necessary for calculating rates and fees for the City's stormwater utility and for the financial analysis in Chapter 9 of this report. An ERU was determined by averaging the impervious surface measured among fifty single-family lots within the City. The resulting unit equates to 2,000 square feet per single-family lot. Therefore, one ERU is equivalent to 2,000 square feet of impervious surface. Commercial ERUs are determined by dividing the amount of impervious surface located on that particular lot by the 2,000 square feet per ERU number. It was calculated that there are a total of 1,343 ERUs currently within the city, with 335 ERUs attributed to single family homes and 1,008 ERUs attributed to commercial sites.

PHYSICAL DESCRIPTION

TOPOGRAPHY

The topography of the central portion of the City of Ilwaco is generally flat with a mean elevation of 11 feet above sea level. The outlying area of the City encompasses some

very hilly terrain with elevations ranging up to 125 feet in the eastern portion of the City and up to 300 feet in the western portion.

SOILS

To the southwest and west of the downtown core of Ilwaco, the soils are Palix silt loam and Ilwaco silt loam (See Figure 3-3). Both are well drained and are more prone to slipping than eroding. Palix soils are formed in colluvium derived from siltstone, on slopes of 8 to 30 percent, and Ilwaco soils are formed in colluvium derived from sandstone, and sit on slopes of 1 to 8 percent. A small pocket of Salzer soils exist near the City park area. Salzer soils form a silty clay that is very deep and very poorly drained. It is often found in old swales and riverbeds formed from fine textured alluvium. It has very slow permeability with very slow or ponded runoff associated with it.

The area northeast of Ilwaco contains Palix, Lebam and Ocosta soils. Lebam soils are deep, well-drained, derived from siltstone, and found on the uplands on slopes of 5 to 30 percent. Ocosta soils are deep and they drain poorly. They form when clayey alluvium is deposited in quiet waters, and therefore are found on flood plains and deltas protected from tidal overflow.

To the north of Ilwaco, the soils are Palix and Lebam. To the northeast of the City, tracing up the Columbia River coastline, there is Willapa, Palix, and Ocosta soils. Willapa soils are deep, well drained and found on wave-cut marine terraces. It is formed in medium to fine-textured marine sediment.

All the soils found in the Ilwaco area are usually covered with a mat of needles, leaves and twigs and have a high available water capacity. Although the soils have good drainage characteristics, there is a high water table in the areas along the River, which significantly reduces infiltration.

SURFACE WATER

The surface water resources of the Ilwaco area consist of the Columbia River, specifically Baker Bay, Black Lake, the Wallacut River and the Pacific Ocean. The western portion of the City borders the Pacific Ocean and Baker Bay lies to the south, at the mouth of the Columbia River. The main channel of the river is approximately three miles south of the City. Another water body within the vicinity is Black Lake, which is situated north of the downtown core and is approximately 32 acres. This lake is categorized as a bog lake, a body of water overlying a layer of peat, and it once served as Ilwaco's primary source of water. Holman Lake is found on the west side of downtown and collects drainage from the more steeper terrain found with the city limits. The Wallacut River is located in the vicinity of the airport and originates east of the City. This river is sometimes known to flood homes located directly on the river's edge in the Vandalia neighborhood.

GROUND WATER AND AQUIFER RECHARGE

There are three groundwater aquifers in the Peninsula area. These aquifers are located in the Terrace Deposits and the Upper and Lower Marine Sand Deposits.

The Terrace deposits have been identified in the Ilwaco-Seaview area. This aquifer is composed of alluvium materials ranging from silt to coarse sand with occasional gravel and could form suitable groundwater aquifers if found unweathered below the water table. The City of Ilwaco conducted a test well drilling program in 1984 to further evaluate the capacity of these deposits. A test well was installed about two miles north of Ilwaco, and one mile east of Seaview. The aquifer was found to underlie peat and weathered marine beach deposits at a depth of 53 feet. Weathering in the upper Terrace Deposits forms an aquitard between the overlying unweathered marine beach deposits and the less weathered, deeper portions of the Terrace Sediments.

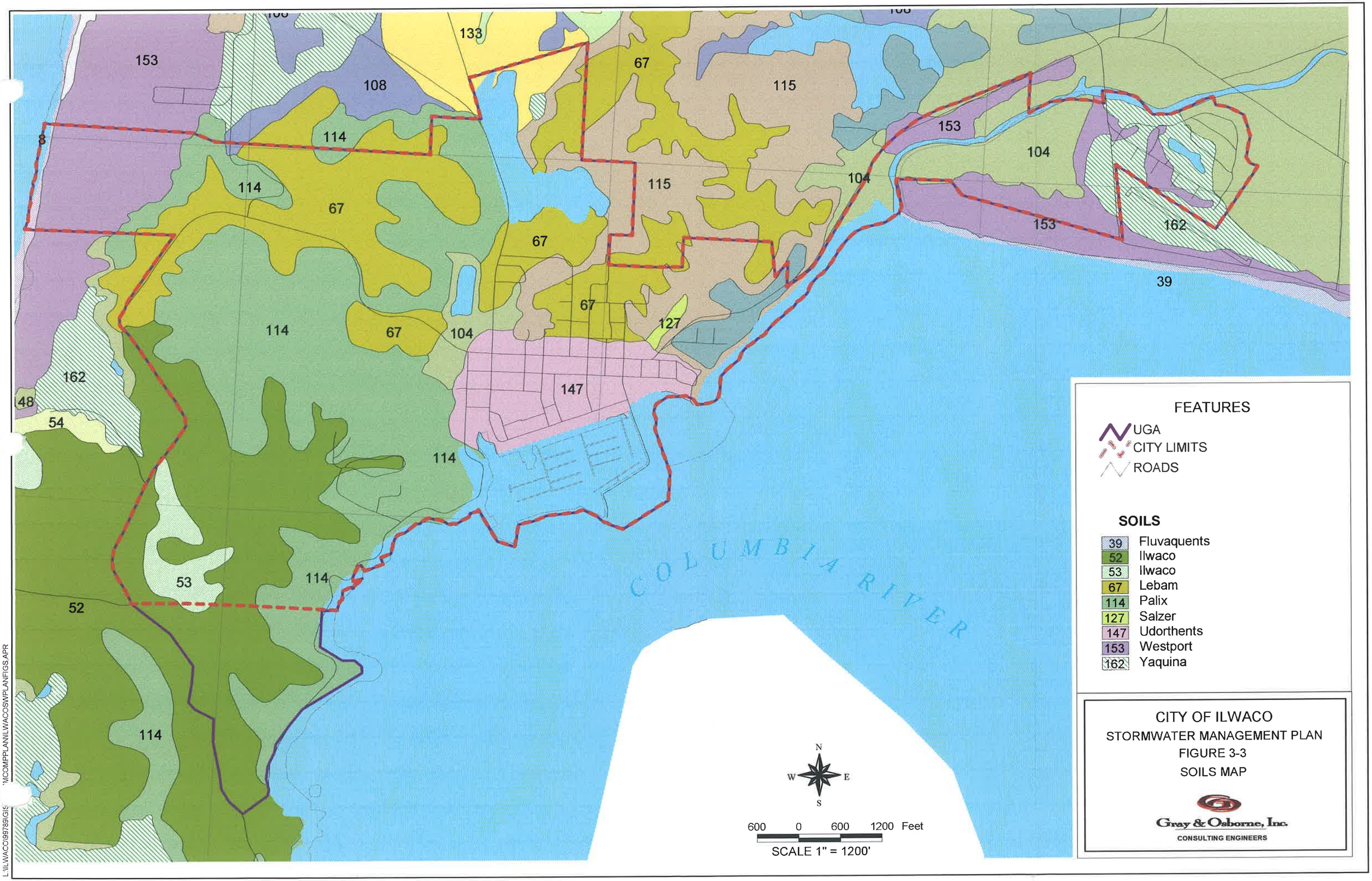
The upper marine sand aquifer overlies an intermediate silt and clay aquitard along the Peninsula. It provides water to numerous small, shallow wells throughout the area. This aquifer has a thickness of 80-90 feet at the south end of the Peninsula and thickens to about 120 feet near Ocean Park.

Throughout the Peninsula there is a sedimentary sequence of sand-clay-sand. These layers were deposited over basalt bedrock, which appears to overlie the older Terrace Deposits. These deposits increase in thickness from the hills east of Long Beach toward the ocean. These deposits also appear to thicken from basalt outcroppings near Ilwaco to Ocean Park where basalt bedrock lies at a depth of 730 feet.

Investigations of groundwater supplies in the Ilwaco/Seaview area established limited groundwater supplies from the three aquifers. Water quality in the upper marine sand aquifer is subject to contamination from domestic and agricultural surface activities. These activities include on-site sewage disposal practices in unsewered areas, application of fertilizer and agricultural chemicals, and other activities. Organic material discharged to the aquifer from these land activities and other natural sources are capable of trihalomethane (THM) formation when chlorinated. Test wells drilled into the lower marine deposit aquifer indicated a high yield potential but poor water quality due to stagnation and possible saltwater intrusion.

CLIMATE

The Ilwaco area has a mild, maritime climate, which is typical of Washington's Pacific coast. The area's climate is classified as the Marine West Coast type, which is characterized by cool, dry summer and moderate winters with considerable rainfall. Table 3-5 lists climatological data, such as temperature, precipitation, and snow fall for a



L:\ILWACO\99789\GIS\MXD\COMPPLAN\ILWACOSWPLANFIGS.APR

32-year average. Data from the Long Beach Experimental Station was utilized as the City of Ilwaco lies within the same climate zone as Long Beach.

TABLE 3-5

City of Ilwaco Climatological Data, 1967 – 1999 (Long Beach Experimental Station)

Month	Average Temperature (F°)	Average Precipitation (Inches)	Average Total Snow Fall (Inches)
January	42	11.48	0.6
February	44	9.45	0.4
March	46	8.86	0.1
April	48	6.17	0.0
May	52	3.90	0.0
June	56	2.91	0.0
July	56	1.63	0.0
August	59	1.79	0.0
September	57	3.78	0.0
October	51	7.28	0.0
November	46	11.43	0.0
December	42	12.82	0.5
Average	50		
Total (annual average)		81.51	1.6

The average annual rainfall within the region for a 32-year period is 81.51 inches, and the average annual snowfall for the same period is 1.6 inches. Data regarding the 2-year and 25-year storms with a 24-hour duration were obtained from isopluvial maps in Ecology's *Stormwater Management Manual for the Puget Sound Basin.* These values were used throughout the model described further in this plan. The 2-year and 25-year storms equated to 3 inches and 4.5 inches, respectively.

GEOLOGIC HAZARD AREAS

Geologically hazardous areas are areas that because of their susceptibility to erosion, sliding, earthquakes, or other geological events are not suited to siting commercial, residential, or industrial development consistent with public health or safety concerns. Typically, landslide hazards in Pacific County are associated with acts of road construction. Landslides are frequent during times of heavy inundation when steep slopes are undercut for roadways. Landslides have been documented along the Fort Canby Road. The hilly portions of the City of Ilwaco contain steep slopes, which are prone to erosion and landslides.

FLOOD HAZARD AREAS

The 100-year flood plain is shown in Figure 3-4. These boundaries are in accordance with the Federal Emergency Management Agency (FEMA). The boundaries of the 100-year flood plain exist at an elevation of approximately 13 feet (NAVD 1988 datum). Areas within the 100-year flood plain include the entire Port region, much of the southern portion of the City, as well as areas directly adjacent to Baker Bay. Although FEMA highly recommends against the placement of any structure in the 100-year flood plain, any structure built within the flood plain's boundaries must provide for adequate protection against the 100-year flood (i.e. structures within the floodplain are constructed at a minimum of one foot above the flood plain elevation).

WETLANDS

Wetlands are defined as those areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

The National Wetlands Inventory documents numerous wetlands areas in and around the Ilwaco area. Figure 3-5 illustrates the wetlands identified by the National Wetlands Inventory. Baker Bay is characterized by large tracts of tidal-salt marsh wetlands. The area directly north of Ilwaco is predominantly cranberry wetlands. Areas of forested and scrub-shrub wetlands are found both east and west of Ilwaco.

Pacific County has adopted a rating system, which attempts to rate each wetland type by specific function. Specific functions may include wildlife habitat, hydrologic features, commercial value and aesthetic qualities. Local wetland functions are associated with their relative value to both human and natural land-use activities. Wetland value reflects the worth, utility, or importance of the wetland to provide a public or private service. The suitability rating determines the value of each wetland type to support a particular function. Wetlands are prioritized from rating #1 to rating #4, with rating #1 wetlands considered the most suited for a particular function.

Rating #1 - Extremely suited to the specific function or wetland characteristic. Contains high quality, native plant and animal communities, which are generally only found in these wetland areas. Considered to be of exceptional local significance and may contain kelp, eelgrass beds, shellfish beds, sole source aquifer recharge areas. Possesses the most significant and locally outstanding function for this type of wetland. Existing environmental conditions may be considered rare.

COLUMBIA RIVER

FEATURES

UGA

CITY LIMITS

ROADS

FEMA FLOOD ZONE

An area inundated by 100-year flooding, for which no BFEs have been determined.

An area of undetermined but possible flood hazards.

An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from the 100-year flooding.

An area that is determined to be outside the 100- and 500- year floodplains.

N

W E

S

600 0 600 1200 Feet

SCALE 1" = 1200'

CITY OF ILWACO
STORMWATER MANAGEMENT PLAN
FIGURE 3-4
FLOODPLAIN MAP

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\ILWACO\99789\GIS\MCOMPPLAN\ILWACOSWPLANFIGS.APR

FEATURES

UGA

CITY LIMITS

ROADS

WETLANDS

E2EMN	Estuarine, Intertidal, Emergent, Regularly flooded
E2USM	Estuarine, Intertidal, Unconsolidated shore, Irregularly exposed
E2USN	Estuarine, Intertidal, Unconsolidated shore, Regularly flooded
L1UBH	Lacustrine, Limnetic, Unconsolidated bottom, Permanently flooded
L2ABH	Lacustrine, Littoral, Aquatic bed, Permanently flooded
PABHX	Palustrine, Aquatic bed, Permanently flooded, Excavated
PEM/SSF	Palustrine, Emergent, Scrub-Shrub, Semipermanently flooded
PEMA	Palustrine, Emergent, Temporarily flooded
PEMC	Palustrine, Emergent, Seasonally flooded
PEMR	Palustrine, Emergent, Seasonal-tidal
PFOA	Palustrine, Forested, Temporarily flooded
PFOC	Palustrine, Forested, Temporarily flooded
PSSC	Palustrine, Scrub-Shrub, Seasonally flooded
PSSR	Palustrine, Scrub-Shrub, Seasonal-tidal
R1UBV	Riverine, Limnetic, Unconsolidated bottom, Permanent-Tidal
U	Uplands

N

W E

S

600 0 600 1200 Feet

SCALE 1" = 1200'

SOURCE: National Wetlands Inventory, US FISH & WILDLIFE

CITY OF ILWACO
STORMWATER MANAGEMENT PLAN
FIGURE 3-5
WETLANDS

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\ILWACO\99789\GIS\COMPPLAN\ILWACOSWPLANFIGS.APR

Rating #2 - Well-suited for most wetland functions. Contains an important number of wetland characteristics and functions based on diversity and size. Contains fewer functions than in Rating #1.

Rating #3 - Contains a limited number of functions. Wetland functions may occur on a temporary or seasonal nature. Plant types are considered common with fair to marginal habitat value. These wetlands may have been altered or been previously disturbed. Functions can be reproduced by other means.

Rating #4 - Wetlands with little value or function. Plant species are common with minimal wildlife habitat. Not within jurisdiction of the Shoreline Management Act or other federal agencies. May not be of use to passive or active land-use and environmental activities. Includes wetlands that are considered isolated and are less than one acre in size.

Pacific County has developed a wetlands mitigation policy to offset losses of wetland areas. Wetland mitigation should consider the function and value of the wetland in addition to overall area of disturbance. Specific acre-for-acre mitigation measures were not developed by the County. Rather, innovative mitigation techniques should be used to provide both public and private benefit. Mitigation techniques may include providing shoreline access through easements or establishing educational trust accounts for school field trips to educate children about the value and function of local wetlands.

UTILITY SERVICES

The Pacific County Public Utility District No. 2 (PUD) is the electrical power provider that serves the City of Ilwaco. PUD's goals and future objectives include providing sufficient electrical capacity to meet existing demand for both the incorporated city limits as well as the urban growth area.

PTI Communications provides telecommunication services to the City of Ilwaco. Cable services are provided by Falcon Cable Company. According to the City's 1997 Comprehensive Plan, the existing channel capacity is 22 channels.

Water, sanitary sewer and storm drain systems are provided by the City of Ilwaco.

CHAPTER 4

EXISTING STORMWATER DRAINAGE SYSTEM

INTRODUCTION

The analysis of stormwater runoff system performance requires knowledge of the components that make up the stormwater system. Ilwaco's storm drainage collection and conveyance system, which ultimately conveys stormwater to the Columbia River, consists of typical components such as catch basins, piping, open ditches, natural streams and wetlands. This chapter presents a physical description of the current stormwater systems within the City.

EXISTING STORMWATER DRAINAGE INVENTORY

The evaluation of the City's drainage facilities begins with the establishment of an inventory of the existing system's components. Information included in the inventory for selected areas is pipe diameter, length and slope invert, elevations of catch basins and configuration of open channels.

An inventory of the existing stormwater drainage system was compiled from field inspection data, surveying from previous jobs and existing as-built maps. A summary of the results is shown in Table 4-1.

TABLE 4-1

Stormwater System Inventory

Structure	Quantity (Linear Feet)
Catch Basins (Each)	170
Open Ditch/Channel	3,716
4-inch Pipe	152
6-inch Pipe	1,762
8-inch Pipe	1,828
10-inch Pipe	80
12-inch Pipe	2,690
15-inch Pipe	3,100
18-inch Pipe	2,575

TABLE 4-1 - (Continued)

Stormwater System Inventory

Structure	Quantity (Linear Feet)
21-inch Pipe	510
36-inch Pipe	918
48-inch Pipe	113

Information from the system inventory was used to model the flow of stormwater through the drainage system. From the information generated by the hydraulic model, conveyance systems can be planned to accommodate storm runoff for any specific design storm. The model can also identify current system deficiencies from which a capital improvement plan can be developed. The improvements may be installed as part of the City Capital Improvement Program or as part of developer improvements. The model results indicate the proper size of the storm pipe to be installed to allow for conveyance of stormwater runoff. For example, the model may indicate that a system component such as a pipe may be satisfactory for the conveyance of runoff from a 2-year storm event, but may not be able to convey runoff from a 10-year storm event. At such time that the City has funding available, or as part of mitigation for a new development, a design can then be completed based upon the model results and the improvement constructed.

A base map provides a tool for City staff to use in planning for future extensions and for tracking facilities maintenance and repair and replacement (Figures 4-1 through 4-4 and inside back cover). The City may wish to expand upon the inventory developed for this project and maintain a detailed set of surface water drainage maps for use by staff as a basic component of the public works department inventory.

BASIN DESCRIPTIONS

Most of the City of Ilwaco is relatively flat with minimal grades available to convey surface water. Infiltration in the area is limited due to the high groundwater table and the poorly drained soils which dominate the region. Though no catastrophic floods have occurred in recent history, the City generally experiences nuisance ponding and flooding during wet weather months. For the purpose of isolating and identifying potential deficiencies within the conveyance system, the City of Ilwaco was divided into 24 separate drainage basins as shown in Figure 4-5 and as described in Table 4-2.

TABLE 4-2

Drainage Basin Descriptions

Basin	Location
Basin O1	Drains to ocean (West side of Robert Gray Drive)
Basin O2	Drains to ocean (Located mostly on east side of Robert Gray Drive)
Basin FL1	Ford's Dry Lake (Northern basin)
Basin FL2	Ford's Dry Lake (Southern basin)
Basin CO1	Cove
Basin CO2	Cove
Basin CO3	Cove
Basin CO4	Cove
Basin C1	City (1st Avenue)
Basin C2	City (W. of 1st Ave., Drains to Eagle Creek)
Basin C3	City (West of Brumbach)
Basin C4	City (East of Brumbach)
Basin C5	City (Area surrounding City Park)
Basin P1	Port of Ilwaco (West Howerton)
Basin P2	Port of Ilwaco (Advent)
Basin P3	Port of Ilwaco (East Howerton)
Basin BL1	Black Lake (West)
Basin BL2	Black Lake (North)
Basin BL3	Black Lake (East)
Basin BL4	Black Lake (South)
Basin BB1	Baker Bay (East of City Park)
Basin BB2	Baker Bay (Hwy 101, West basin)
Basin BB3	Baker Bay (Hwy 101, Mid
Basin BB4	Baker Bay (Hwy 101, East basin)
Basin V1	Vandalia Neighborhood

DRAINAGE BASIN O1 - DRAINS TO OCEAN (WEST SIDE OF ROBERT GRAY DRIVE)

Basin O1 includes areas draining west into the Pacific Ocean. The terrain is somewhat steep with slopes ranging up to 16%. The land use designation for the basin is resort residential. Soil in the area is dominated by Ilwaco soils, which are a moderately well drained soil. The entire drainage area for Basin O1 is approximately 126 acres.

DRAINAGE BASIN O2 - (LOCATED MOSTLY ON EAST SIDE OF ROBERT GRAY DRIVE)

Basin O2 also drains toward the Pacific Ocean and currently consists of second growth and recently logged forested areas. The land use designation within the basin is resort residential. Like Basin O2, the area consists of mostly Ilwaco soils. The entire drainage area for Basin O2 is approximately 56 acres.

DRAINAGE BASIN FL1 – FORD'S DRY LAKE (NORTHERN BASIN)

Basin FL1 consists of drainage to "Ford's Dry Lake", a depression located west of the central part of the City. This depression ultimately allows water to drain through the soils which consist of mainly Palix and Lebam soils. Palix and Lebam soils are silt loams that have moderate permeability and high water capacity. The land use designation for this area is resort residential and the entire drainage area for Basin FL1 is approximately 161 acres.

DRAINAGE BASIN FL2 - FORD'S DRY LAKE (SOUTHERN BASIN)

Basin FL2 consists of the drainage area coming from the south and entering into Ford's Dry Lake. This is currently, a second growth and recently logged forested area with a future land use designation of resort residential. The soils in the basin include mostly Palix and Lebam but a small percentage of the basin consists of Ocosta soil which is a silty clay loam that has a very slow permeability. The entire drainage area for Basin FL2 is approximately 96 acres.

DRAINAGE BASIN CO1 – COVE

Basin CO1 is located on the City's southern limits. This basin discharges to the east into the Columbia River by way of a number of culverts located under Robert Gray Drive. As with the previous basins, the land use designation for this area is resort residential. The soil classification in this basin is predominantly Palix and Lebam, which are moderately drained silt loams. The entire drainage area for Basin CO1 is approximately 47 acres.

DRAINAGE BASIN CO2 - COVE

Basin CO2 is a small drainage basin located just north of Basin CO1. It is currently forested and drains east into the Columbia River. Resort residential is the land use designated for this basin. Soils in the basin include Palix which is moderately well drained. The entire drainage area for Basin CO2 is approximately 6 acres.

DRAINAGE BASIN CO3 – COVE

Basin CO3 consists of the area north of Basin CO2. Land use designations within this basin include single family residential and light industrial. The basin soil in this region is the Palix silt loam. The area for Basin CO3 is approximately 54 acres.

DRAINAGE BASIN CO4 – COVE

Basin CO4 consists of the region south of Eagle Street which drains directly into the Columbia River. Land use designations include mostly single family residential and light industrial. A small portion of resort residential and commercial areas are included as well. Soil in the area is predominately Palix but the area also includes Udorthents. The soil characteristics for Udorthents range from well to excessively drained soils. The drainage area for Basin CO4 is approximately 45 acres.

DRAINAGE BASIN C1 – CITY (1ST AVENUE)

Basin C1 consists of the area along 1st Avenue, south of Willow Street. Drainage from this area is collected through catch basins located on 1st Avenue and then conveyed down an 18-inch pipe where it then crosses the boat yard and enters into the Columbia River. Like most portions of the central City area, this basin is predominantly flat. The soils within this basin are classified as Udorthents, which is a well to excessively drained soil. However, the combination of a high groundwater table and a predominant impervious surface prevents the efficient infiltration of stormwater in this area. The land use designation for this area is core commercial. The drainage area for Basin C1 is approximately 10 acres.

DRAINAGE BASIN C2 – CITY (W. OF 1ST AVE., DRAINS TO EAGLE CREEK)

Basin C2 consists of the area located mostly west of 1st Avenue and includes a variety of terrain, from fairly steep slopes to flat areas. A number of sub-basins located adjacent to 1st Avenue drain into an 18-inch pipe located in the street. This pipe conveys stormwater south to a point across from ~~Willow~~ Hemlock Street where it then joins a 36-inch pipe. This 36-inch pipe conveys water draining from a local wetland situated west of Brumbach Avenue. From 1st Avenue, this 36-inch pipe carries flow towards the west to a channelized stream that is later joined by a tributary that conveys stormwater from the hillside found on the west side of Basin C2. At this point, the stream is called Eagle Creek. The creek flows behind a number of homes located on 2nd Avenue until Eagle Street where it is then conveyed east under 2nd Avenue through a 36" pipe. It then daylights briefly on the north side of Eagle until it reaches another 36" pipe that conveys it south toward the Columbia River. The piping system eventually changes into a 48" pipe that then discharges the creek into the river. Land use designations within this basin

include recreation, low-density commercial, core commercial, multi-family residential and single-family residential. The basin contains a number of soils including Palix, Lebam, Ocosta, Seastrand, Orcas, Udorthents, and Yaquina. Palix and Lebam are moderately drained silt loams whereas Ocosta is a silty clay loam that is poorly drained. Seastrand and Orcas are poorly drained soils. Yaquina is a somewhat poorly drained soil whereas Udorthents is a well to excessively well drained soil. The drainage area for this basin is approximately 131 acres.

DRAINAGE BASIN C3 – CITY (WEST OF BRUMBACH)

Basin C3 consists of the area between 1st Avenue and Brumbach Avenue. The drainage system consists of a mixture of pipes and ditches. The system is primarily piped with pipes ranging from 6" to 15". At the southerly extension of Myrtle Avenue, a drainage ditch running east-west joins into the 15" line that runs south through the Port of Ilwaco and eventually discharges into the Ilwaco Marina. A tide gate is located at the discharge end of this 15" pipe. Land use designation in this area includes both core and low-density commercial as well as single family housing. As with C1, the soils within this basin are classified as Udorthents, which is a well to excessively drained soil. However, the combination of a high groundwater table and a predominance of impervious surface prevents the efficient infiltration of stormwater in this area. The area of drainage Basin C3 is approximately 30 acres.

DRAINAGE BASIN C4 - CITY (EAST OF BRUMBACH AVENUE)

Like Basin C3, Basin C4 consists of a series of pipes and drainage ditches in the area east of Brumbach Avenue and west of Eliza Avenue. Drainage within this area is piped along Advent Avenue which then enters a ditch that runs along the south side of Willow Street. This ditch then enters a 21" pipe located under Elizabeth Avenue. By Lake Street, this pipe joins with an 8" pipe that collects runoff to the west of Elizabeth. Together, this flow is conveyed through an 18" pipe that discharges to the east end of the Ilwaco Marina. It should be noted that prior to discharge, this pipe is joined by another 18" pipe that collects the runoff along Eliza Avenue. Soil in the basin is classified as Udorthents which, as stated before, is a well to excessively well-drained soil but due to the high groundwater table, little infiltration occurs within this area. The land use designation for this basin is single family residential. The total drainage area for Basin C4 is approximately 31 acres.

DRAINAGE BASIN C5 - CITY (AREA SURROUNDING CITY PARK)

Basin C5 consists of the City Park and the area north of Highway 101. This basin is comprised of mostly single family residences and forested areas. Drainage from the hills to the north are collected along ditches and then conveyed to an 18" pipe under Highway 101. This flow is then directed along Maryann Avenue. The 18" pipe continues south

toward the Columbia River. However, at the intersection of Maryann and Lake Street, another 18" pipe can convey flow to the east and out towards Yellow Bluff. This was the original direction for the flow in Basin C5. The 18" pipe continuing south to the River was put in to relieve the pressure occurring in the pipes towards the east. The inverts of these two pipes are approximately the same so flow can go both directions. The soils within Basin C5 include Palix, Willapa and Salzer. Palix and Willapa soils are a silt loam that are moderately well drained. Salzer soils on the other hand, is a silty clay that is very poorly drained. Land use within this basin is mostly single family residential. The total area for this basin is approximately 66 acres.

DRAINAGE BASIN P1 – PORT OF ILWACO (WEST HOWERTON)

Basin P1 is located on the west side of Howerton Street. The exact location of the drainage system for this basin is unknown but it has been confirmed that an 8-inch pipe originates on the north side of Howerton and eventually discharges into the marina. This basin is currently comprised of commercial businesses and remains zoned for low-density commercial in the future. The soil within Basin P1 is Udorthents. The total area for this basin is approximately 7 acres.

DRAINAGE BASIN P2 – PORT OF ILWACO (ADVENT)

Between Pearl Avenue and the extension of Quaker Avenue is Basin P2. The drainage system for this particular area is comprised of a series of ditches and pipes. A ditch that is approximately 3 feet deep by 5 feet wide runs along the south side of the houses located west of Advent. A smaller ditch conveys stormwater from the east side of Advent Avenue. Joined together, this water enters an 8-inch pipe that directs flow toward the marina where it is then discharged through a 12-inch pipe. A majority of this land is currently open field but it is designated as low-density commercial in the future. The soil within Basin P2 is Udorthents and the total area for this basin is approximately 11 acres.

DRAINAGE BASIN P3 – PORT OF ILWACO (EAST HOWERTON)

Basin P3 is located on the east end of Howerton Street. Like P2, this basin utilizes both ditches and pipes to convey the water southward into the marina. An east-west ditch runs along the south side of the homes located on Lake Street. From this ditch, water enters into an 8" pipe that eventually makes its way to the marina. During survey and field visits, the discharge location of the drainage system was obstructed due to the heavy amount of debris located along the marina's edge. It is presumed that at least an 8" pipe originates on the north side of Howerton and according to Port officials, eventually discharges through a 12-inch pipe into the marina. This basin is currently comprised mostly of open land and commercial businesses. The future land use designation for this area is low-density commercial. The soil within Basin P1 is Udorthents. The total area for this basin is approximately 5 acres.

DRAINAGE BASIN BL1 - BLACK LAKE (WEST)

Basin BL1 consists of the area directly to the west of Black Lake. It consists of mostly forested areas and has a land use designation of low-density commercial. Drainage within this 26 acre area is directed toward Black Lake. The dominant soil classification in this area is Palix, a moderately well drained soil.

DRAINAGE BASIN BL2 – BLACK LAKE (NORTH)

Basin BL2 includes the northern limits of the City of Ilwaco and drains into Black Lake. The soil classification in this area is mostly Palix and Lebam, which are moderately-well drained soils. For the portion of the basin that is within the city limits, the land use designation is park land. The total area of Basin BL2 is approximately 42 acres.

DRAINAGE BASIN BL3 – BLACK LAKE (EAST)

Basin BL3 consists of the area that drains runoff to the east side of Black Lake. Soils in this basin are classified as Palix and Lebam. The basin is comprised of a total area of approximately 45 forested acres. Future land designations have this area as either park or forest land.

DRAINAGE BASIN BL4 – BLACK LAKE (SOUTH)

Basin BL4 drains the area located to the south of Black Lake which primarily consists of the high school and its associated grounds. The portion of the basin within the city limits is designated as single family residential whereas the portion outside of the limits is designated as forest land. Soils in this basin are classified as Palix and Lebam, moderately well drained soils. The total area for this basin is approximately 51 acres.

DRAINAGE BASIN BB1 – BAKER BAY (EAST OF CITY PARK)

Basin BB1 consists of the area east of the City Park. No structural drainage system is known to exist in this area. Runoff flows directly into Baker Bay. The dominant soil classification in this area is Willapa followed by Palix soils, both of which are moderately well drained soils. However, due to the high groundwater table, water does not readily infiltrate into the ground. The total area for this basin is approximately 12 acres.

DRAINAGE BASIN BB2 – BAKER BAY (HWY 101, WEST BASIN)

Basin BB2 consists of mostly forested area. Similar to Basin BB1, no structural drainage system is known to exist in this area, thereby allowing runoff to flow directly into Baker Bay. The dominant soil classification in this area is Palix soils. However, Willapa and

Fluvaquents are present as well. Willapa is a moderately drained soil whereas Fluvaquents located in tidal regions are very poorly drained. These Fluvaquent soils coupled with a high groundwater table south of the Highway makes infiltration in this area nearly impossible. The land use designation for this area is recreation residential and forestland. The total area for this basin is approximately 25 acres.

DRAINAGE BASIN BB3 – BAKER BAY (HWY 101, MID-BASIN)

Basin BB3 also consists of mostly forested area. Similar to the other Baker Bay basins, no structural drainage system is known to exist in the BB3 basin area. Therefore, stormwater either infiltrates into the hillside or flows directly into Baker Bay. The dominant soil classification in this area is Palix soils. However, Willapa and Fluvaquents are present as well. Willapa is a moderately drained soil whereas Fluvaquents located in tidal regions are very poorly drained. Again, as with Basin BB2, these poorly drained soils coupled with a high ground water table creates an area not conducive to infiltration. The land use designation for this area is recreation residential and forestland. The total area for this basin is approximately 42 acres.

DRAINAGE BASIN BB4 – BAKER BAY (HWY 101, EAST BASIN)

Similar to Basin BB3, Basin BB4 also consists of mostly forested land. Again, no structural drainage system is known to exist in this basin area. Stormwater either infiltrates into the hillside or flows directly into Baker Bay. The dominant soil classification in this area is Palix soils. However, Westport and Fluvaquents are present as well. Westport soils are excessively drained whereas Fluvaquents located in tidal regions are very poorly drained. The land use designation for this area is recreation residential and forestland. The total area for this basin is approximately 82 acres.

DRAINAGE BASIN V1 – VANDALIA NEIGHBORHOOD

Basin V1 consists of mostly manufactured homes. The dominant soil classification in this area is Yaquina soils however, Westport soils are present as well. Westport soils are excessively drained whereas Yaquina soils are somewhat poorly drained. The land use designation for this area is single family residential and single family residential-manufactured homes. The total area for this basin is approximately 64 acres.

KNOWN DRAINAGE PROBLEMS

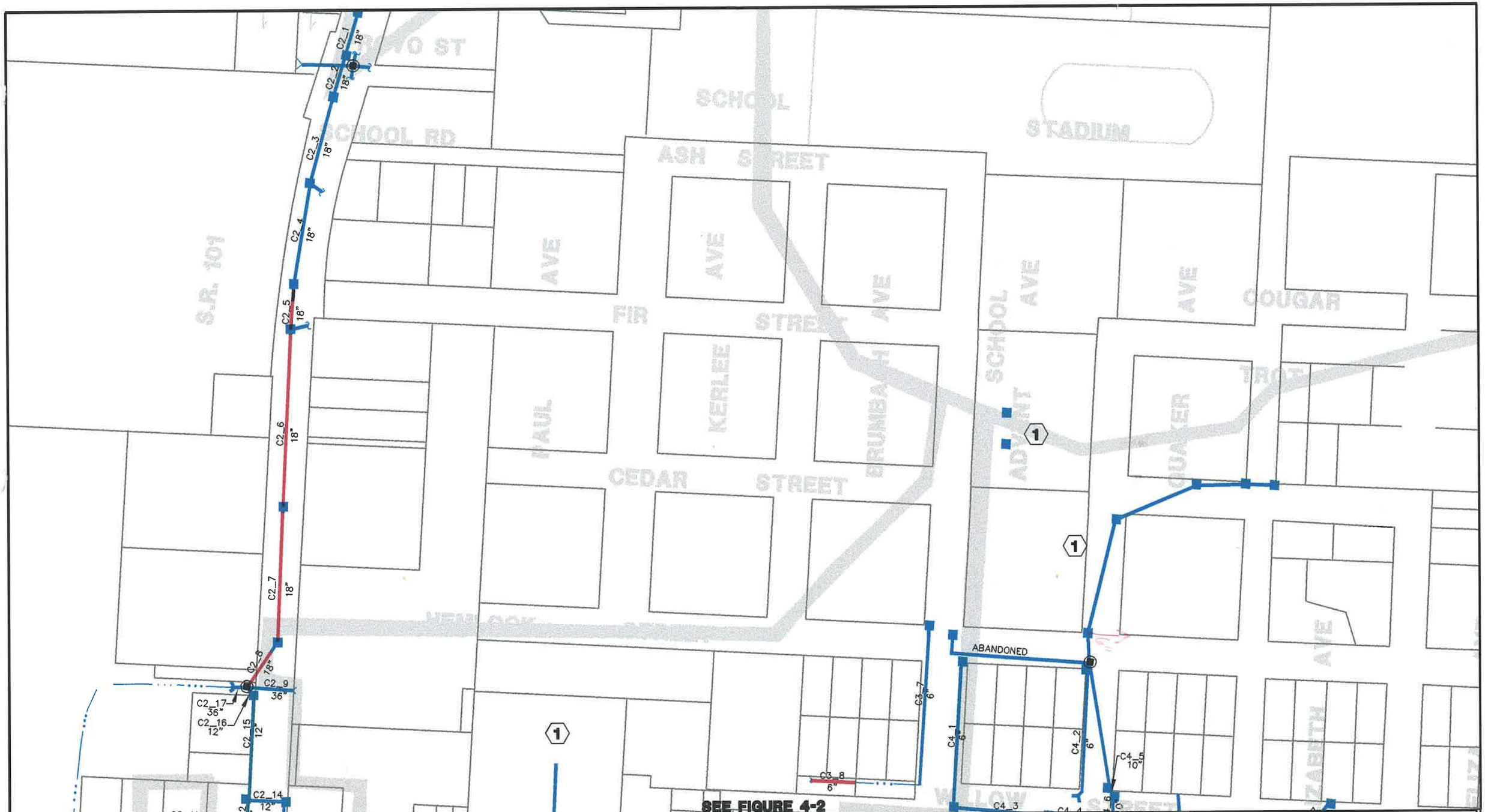
It was determined during a site visit on October 31, 2000, and through discussion with Public Works personnel, that a number of projects should be undertaken which would substantially reduce the locations and frequencies of nuisance ponding within the city. It should be noted that tidal effects have a great influence on the release of stormwater within the City of Ilwaco. Public works personnel stated that small flooding problems

are resolved within eight hours due to the change in tides. Table 4-2 lists some of the problems associated with these tidal effects as well as problems that are caused by other factors. Possible solutions for these problems may be found in chapter 8.

TABLE 4-3

Existing Stormwater Problems

Basin	Location	Stormwater Problem
Basin C2	West of 2nd Avenue	Houses experience flooding of Eagle Creek approximately once a year
Basin P1	East of Eagle St. / 1st Ave.	General flooding within this vicinity
Basin C3	South end of Myrtle Ave.	Flooding in area of ditches
Basin C4	Bioswale along Willow St.	Constant flooding problem – Maintenance crew has dug this ditch deeper over the years in order to detain water within the ditch instead of the roadway/neighboring yards.
Basin C5	Maryann Ave./ Hwy 101	Flooding at northwest corner of this intersection. Ditch collecting runoff from hillside overflows. Possibly undersized pipe crossing Hwy 101 (18" exists there now).
Basin C5	Yellow Bluff Outlet	Heavy debris is cleaned in front of this outlet pipe every one to two days throughout the year.
Basin V1	Vandalia neighborhood	Wallacut River causes flooding for homes along this river. Ditches are not maintained due to utilities running down the middle of them.



SCALE
1" = 200'

AREA OF DETAIL

STORM LINE
DITCH LINE
BASIN BOUNDARY LINE
PARCEL LINE
RECOMMENDED PIPE REPLACEMENT

NOTES:
(1) PIPE SIZE AND/OR LOCATION COULD NOT BE CONFIRMED IN FIELD VISITS. (OCTOBER 2000)

CITY OF ILWACO

FIGURE 4-1
STORM WATER CONVEYANCE SYSTEM

SEE FIGURE 4-1

SEE FIGURE 4-4

SEE FIGURE 4-3

C2_9 36"
C2_17 36"
C2_16 12"
C2_15 12"
C2_14 12"
C2_11 4"
C2_12 12"
C2_13 12"
C2_10 4"
C2_18 36"
C2_19 36"
C2_22 36"
C2_21 36"
C2_20 12"
C1_1 15"
C1_2 15"
C1_3 15"
C2_23 36"
C2_24 36"
C3_1 10"
C3_2 12"
C3_3 12"
C3_4 12"
C3_5 12"
C3_6 15"
C3_7 6"
C3_8 6"
C3_9 6"
C3_10 6"
C3_11 4"
C3_12 4"
C3_13 8"
C3_14 8"
C3_15 8"
C3_16 8"
C3_17 8"
C3_18 8"
C3_19 15"
C3_20 15"
C3_21 15"
C2_22 12"
C4_1 6"
C4_2 6"
C4_5 10"
C4_3 12"
C4_4 6"
C4_6 10"
C4_8 6"
C4_7
C4_9 21"
C4_10 8"
P2_1 8"
P2_3 12"
P2_2 12"
ABANDONED
1

SPRUCE ST
MAIN ST
MYRTLE AVE
WILLIAMS AVE
PEARL AVE
ADVENT AVE
WILLOW STREET

SCALE
1" = 200'

AREA OF DETAIL

STORM LINE
DITCH LINE
BASIN BOUNDARY LINE
PARCEL LINE
RECOMMENDED PIPE REPLACEMENT

NOTES:
1. PIPE SIZE AND/OR LOCATION COULD NOT BE CONFIRMED IN FIELD VISITS. (OCTOBER 2000)

CITY OF ILWACO

FIGURE 4-2
STORM WATER CONVEYANCE SYSTEM

SEE FIGURE 4-2

C3_4 12"
C3_10 6"
C3_11 4"
C3_12 4"
C3_13 8"
C3_18 8"
C3_17 8"
C3_16 8"
C3_14 8"
C3_15 8"
C4_9 21"
C4_10 8"
C4
C3_5 12"
C3_19 15"
C3_6 15"
C3_20 15"
C3_21 15"
C2_22 12"
C3_23 15"
C3_24 15"
C1_2 15"
C1_3 15"
C1_4 15"
C2_23 36"
C2_24 36"
C2_25 36"
C2_26 48"
P2_1 8"
P2_3 12"
P2_2 12"
P2_4 12"
P2_5 12"
P1_1 8"
P1_2 8"
ASSUMED
1

MAIN ST
SECOND AVE
WILLIAMS AVE
MYRTLE AVE
PEARL AVE
ADVENT AVE
BAY ST
ST
HOWERTON STREET
WATERFRONT WAY

SEE FIGURE 4-4

SCALE
1" = 200'

AREA OF DETAIL

STORM LINE
DITCH LINE
BASIN BOUNDARY LINE
PARCEL LINE
RECOMMENDED PIPE REPLACEMENT

NOTES:
(1) PIPE SIZE AND/OR LOCATION COULD NOT BE CONFIRMED IN FIELD VISITS. (OCTOBER 2000)

CITY OF ILWACO
FIGURE 4-3
STORM WATER CONVEYANCE SYSTEM

JN DATE: 01/22/01 PATH: L:\ILWACO\99789\BASEMAP\11X17L

SEE FIGURE 4-3

SEE FIGURE 4-3

WILLOW STREET

SPRUCE ST

PEARL AVE

ADVENT

MARY

CITY PARK

ABANDONED

C3_8 6"
C4_3 12"
C4_4 6"
C4_6 10"
C4_7 4"
C4_8 8"
C4_9 21"
C4_14 12"
C4_15 18"
C5_1 18"
C5_2 18"
C5_3 8"
C5_5 12"
C5_6 15"
C5_7 15"
C5_4 18"
C3_9 6"
C3_10 6"
C3_11 4"
C3_12 4"
C3_18 8"
C3_17 8"
C3_16 8"
C3_14 8"
C3_15 8"
C4_10 8"
C4_11 18"
C4_12 8"
C3_19 15"
C3_20 15"
C3_21 15"
C3_22 12"
C3_23 15"
P2_1 8"
P2_2 12"
P2_3 12"
P2_4 12"
P3_1 8"
P3_2 12"
P3_3 12"
P3_4 12"
C4_13 18"
C4_16 18"
C4_17 18"
C4_18 18"

1

1

F: UN DATE: 01/22/01 PATH: L:\ILWACO\99789\BASEMAP\11:

SCALE
1" = 200'

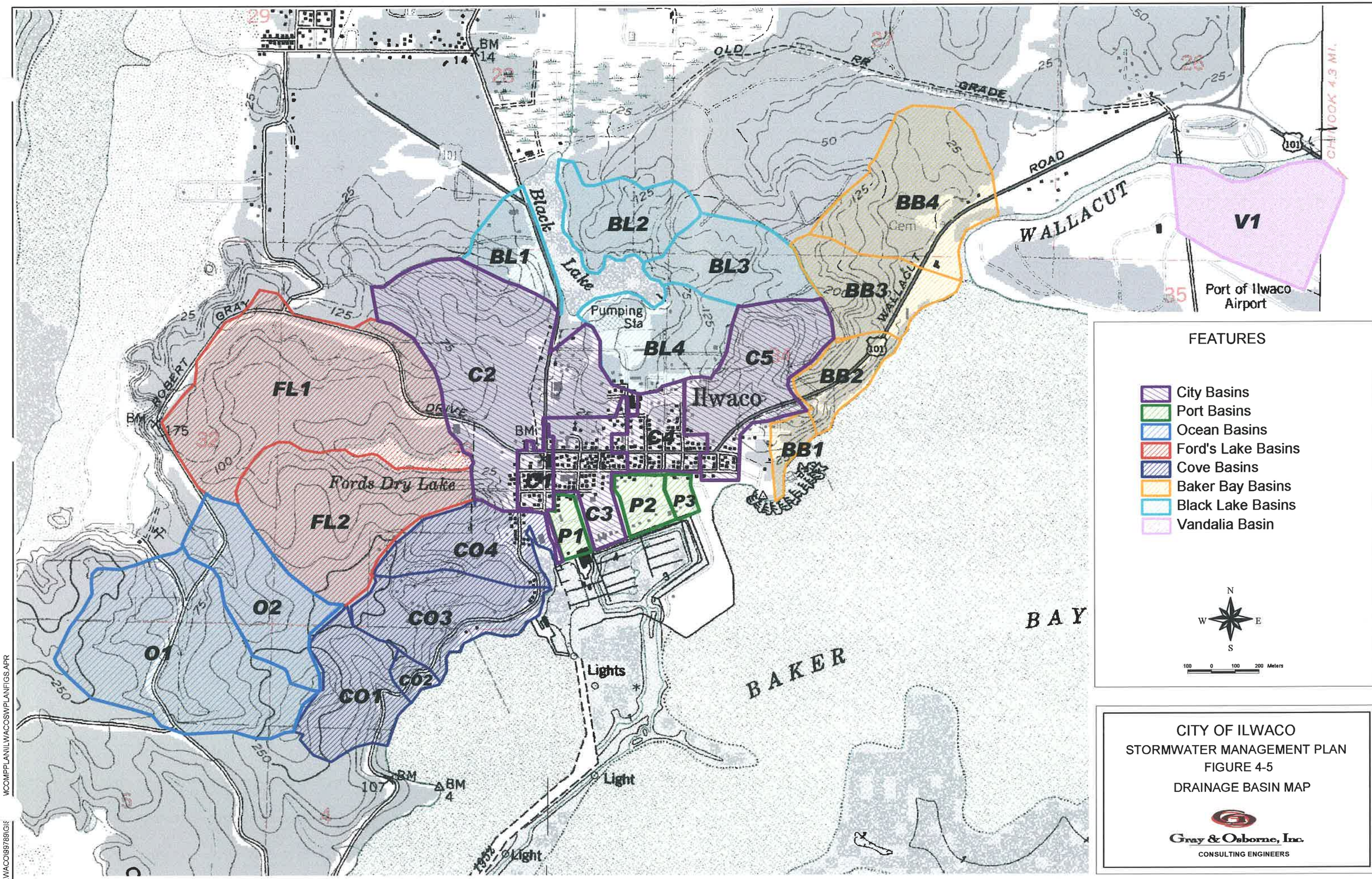
AREA OF DETAIL

STORM LINE
DITCH LINE
BASIN BOUNDARY LINE
PARCEL LINE
RECOMMENDED PIPE REPLACEMENT

NOTES:
1. PIPE SIZE AND/OR LOCATION COULD NOT BE CONFIRMED IN FIELD VISITS. (OCTOBER 2000)

CITY OF ILWACO

FIGURE 4-4
STORM WATER CONVEYANCE SYSTEM



SOURCE: TOPOGRAPHIC MAP - USGS

CITY OF ILWACO
STORMWATER MANAGEMENT PLAN
FIGURE 4-5
DRAINAGE BASIN MAP

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\ILWACO\97789\GIS\COMPPLAN\ILWACOSWPLANFIGS.APR

CHAPTER 5

HYDROLOGIC MODELING

Hydrologic and hydraulic analysis of the Ilwaco stormwater system was performed using the EPA's Surface Water Management Model (SWMM). The program is capable of modeling existing basin conditions as well as future land use conditions to reflect future anticipated stormwater runoff. The hydrologic/hydraulic model for the City of Ilwaco was developed to assess the capacity of the current stormwater system under these conditions.

MODELING BACKGROUND

Hydrologic analysis addresses the movement of rainfall to the conveyance system. The purpose of a hydrologic model is to estimate or predict the flow of stormwater runoff into the conveyance system. The input parameters to the model assume that within each hydrologic basin or collection area there are discreet locations at which runoff enters the conveyance system, such as catch basins. In actuality, runoff enters a conveyance system at numerous locations, for example, any point along the entire length of a ditch. For these situations it was assumed that the runoff enters the system at a known point downstream and time of concentration values were adjusted accordingly. The information generated in the hydrologic model is presented in the form of a hydrograph, a standard plot of runoff (cubic feet per second, cfs) versus time (hours) for a given location and design storm event.

Hydrologic modeling methods require input parameters that describe physical drainage basin characteristics. Together with the distribution of rainfall over time, these parameters determine the shape of the resulting hydrograph generated by the model. Key parameters are the area of pervious and impervious surfaces, the interconnectivity of the impervious areas, topography, and infiltration characteristics of the soil. As part of the hydraulic modeling, all stormwater conveyance information was obtained through the limited number of existing as-builts for the area, historical survey records, and data collected during field visits.

The basic steps in the development of the hydrologic or runoff model include:

- Development of rainfall intensity over time.
- Delineation of the drainage basins and sub-basins.
- Identification of land use and estimation of the amount of pervious and impervious area.
- Identification of soil types and estimation of the infiltration parameters.
- Identification of topographic characteristics and estimation of flow parameters including average slope, roughness coefficients, and depression storage.

Based upon these parameters, the model estimates the resulting runoff from each sub-basin. The resulting runoff hydrographs are added together within the conveyance system to provide inflow volumes. Hydraulic analysis is then used to estimate the peak flow rates and the water surface elevations over time throughout the conveyance system for a given storm event. Hydraulic analysis is based on the physical characteristics of the conveyance system, such as cross-sectional area, slope, and roughness.

It should be especially noted that missing information relating to the conveyance system was supplemented with worst case assumptions. These assumptions include the estimation of pipe invert levels at approximately 3 feet below the ground and a slope corresponding to the flat, natural topography above the pipe. Since no survey was conducted throughout the compilation of this plan, any recommended capital improvement project areas resulting from this plan need to be surveyed to ensure the most accurate and effective design for the project. All recommended pipe sizes in this chapter assume that the existing slope will be utilized in the future. However, the most optimum slope should be analyzed in order to provide maximum capacity while also allowing sand and other sediment to leave the pipe. **Prior to the implementation of any design projects recommended throughout this plan, the slope should be carefully analyzed to ensure that the maximum pipe capacity is attainable while allowing the minimum sized pipe to be installed.**

CALIBRATION

The model was calibrated using data collected from continuous flow meters that were installed as part of this project. Flows were measured at two separate locations. The flow meters were in place for a 4-week period between January 25 and February 28, 2000. The first location was in an 18-inch pipe within a manhole on 1st Avenue, at the west end of Main Street. The second was in an 18-inch pipe within a manhole at Lake Street and Elizabeth Avenue. A historical storm event was used to calibrate the model. Measured flows were compared to flows generated by the model using daily rainfall data for Long Beach obtained from both the National Weather Service and the Long Beach Super 8 Motel. This rainfall was distributed using the SCS Type 1A storm shown in Figure 5-1. It should be noted that calibrating pipes based on this form of rainfall distribution can sometimes be inaccurate due to the distribution of rain that actually occurred throughout the modeling period.

Calibration of the model was performed by adjusting the input parameters until the observed flows from selected storm events compared favorably to the modeled runoff from the same period. Reasonable calibration was obtained at the 1st Avenue location. Figure 5-2 shows flow generated by the model compared with those obtained from the flow meter for the 1st Avenue system. The model did not accurately simulate the flows being conveyed through the pipe along Lake Street as seen in Figure 5-3. The model under predicted the amount of water flowing through this 18-inch pipe.

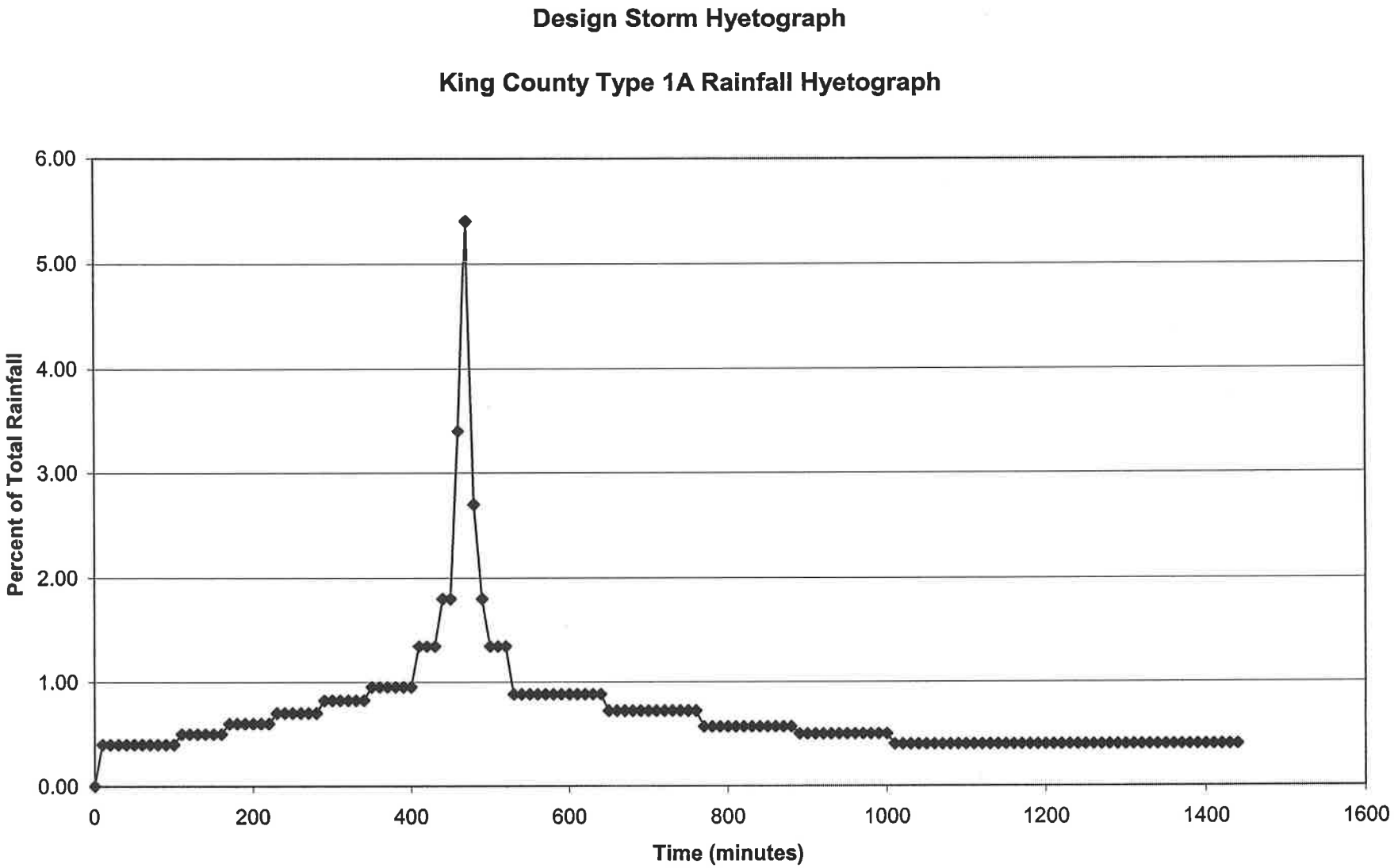


Figure 5-1: Design Storm Hyetograph

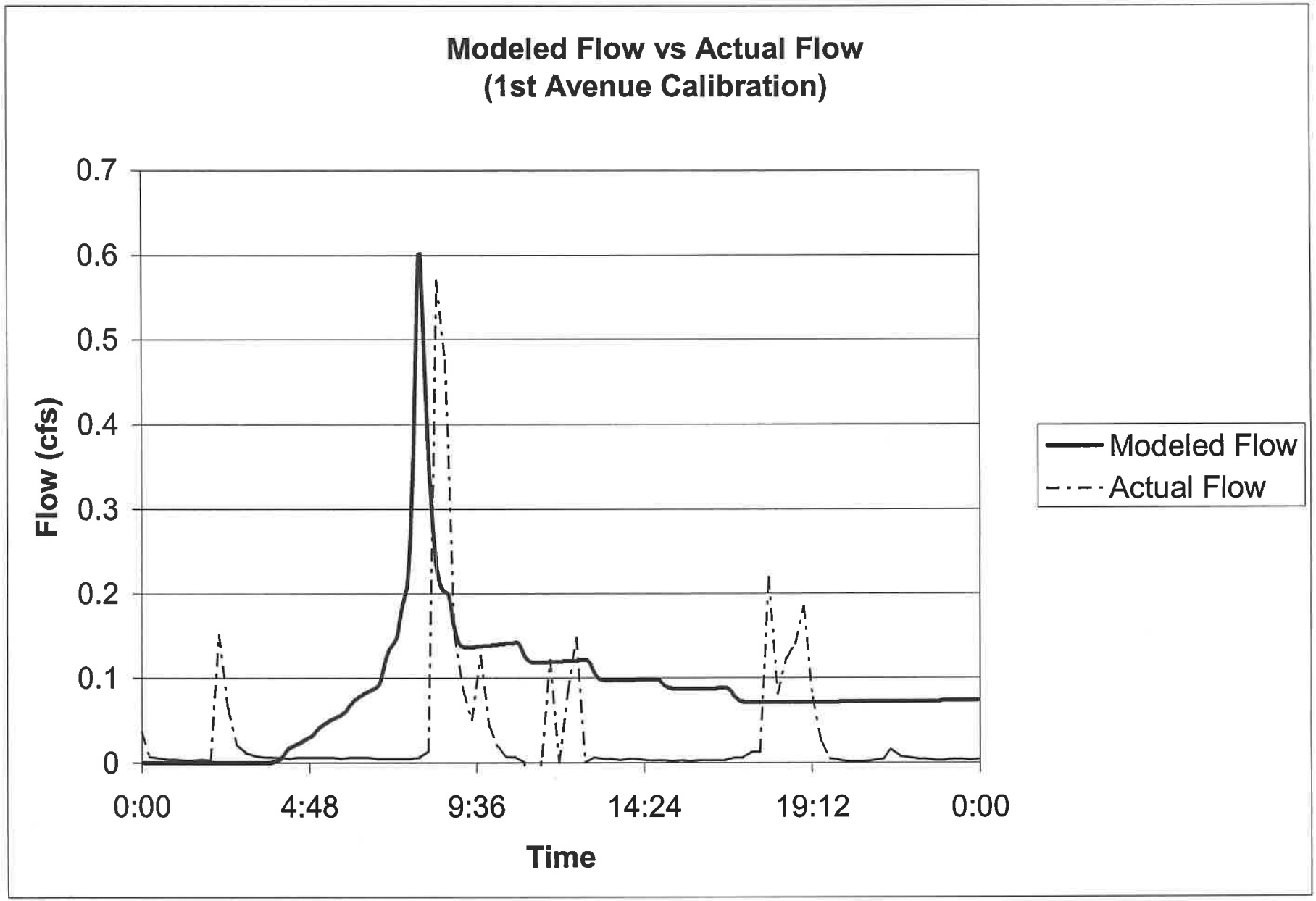


Figure 5-2: Modeled versus Actual Flow Used for Calibration of 1st Avenue

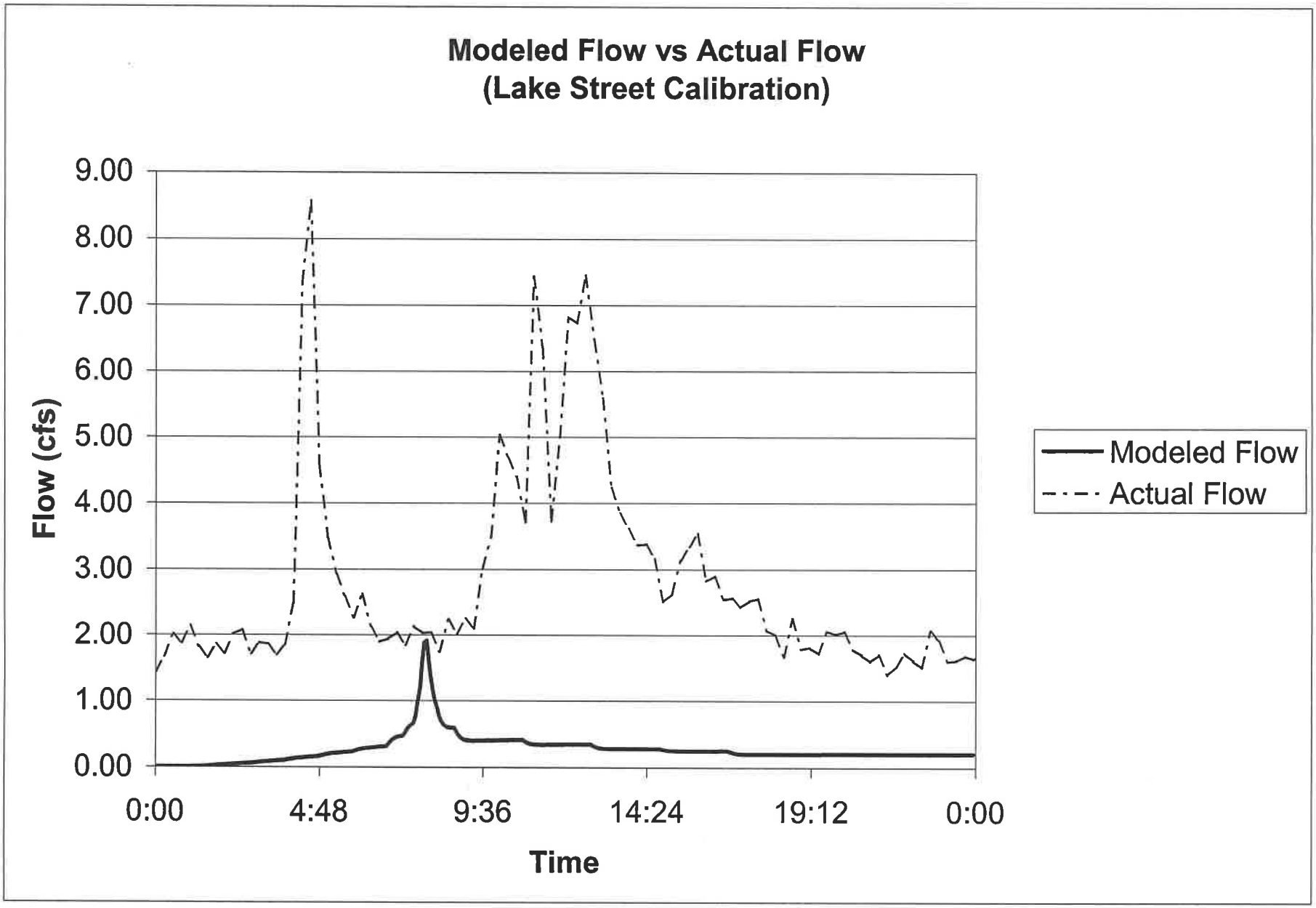


Figure 5-3: Modeled versus Actual Flow Used for Calibration of Lake Street

We believe the reason for this is the high amount of groundwater that was present within this area at the time of testing. To calibrate runoff, the model for Lake Street would have required the assumed size of the drainage basin to be increased to an area much larger than justifiable based upon the topographic map and site knowledge. Therefore, it was decided that we would apply the adjusted model parameters associated in calibrating the 1st Avenue system to this basin. These same parameters were also used for all basins lying outside of these two calibration areas.

DESIGN STORM

All storm event models, such as SWMM, require the input of data describing rainfall intensity over time. Design storms are defined in terms of:

- Return frequency – the statistically estimated length of time between which storms with a given total amount of rainfall will occur
- Total rainfall (depth in inches)
- Storm duration and rainfall distribution over time

Design storms are hypothetical storms based upon a statistical analysis of historical storm events. For western Washington, design storm rainfall, both intensity at a given time and the total volume, are described in the Washington Department of Ecology *Stormwater Management Manual for the Puget Sound Basin*. The 25-year design storm was used to size the conveyance system. This design storm results in a total precipitation of 4.5 inches over a 24-hour period.

The design storm dictates the rainfall intensity at a given time and the total rainfall depth in inches. This creates a volume and distribution of rainfall over a given period of time. Figure 5-1 shows the recommended hyetograph (rainfall distribution) used for modeling rainfall events in western Washington. The hyetograph shown is the standard SCS Type 1A rainfall distribution, modified for western Washington.

In order to complete the model, the City of Ilwaco was divided into 24 separate drainage networks using a 25-foot contour map of the area as seen in Figure 4-5. These networks were in turn, divided into smaller sub-drainage basins, and parameters for each of these smaller basins were input into the model.

The pipe sizes, slopes and general ditch elevations for the storm drainage networks were obtained from the field survey. The ditch bottom elevations were assumed to be approximately two to three feet below the surrounding ground elevation with the constraint that the slope of the ditch was consistent to the general topographic slope parallel to, and in the vicinity of, the ditch. All ditches were assumed to be grass lined with a Manning's "n" coffecient of 0.0026. All pipes were assigned a Manning's "n" coefficient value of 0.014. Basin characteristics were established through field observation, Soil Conservation Service Soil Surveys, and topographical information provided on the USGS map shown in Figure 4-5.

The outfall for these conveyance systems was modeled using a tidal period where the mean low water elevation is at 1.23 (Datum: NAVD 88) and the mean high water elevation is at 7.23. These elevations are for the North Jetty, Cape Disappointment area and were obtained from the National Oceanic Atmospheric Administration (NOAA) Service. Assumptions were made that these high and low water elevations occur on a daily basis at an interval of once every eight hours. The model also assumed that upkeep and maintenance for the conveyance systems within the Ilwaco city limits is carried out on a routine basis.

As mentioned earlier, all conveyance systems were sized for the 25-year event. For the purposes of the 25-year storm event, all flat areas of Ilwaco (i.e. South of Willow Street) were modeled as impervious. This was done because during wet periods, the water table is near the ground surface, resulting in surface ponding and allowing only minimal infiltration to occur.

Difficulties encountered in the modeling effort were related to the lack of elevation differential. The lack of "slope" within Ilwaco made the delineation of the drainage basins within the downtown core of the City rather difficult. Under current land use conditions, ponding occurs over much of the area in yards, especially within the flatter portions of the City. Depressions causing this ponding restrict stormwater from entering the conveyance systems. With increased development throughout Ilwaco, the areas where ponding will, or can, occur may be diminished due to regrading, forcing a greater volume of water to travel to the conveyance systems. The model input parameters (primarily abstraction) accounted for this change in drainage patterns that is assumed to occur with future land use and improved drainage. Abstraction is a model parameter that simulates the amount of rainfall that does not flow into the conveyance system or soak into the ground. The modeling results of future conditions assume that all water that is not infiltrated within a particular basin is captured and sent through the modeled conveyance system.

Many drainage basins within the current city limits are undeveloped. Significant future development in these large areas will require the developer to provide detention and treatment per the Washington State Department of Ecology's *Stormwater Technical Manual* standards. Assuming detention facilities are installed and maintained, development should not significantly increase the peak flows experienced by the public conveyance systems. The model however, assumed the worst case scenario where detention systems were not maintained and therefore, were not successful in dampening the peak flow. The results for these areas display the predicted future peak flow rate for the basin as well as the flow rate that corresponds to the drainage existing within the basin today.

MODEL RESULTS

The following paragraphs describe the model results. A sample SWMM output file is included in Appendix C. The segment designations that appear in the tables refer to the pipe or ditch identifier shown in figures 4-1 through 4-4. Many sections of pipes were found to be undersized for the peak flow predicted for a 25-year storm. Replacing all undersized pipes with the sizes recommended from the model would represent an exorbitant cost to the City. Therefore, after running the model, the drainage systems within the City were analyzed further to determine a more economical approach to improving the system. The original model assumption was that a conveyance system would be large enough to handle the peak flow occurring within a 24-hour time period during the 25-year storm. Due to the use of the SCS Type 1A rainfall distribution (as described above), the peak flow occurs at a rate much higher than what is found throughout the rest of the storm. Since the pipes are sized based upon this peak, it is important to note that the smaller this peak is, the smaller the pipe is.

In order to lower this peak flow rate, we assumed a 15% "out of system" volume would be allowed. This translates to allowing 15% of the total volume of water created during that 24-hour period to remain out of the system (i.e. flows on to the streets, yards, etc) until enough capacity is available in the pipes. When this time comes, the 15% "out of system" volume returns to the conveyance system and is carried to its final discharge point. Using a graph, as shown in Figure 5-3, it was determined that if the pipe was sufficiently sized to accommodate 17% of the peak flow rate, a pipe could convey 85% of the volume of water generated during that 24-hour storm. For example, note in Figure 5-4 that the Type 1A rainfall event gives a peak of 3.6 cfs at a particular location in Ilwaco. Calculating 17% of this peak flow rate results in a rate of approximately 0.7 cfs. Therefore, a pipe that has a 0.7 cfs capacity could convey approximately 85% of the runoff from the 25-year storm event. Based on the Type 1A rainfall event, a flow rate greater than 0.7 cfs would be predicted to occur for a 2 hour period during 24 hours. The remaining 15% of the volume would slowly enter into the system as the water that is already in the pipe discharges downstream. Note that although pipes were sized based on this method, the minimum recommended size of storm drain pipe is 12 inches in diameter.

Both design scenarios will be listed in the tables throughout the remainder of this chapter. One column titled "Full Volume Pipe Diameter" indicates the size of pipe needed to convey all of the 25-year storm (no ponding outside of the pipe will be experienced) whereas another column titled "Recommended Level of Service Pipe Diameter" will list the size of pipes that are necessary to convey 85% of the storm runoff volume (resulting in 15% of the storm's volume being temporarily stored outside of the pipes). This latter scenario is recommended due to its economic benefits.

The major difficulty that the City of Ilwaco faces in the installation and upgrade of its stormwater system is the lack of topographic slope in the downstream portions of the

City. This results in low capacities within storm drainage systems and the consequent need to install larger pipes to handle the predicted flow. Resizing upstream pipes that are deficient often creates the need to increase pipe sizes downstream to handle the increase in flows. Downstream pipes initially not shown as having deficient capacity by the model became deficient when upstream pipes were resized.

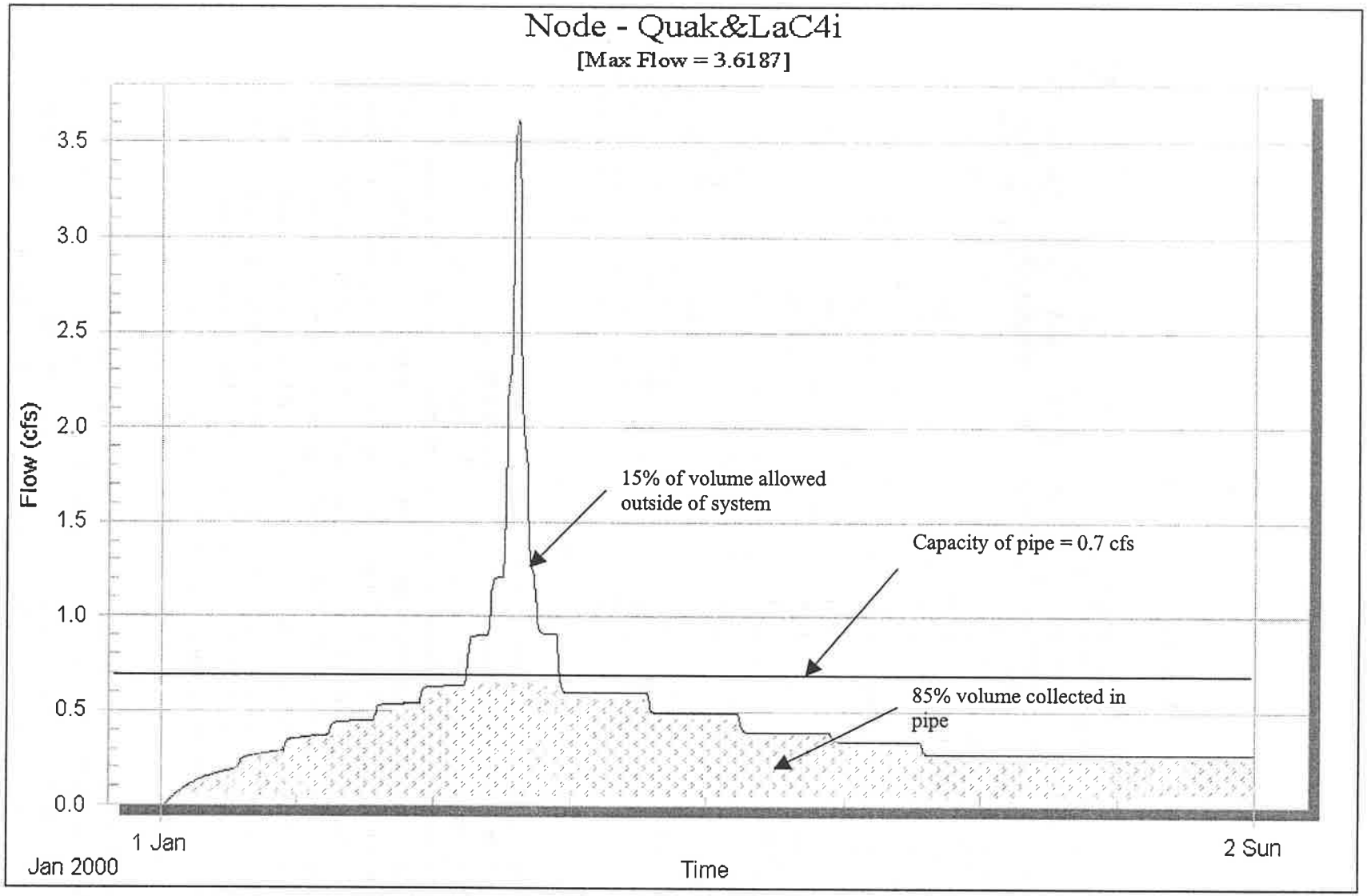


Figure 5-4 - Example for Determining Revised Peak Flow Based on 85% of Storm's Volume

TABLE 5-2

Deficient Components – Basin C2

Segment / Location	Existing Capacity, Cfs	Future Peak Flow 25-year Storm, cfs	Existing Pipe Diameter, in.	Full Volume Diameter, in.	Recommended Level of Service Pipe Diameter, in.
C2_2 / 1st Ave	2.00	6.5	18"	36"	No Change
C2_3 / 1st Ave	4.80	12.3	18"	36"	No Change
C2_4 / 1st Ave	4.00	13.9	18"	36"	No Change
C2_5 / 1st Ave	1.10	16.2	18"	36"	30"
C2_6 / 1st Ave	34.0	32.3	18"	36"	30"
C2_7 / 1st Ave	8.00	24.0	18"	36"	30"
C2_8 / 1st Ave	23.0	24.0	18"	36"	30"
C2_10 / 1st Ave	0.26	1.45	4"	12"	12"
C2_11 /1st Ave	0.37	1.45	4"	12"	12"
C2_12 / 1st Ave	0.97	1.42	12"	18"	No Change
C2_15 / 1st Ave	0.66	2.53	12"	24"	No Change
C2_21 / Spruce	16.0	47.8	36"	60"	No Change
C2_22 / Spruce	16.0	47.8	36"	60"	No Change
C2_23 / Eagle	26.0	54.5	36"	48"	No Change
C2_25 / Boatyard	37.0	54.6	36"	48"	No Change

Recommended pipe sizes were designed to carry 17% of the peak flow. Utilizing this level of service, model results show deficient capacity along the 1st Avenue system in addition to a few segments of pipe downstream. The model shows that at the existing slopes, pipe diameters need to be increased along a portion of the system to avoid flooding during the 25-year storm event. However, the portion of the system along 1st Avenue has not historically been a problem. Information for these pipes was obtained from survey data compiled in 1997. From this data, it appears that the Washington State Department of Transportation (WSDOT) installed pipes with very little slope to them. Since this area is not currently recognized as being a problem, it is recommended that this section of the conveyance system remain as is until further work is done on the highway by WSDOT. At such time, the system should be analyzed further to determine the most optimum slope and minimum pipe sizes necessary to gain full capacity of the pipes within the system.

From Table 5-2, it is evident that some recommended pipe sizes are greater than what is necessary to convey the 25-year storm (example: The existing 18" pipe labeled C2_6 has sufficient capacity to handle the 25-year storm. However, as seen in Table 5-2, a pipe size of 30" is recommended). This is due to the fact that it is standard practice that pipes should not decrease as the conveyance system proceeds downstream. Again, any change in pipe sizes along 1st Avenue should include an analysis of the variability of slope pertaining to these pipes prior to their installation. Also note that some of the

Also note that it is standard practice to have downstream pipes that match the size of or are larger than the upstream pipes. Therefore, as seen throughout a portion of these modeling results, some pipes that have sufficient capacity were recommended for an increase in pipe size simply due to the fact that the surrounding pipes were undersized and needed to be increased.

BASIN C1 (CITY- 1ST AVENUE)

Basin C1 includes areas draining into 1st Avenue from the block west of the street to portions of the area just east of 1st Avenue. This system consists of 15-inch pipes that convey water from just north of Spruce Street to Baker Bay. The zoning designation for the basin is core commercial. The entire drainage area for basin C1 is approximately 10 acres. Table 5-1 identifies those components of this system that were shown to be undersized if the pipe was designed to carry the full 25-year storm event. When designing to the recommended level of service of only 17% of the peak flow (or 85% of the storm's volume), all existing pipes are adequately sized.

TABLE 5-1

Deficient Components – Basin C1

Segment / Location	Existing Capacity, Cfs	Future Peak Flow 25-year Storm, cfs	Existing Pipe Diameter, in.	Full Volume Diameter, in.	Recommended Level of Service Pipe Diameter, in.
C1_2 /1st Ave	4.2	6.5	15"	24"	No Change
C1_3 /1st Ave	4.0	11.1	15"	24"	No Change
C1_4 /1st Ave	4.0	15.0	15"	36"	No Change

BASIN C2 (CITY – 2ND AVE., DRAINS TO EAGLE CREEK)

Basin C2 consists of the area along 1st Ave, north of Spruce, as well as the wetland area located southwest of the high school. The upper portions of this basin also include the forested hillside west of 1st Avenue. To the south, basin C2 includes the homes west of 2nd Avenue. From the upper reaches of the basin, drainage is piped along 1st Avenue and is then conveyed through a series of ditches between Spruce Street and Eagle Street. After crossing under 2nd Avenue and directed south under Eagle Street, the water is conveyed through 36" and 48" pipes until it reaches Baker Bay. The homes located west of 2nd Avenue have historically experienced flooding due to the overflows of the ditch within this area. Land use designations within this basin include recreation, low-density commercial, core commercial, multi-family residential and single-family residential. The entire drainage area for Basin C2 is approximately 131 acres. Table 5-2 identifies those components of the Basin C2 system that were shown to be undersized for the 25-year storm event. All deficient pipes for Basin C2 can be found in Figures 4-1 and 4-2.

downstream pipes initially were not shown as having deficient capacity in the model but later became deficient when the upstream pipes along 1st Avenue were resized.

In addition, it should be noted that a trapezoidal shape was assumed for the modeling of ditches when in reality, heavy vegetation and debris can change the geometry of the channels and obstruct drainage from flowing "normally". A regular maintenance schedule for these ditches may help prevent the historic flooding occurring behind the homes along 2nd Avenue.

BASIN C3 (CITY - WEST OF BRUMBACH)

Basin C3 consists of the drainage system along Williams and Myrtle. The system consists of pipes ranging from 6" to 15" in diameter that run along both streets. These pipes then combine at the south end of Myrtle and collect flow from ditches located on the north side of the Port property. After collecting flow from these ditches, the pipe eventually discharges into the marina. The discharge pipe for this system is 15" in diameter and is the only pipe in the marina known to have a tide gate. Land use designation in this area includes both core and low-density commercial and single family housing. The drainage area for Basin C3 is approximately 30 acres. Table 5-3 and Figures 4-1, 4-2, and 4-3 identify those components of the Basin C3 system that were shown to be undersized in the model.

TABLE 5-3

Deficient Components – Basin C3

Segment / Location	Existing Capacity, Cfs	Future Peak Flow 25-year Storm, cfs	Existing Pipe Diameter, in.	Full Volume Pipe Diameter, in.	Recommended Level of Service Pipe Diameter, in.
C3_2 / Williams	0.90	2.25	8"	12"	12"
C3_3 / Williams	2.10	4.81	12"	18"	No Change
C3_4 / Williams	2.10	7.31	12"	18"	No Change
C3_5 / Williams	1.40	10.7	12"	24"	18"
C3_6 / Williams-Myrtle	1.50	14.1	15"	36"	18"
C3_8 / Myrtle	0.19	3.92	6"	18"	12"
C3_9 / Myrtle	0.49	2.17	6"	12"	12"
C3_10 / Myrtle	0.48	8.11	6"	18"	12"
C3_11 / Myrtle	0.005	<0.01	4"	12"	12"
C3_17 / Lake St.	0.72	2.85	8"	18"	12"
C3_18 / Lake St.	0.72	2.80	8"	18"	12"
C3_19 / Myrtle	3.80	13.8	15"	24"	18"
C3_20 / Myrtle	4.20	27.7	15"	36"	24"
C3_21 / Myrtle	4.20	27.7	15"	36"	24"
C3_23 / Myrtle	4.00	31.9	15"	36"	24"
C3_24 / Myrtle	4.00	35.8	15"	36"	24"

Model results show most pipes to be undersized during the 25-year storm event. This is primarily due to the relatively flat grade of the pipes within the area. However, most of the conveyance information pertaining to this basin was assumed under a worst case scenario due to a lack of as-builts and insufficient survey data for this area. Recommended pipe sizes shown in Table 5-3 are a result of modeling to 17% of the peak flow. Assumed slopes for these pipes were based on surface topography within this basin. This area should be surveyed in more detail if any upgrades in pipe sizes are to be made in the future. Also, the ditches along the back side of the Port property have been known to overflow in the past. Increasing the pipe sizes downstream, as well as regularly maintaining these ditches, may help alleviate flooding problems within this vicinity.

BASIN C4 (CITY - EAST OF BRUMBACH AVENUE)

Basin C4 consists of drainage that is collected along Advent and the east side of Brumbach. This flow is channeled through a ditch located on the south side of Willow. The water from this ditch is then conveyed into a pipe system that runs south along Quaker and eventually east on Lake Street. Before discharging into the Marina, flow collected from Eliza joins the Lake Street system near the Ilwaco wastewater treatment plant. The system consists of a mixture of pipe sizes ranging from 6" to 18" and a series of ditches. There have been historic flooding problems with the ditch along Willow. According to City staff, this ditch overflows on a regular basis. Previous attempts to alleviate the flooding by digging the ditch deeper have proven unsuccessful. The land use designation for this basin is single family residential. The entire drainage area for Basin C4 is approximately 31 acres. Table 5-4 identifies those components of the Basin C4 system that were shown to be undersized. These pipes are also depicted in Figure 4-4.

TABLE 5-4

Deficient Components – Basin C4

Segment / Location	Existing Capacity, Cfs	Future Peak Flow 25-year Storm, cfs	Existing Pipe Diameter, in.	Full Volume Diameter, in.	Recommended Level of Service Pipe Diameter, in.
C4_4 / Willow	0.63	4.93	6"	18"	12"
C4_8 / Willow	0.72	7.84	8"	24"	12"
C4_9 / Quaker	9.9	19.1	21"	36"	No Change
C4_10 / Lake	0.33	7.01	8"	24"	12"
C4_11 / Lake	5.2	28.7	18"	36"	No Change
C4_13 / Elizabeth	3.8	30.2	18"	36"	24"
C4_14 / Eliza	3.7	7.03	12"	18"	No Change
C4_15 / Eliza	1.3	9.98	18"	36"	24"

TABLE 5-4 – (continued)

Deficient Components – Basin C4

Segment / Location	Existing Capacity, Cfs	Future Peak Flow 25-year Storm, cfs	Existing Pipe Diameter, in.	Full Volume Diameter, in.	Recommended Level of Service Pipe Diameter, in.
C4_16 / WWTP	1.3	11.0	18"	36"	24"
C4_17 / WWTP	17	10.6	18"	36"	24"
C4_18 / Marina	8.6	40.8	18"	36"	24"

Model results show deficient capacity along most of the system south of the Willow Street ditch. Note once again, the model assumes the slopes of the pipes will not be changed in the future. According to the model, the pipes downstream of the ditch along Willow should be increased to 24 inch diameter to provide adequate capacity in the system and to alleviate flooding among properties on Willow Street. Until a pipe is installed in the Willow Street ditch, the ditch should be cleaned routinely so that the ditch is functioning at full capacity. Alternatively, the ditch system could be piped through a 24" pipe which would help alleviate historical flooding problems along Willow.

BASIN C5 (CITY - AREA SURROUNDING CITY PARK)

Basin C5 consists of the drainage area located on the east end of downtown Ilwaco. Drainage from the upper reaches of this basin flows into a ditch on the north side of Spruce (Highway 101) where it then flows into a pipe down Maryann. Flow collected along Lake Street to the west of Maryann joins with this flow and continues to the intersection of Lake Street and Maryann where a catch basin allows flow to either go east where it discharges to the Yellow Bluff area or straight south where it discharges directly into Baker Bay. Land use within this basin is mostly single family residential. The drainage area for Basin C5 is approximately 66 acres. Table 5-5 identifies the results of the model.

TABLE 5-5

Deficient Components – Basin C5

Segment / Location	Existing Capacity, Cfs	Future Peak Flow 25-year Storm, cfs	Existing Pipe Diameter, in.	Full Volume Pipe Diameter, in.	Recommended Level of Service Pipe Diameter, in.
C5_1 / Spruce	9.9	30.0	18"	36"	No Change
C5_2 / Mary Ann	8.7	31.6	18"	36"	No Change
C5_3 / Lake	0.34	0.86	8"	12"	No Change
C5_4 / Spruce	15.0	26.9	18"	24"	No Change
C5_5 / Spruce	1.4	8.17	12"	24"	No Change
C5_6 / Spruce	2.7	8.57	15"	24"	No Change
C5_7 / Eliza	5.2	18.2	15"	24"	No Change

Model results reveal that pipe diameters would need to be increased along most of the system to avoid flooding during the 25-year storm event. However, under the level of service recommended, the current pipe sizes will be adequate to handle 85% of the storm's volume (or 17% of the peak flow rate). Therefore, no improvements are recommended for this region. Outfall elevations for this area were unavailable and hence, were assumed based on site visits and worst case scenarios. Again, if future upgrades are to be done within this basin, it would be beneficial to do a survey here in order to determine the most economical and efficient size pipes to install.

BASIN P1 (PORT OF ILWACO - WEST HOWERTON)

Basin P1 consists of the small drainage area along the west side of Howerton Street. The drainage for this area is not well defined. Therefore, a number of assumptions had to be made. It is known that an 8-inch pipe discharges into the marina from this area. However, the worst case scenario where the upstream invert is located roughly 3 feet below the ground surface was assumed. Likewise, the outfall of this pipe was estimated at an elevation similar to other pipes draining into the marina. This basin is currently comprised of commercial businesses and remains zoned for low-density commercial in the future. The drainage area for Basin P1 is approximately 7 acres. Table 5-6 identifies those components of the Basin P1 system that are assumed to be undersized when designed to carry the entire peak flow during the 25-year storm event.

TABLE 5-6

Deficient Components – Basin P1

Segment / Location	Existing Capacity, Cfs	Future Peak Flow 25-year Storm, cfs	Existing Pipe Diameter, in.	Full Volume Pipe Diameter, in.	Recommended Level of Service Pipe Diameter, in.
P1_1 / W. Howerton	0.8	6.8	12"	18"	No Change
P1_2 / W. Howerton	1.4	10.4	12"	18"	No Change

Model results show that under the number of assumptions presumed for this basin, an 18-inch diameter pipe would be needed to convey the peak flow from the 25-year storm event. However, under the recommended level of service (design to 17% of the peak flow rate), no upgrades will be necessary in this area. It should be noted that due to a lack of sufficient data, this basin should be analyzed in further detail if future pipe upgrades are to be made at a later date.

BASIN P2 (PORT OF ILWACO -ADVENT)

Basin P2 consists of the area surrounding the southern portion of Advent. Tributary areas include approximately 450' to the west of Advent and approximately 200' to the east of Advent all the way down to the marina. Water is collected into ditches that run east-west and eventually into a series of 8-inch and 12-inch pipes that direct the flow toward the marina. Historically, flooding within these ditches has occurred. A majority of the basin is currently open field but it is designated as low-density commercial in the future. The area for Basin P2 is approximately 11 acres. Table 5-7 identifies those components of the Basin P2 system that were shown to be undersized when designed to carry the entire peak flow during the 25-year storm event.

TABLE 5-7

Deficient Components – Basin P2

Segment / Location	Existing Capacity, Cfs	Future Peak Flow 25-year Storm, cfs	Existing Pipe Diameter, in.	Full Volume Pipe Diameter, in.	Recommended Level of Service Pipe Diameter, in.
P2_1 / Advent	1.1	6.11	8"	18"	11"
P2_2 / Howerton	3.1	6.30	12"	18"	No Change
P2_3 / Howerton	3.1	10.3	12"	18"	No Change
P2_4 / Howerton	3.1	10.2	12"	18"	No Change
P2_5 / Howerton	3.1	10.3	12"	18"	No Change
P2_6 / Marina	3.1	12.9	12"	24"	No Change

It appears from the model that the whole conveyance system south of the ditches would be undersized for the peak flow during a 25-year storm event. However, under the recommended level of service of providing storage for 85% of the storm's volume, only the first pipe would need to be upgraded. The model did not reveal any capacity problems for the ditches but as noted before, flooding within the ditches has posed a problem in the past. As with basin C2, a trapezoidal shape was assumed for the modeling of the ditches when in reality, heavy vegetation and debris can change the geometry of the channels and obstruct drainage from flowing "normally". A regular maintenance schedule for these ditches may help prevent the flooding occurring within this area. Also note that only the elevations of the catch basin rims, the invert elevations for the inlet pipe (where the ditches join together) and the outfall were known. Knowing these two inverts, an assumed slope for the pipes was calculated. Using this slope, the inverts for the remaining pipes were assumed as well.

BASIN P3 (PORT OF ILWACO - EAST HOWERTON)

Basin P3 consists of the drainage area that involves the East Howerton region. A ditch collects water along the north portion of the basin and then joins an 8-inch pipe. From here, the water is conveyed through a series of pipes that discharge into the marina. Local residents confirmed that the pipe does discharge to the east end of the marina but during site visits, the exact location was unknown due to heavy vegetation located along the marina edge. Port staff verified this outfall to be 12 inches in diameter. The drainage area for Basin P3 is approximately 5 acres and the land use designation is low-density commercial. Table 5-8 and Figure 4-4 identifies those components of the Basin P2 system that were shown to be undersized in the model.

TABLE 5-8

Deficient Components – Basin P3

Segment / Location	Existing Capacity, cfs	Future Peak Flow 25-year Storm, cfs	Existing Pipe Diameter, in.	Full Volume Pipe Diameter, in.	Recommended Level of Service Pipe Diameter, in.
P3_1 / E. Howerton	1.2	2.71	8"	12"	12"
P3_4 / E. Howerton	3.2	5.54	12"	18"	No Change

Model results show that a portion of the system does not have adequate capacity to convey the 25-year storm event under the recommended level of service. However, as stated previously, only limited rim and invert elevations were known for the conveyance system within this basin. The outfall elevation was assumed to be at a level similar to nearby outlets. Likewise, the invert elevation for the inlet pipe was assumed based on visits to the site. Pipe slopes and invert elevations between these two points were determined by calculating a presumed slope for the system. As with the other models,

the recommended pipe sizes shown in Table 5-8 were determined based on these presumed pipe slopes.

OUTLYING BASINS

Numerous basins outside the downtown core were modeled for both their existing and future peak flows. Table 5-9 displays the peak flow results for the 25-year storm. These peak flows do not take on-site detention into consideration. Please refer to Chapter 4 for a complete description of these individual basins.

TABLE 5-9

Deficient Components – Outlying Basins

Basin	Existing Flow 25-year Storm, cfs	Future Peak Flow 25-year Storm, cfs	Percent Increase
O1 (Ocean)	44.7	62.8	+ 40%
O2 (Ocean)	13.6	46.8	+ 244%
FL1 (Ford's Dry Lake)	37.3	104.0	+ 179%
FL2 (Ford's Dry Lake)	18.0	55.6	+ 209%
CO1 (Cove)	13.5	27.6	+ 104%
CO2 (Cove)	2.0	2.6	+ 31%
CO3 (Cove)	19.9	26.8	+ 35%
CO4 (Cove)	14.5	24.1	+ 66%
BL1 (Black Lake)	8.9	37.1	+ 317%
BL2 (Black Lake)	5.9	5.9	0%
BL3 (Black Lake)	5.0	5.0	0%
BL4 (Black Lake)	31.0	31.0	0%
BB1 (Baker's Bay)	3.3	5.8	+ 77%
BB2 (Baker's Bay)	7.9	15.9	+101%
BB3 (Baker's Bay)	9.7	15.6	+ 61%
BB4 (Baker's Bay)	10.9	16.9	+ 55%
V1(Vandalia)	24.9	24.9	0%

As most of these basins are expected to experience an increase in flow, it is recommended that as development occurs, each developer should take appropriate measures to detain this water and release it at pre-developed flow rates in accordance with local regulations.

CHAPTER 6

NONPOINT SOURCE POLLUTION ANALYSIS

INTRODUCTION

The Town of Ilwaco lies on the north side of the Columbia River on Baker Bay approximately two miles upstream from the mouth. The largest freshwater body in the vicinity of Ilwaco is Black Lake. Tarlatt Slough flows 4.5 miles north from Black Lake into the south end of Willapa Bay. It is the largest of numerous sloughs flowing into the Columbia River and Willapa Bay in the vicinity of Ilwaco.

Ilwaco's surface water features are a significant part of its natural beauty and rich heritage. Fish and wildlife habitat, clean water and aesthetic appeal are benefits of the surface water resources which must be managed to wisely protect their value. Without proper management, urban runoff may cause the degradation of surface water resources.

The Lower Columbia River supports significant stocks of chinook, coho and chum salmon and steelhead. In addition to these species, the Upper Columbia River watershed supports two stocks of sockeye salmon. Cutthroat trout and bull trout/Dolly Varden are also present in the Columbia River Watershed, as are white and green sturgeon and American shad. While all of these species migrate along the Columbia, high temperatures, low flows and the lack of spawning gravel prevent or inhibit the salmonids from utilizing the lakes and sloughs near the mouth of the river.

Stormwater is defined as the runoff from residential, commercial, and other urban areas. As rain falls and runs off of urban surfaces, pollutants associated with the urban environment are removed and transported to natural surface waters where they may damage aquatic organisms and reduce the aesthetic value of the water body.

Nationwide, approximately 30% of water quality problems have been attributed to stormwater runoff. Many sources of stormwater pollution are uncontrolled. Sources of nonpoint pollution are numerous, varied and hard to detect, but their cumulative effect on water quality and habitats can be significant. Compared to most communities nationwide, Ilwaco is relatively undeveloped and the City's stormwater is unlikely to carry significant concentrations of metals and polyaromatic hydrocarbons (PAHs) normally associated with urban runoff. However, due to livestock, bacterial concentrations may be similar if not higher in rural areas, such as Ilwaco, than in highly urbanized areas.

IMPACTS TO WATER QUALITY

Pollutants discharged in stormwater are largely uncontrolled. In the Puget Sound area, stormwater has been estimated to contribute about 7% of the total flow from all point and nonpoint sources but about 60% of the total lead, 30% of the total zinc, and nearly all of the total fecal coliform bacteria. Research in western Washington has shown that the concentrations of many pollutants found in stormwater from residential, commercial, and industrial areas exceed water quality criteria. Water quality monitoring data collected by Beak Consultants in 1992 indicated that stormwater runoff to the Wallacut River carried fecal coliform bacteria in sufficient concentrations to render the River out of compliance with State standards (WAC 173-201A-045(1).

The National Water Quality Inventory, 1986 Report to Congress (EPA 1986), also concluded that diffuse sources of water pollution, including runoff from urban areas, are the leading cause of water quality impairment.

The Nationwide Urban Runoff Program (NURP), (EPA, 1983), included extensive field monitoring throughout the United States to characterize urban runoff flows and pollutant concentrations. Listed below are the conclusions reached in the NURP Study:

1. Heavy metals (especially copper, lead and zinc) are the most prevalent priority pollutant constituents found in urban runoff. End-of-pipe concentrations exceed EPA ambient water quality criteria and drinking water standards in many instances. Some of the metals are present often enough and in high enough concentrations, to be potential threats to beneficial uses.[1]

2. The organic priority pollutants were detected less frequently and at lower concentrations than the heavy metals.

3. Coliform bacteria are present at high levels in urban runoff and can be expected to exceed EPA water quality criteria during and immediately after storm events in many surface waters, even those providing high degrees of dilution.

[1] In Ilwaco, the wastewater treatment plant (WWTP) outfall is the only documented source of significant concentrations of heavy metals, specifically copper. It was assumed that the copper was due to discharge of boat hull cleaning water into the wastewater treatment plant. The Port of Ilwaco no longer allows the discharge of boat hull wash water to the treatment plant.

4. Nutrients are generally present in urban runoff, but with a few individual site exceptions, concentrations do not appear to be high in comparison with other possible discharges to receiving water bodies.

5. Oxygen demanding substances are present in urban runoff at concentrations approximating those in secondary treatment plant discharges.[2]

6. Total suspended solids (TSS) concentrations in urban runoff are fairly high in comparison with treatment plant discharges. Urban runoff control is strongly indicated where water quality problems associated with TSS, including build-up of contaminated sediments, exist.[3]

The effects of the pollutants listed above on receiving waters are site-specific, however, the following generalities can be assumed:

- Urban runoff produces frequent exceedances of ambient water quality criteria for heavy metals on freshwater aquatic life. Metals content in Ilwaco stormwater should be significantly lower than most cities, due to the low population and relatively low traffic volumes.

- Although a significant number of problem situations could result from heavy metals in urban runoff, levels of freshwater aquatic life use impairment (suggested by the magnitude and frequency of ambient criteria exceedances) were not observed.

- Copper, lead and zinc appear to pose a significant threat to aquatic life uses in some areas of the country. Copper is suggested to be the most significant of the three.

- Organic priority pollutants in urban runoff generally do not pose a general threat to freshwater aquatic life.

---

[2] Due to the lack of intense agriculture in the vicinity of Ilwaco, runoff from the area is relatively residential in nature, with minimal biochemical oxygen demand (BOD) in most areas, with the exception of the Wallacut River as noted above.

[3] Stormwater runoff from areas under construction around Ilwaco has the potential to contribute significantly to TSS levels. Construction Best Management Practices for sediment and runoff control should be required for all projects with the potential for discharging runoff from the site.

- The physical aspects of urban runoff, e.g., erosion and scour, can be significant causes of habitat disruption and can affect the type of fishery present.

- Sediment contamination due to the build-up of priority pollutants can be attributed wholly or in part by urban runoff.

- Coliform bacteria may be present at high levels in urban runoff and may be expected to exceed EPA water quality criteria during and immediately after storm events in most rivers and streams. Coliform bacteria discharges in urban runoff have a significant negative impact on the recreational uses of lakes.

- Domestic water supply systems with intakes located on streams in close proximity to urban runoff discharges are encouraged to check for priority pollutants which have been detected in urban runoff, particularly those in the organic category.

- Nutrients in urban runoff may accelerate eutrophication problems and severely limit recreational uses, especially in lakes. However, NURP's lake projects indicate that the degree of beneficial use impairment varies widely, as does the significance of the urban runoff component.

- Adverse effects of urban runoff in marine waters are highly specific to the local situation. Though estuaries and embayments were studied to a very limited extent in NURP, they were not believed to be generally threatened by urban runoff. Coliform bacteria present in urban runoff are the primary pollutants of concern, causing direct impacts on shellfish harvesting and beach closures.

- Groundwater aquifers that received deliberate recharge of urban runoff do not appear to be imminently threatened by this practice at the two locations where they were investigated.

The conclusions reached by the NURP study indicate that sedimentation, erosion and bacterial pollution are the pollutants of most concern in stormwater runoff. The Bellevue, Washington NURP project concluded that habitat changes associated with streambed scour and sedimentation produced by urbanization were more significant than pollutant concentrations. This conclusion may be an important factor when developing the area west of the downtown core of Ilwaco.

WATER QUALITY STANDARDS

The following discussion focuses on the criteria used to evaluate water quality contaminants, and sources most common in runoff. In Section 6.5, problems in the Ilwaco area are identified. Appropriate strategies for addressing problem areas and reducing adverse impacts are then summarized.

Stormwater runoff constitutes the primary transport mechanism for nonpoint pollution. Pollution problems associated with land utilization and development encompass the common use of potential pollutants such as pesticides, fertilizers, petroleum products, and numerous others. A further problem stemming from residential, commercial, and industrial land uses is the higher volume of runoff because of the higher percentage of impervious area. In developed areas, certain pollutants are more prevalent that in undeveloped areas. Pollutants accumulate in surficial soils and on paved surfaces from vehicular emissions, atmospheric deposition, spills, leaks, improper waste storage/disposal practices, and fertilizer/pesticide application. They are then washed off the land surface during subsequent storm events and transported via stormwater runoff to nearby water bodies or infiltrated to shallow groundwater.

Although these types of nonpoint pollution can be attributed to an individual source, their intermittent nature makes them difficult to identify and control. For the purposes of this report, these discharges have been considered nonpoint pollution sources. Parameters that define nonpoint pollution are discussed below in terms of state standards and potential sources.

PARAMETERS OF CONCERN

Water quality parameters affecting stormwater comprise a long list and are classified in many ways. Typical categories include sediment, nutrients, and metals; oxygen demanding and inert material; particulate and dissolved; chemical, biological, and physical; toxic and nontoxic; and organic and inorganic. Many specific pollutants are incorporated into one classification if their effects on receiving water are similar. Receiving water can assimilate a limited quantity of each, but there are thresholds beyond which the measured amount becomes a pollutant and results in an undesirable impact.

Human health considerations for fresh water can be monitored through the analysis of conventional water column parameters, nutrients, and oil and grease. The following section provides a brief description of contaminants, likely sources, and potential environmental effects.

Dissolved Oxygen (DO) is necessary in water to maintain life. In the oxidation of organic matter by biological activities, oxygen from water is used. Low DO problems result when the rate of oxygen-demanding material exceeds the rate of replenishment.

DO levels are especially important during summer when low stream flows and high temperatures make oxygen less available to aquatic life. Dissolved oxygen concentrations may also become critical when wastes that require oxygen for decomposition enter the water. In addition to diurnal variation, DO also varies with season and stream site. These natural variations are caused by differences in such things as light intensity, nutrient levels and hydrogeological conditions. Natural variation can also be caused by water sources. Groundwater or water draining bogs and marshes will typically have lower DO concentrations. Fish kills and reduction in aesthetic values have resulted from low-DO conditions.

pH impacts chemical and biological systems of natural waters. Similar to DO, pH responds to natural environmental factors. Changes in pH affect the degree of dissociation of weak acids and bases which affect the toxicity, reactivity, and solubility of many compounds. Diurnal variations in pH occur as a result of changes in production and respiration rates and different water sources such as groundwater or water draining wetlands.

Temperature extremes affect stream productivity and eventually may result in loss of aquatic life. Temperature also affects stream chemistry, specifically the solubility of oxygen, carbon dioxide and metals, and varies diurnally and seasonally.

Turbidity is not a measurement of mass or concentration; it is a water quality attribute. Therefore, it can not be used as a quantitative measure to calculate loadings, but is used qualitatively to compare against a standard. Turbidity responds to physical factors such as runoff, proximity to exposed erodible soils, and stream flow.

Nutrients are chemicals that stimulate the growth of algae and water plants. Typical sources include detergents, fertilizers, septic system effluent, manure, etc. The primary nutrients of concern are **nitrogen** and **phosphorous**. Forms of nitrogen include ammonia, nitrite, and nitrate, which are components of fertilizers, septic system effluent, and manure. The typical nutrient concentrations in stormwater runoff are often more than sufficient to stimulate the growth of algae and plant species. The increased algal activity will initially raise DO levels. Once decomposition of dead algae begins, DO levels drop, surface algal scums form, and water discoloration and odors may occur.

Nitrogen and phosphorus are the principal nutrients for algae and other plants in fresh water ecosystems including wetlands, streams, and lakes. Phosphorus is often the controlling nutrient for algae growth in fresh waters. A large input from nonpoint sources can result in algal blooms that can affect recreational use and reduce the overall quality of receiving waters. Nitrogen can affect the tropic status of receiving waters, and it is also an important parameter for waters used as drinking water supplies.

Pathogens/bacteria commonly refer to fecal coliform bacteria, which are found in the intestinal tracts of warm-blooded animals, including humans. Concentrations of fecal coliform bacteria in surface waters have historically been used as an indicator of water-borne pathogenic bacteria or viruses. Therefore, fecal coliform bacteria concentrations are used as indicators of potential public health concerns. High levels can indicate failing septic systems, poor livestock management practices, poorly operated wastewater treatment systems, municipal storm and sanitary sewers, and other point or nonpoint sources.

High oil and grease concentrations are associated with urban and industrial stormwater runoff. In addition to representing a water quality problem, they can also serve as indicators of a wide array of hydrocarbon compounds that can be toxic to aquatic life at low concentrations. Typically, oil and grease concentrations are low in receiving waters and are usually associated with runoff events.

Total suspended solids originate from erosion of urban and agricultural soils. Sediments washed off paved surfaces are transported by runoff and discharged to receiving waters. Land-clearing activities associated with urban development as well as poor livestock and crop management can accelerate soil erosion and increase sediment transport to receiving waters. The conversion of land from forest to urban increases impervious surfaces and accelerates stormwater runoff. The total volume and peak rate of stormwater is increased and can cause scouring in stream channels, thereby increasing the suspended solids loading in the stream.

Metals commonly found in stormwater runoff from road surfaces and parking areas that are of concern include lead, zinc, copper, chromium, arsenic, cadmium, and nickel. Other potential sources of metals originate from commercial car washes, auto repair facilities, and industrial operations. Most metals are adsorbed onto suspended solids present in the runoff and are probably not toxic to aquatic life.

Toxic organic compounds include a variety of contaminants such as pesticides, petroleum hydrocarbons, and volatile organic compounds. Potential nonpoint sources of these contaminants include urban and agricultural runoff, hazardous substance spills, improper disposal of waste products, and industrial discharges. Compounds that are most frequently found in runoff include phosphates, polyaromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and some pesticides. The availability of toxic organic compounds is difficult to determine because of their adsorption to particulate matter. Particulate-bound contaminants are usually flushed out of the receiving system during high stormwater flows.

Organic material is an integral component of topsoil. The organic content of soil is primarily produced by microorganisms during the degradation of dead plant and animal material. The microbial degradation of organic matter in aerobic systems results in the

consumption of oxygen. Waters high in organic matter may experience depressed oxygen concentrations relative to concentrations at saturation.

CRITERIA

Water quality standards for surface water in Washington State are established in Chapter 173-201A WAC. Standard criteria allow for comparison of the data of interest to a safe or desired concentration or level. Management practices that violate established standards are subject to further investigation and ultimately appropriate corrective measures.

The Department of Ecology has responsibility for managing the state's water resources which are classified into five classes for surface water: Class AA (extraordinary), Class A (excellent), Class B (good), Class C (fair), and Lake. Specific surface water bodies are classified under WAC 173-201A-080 or 173-201A-085. All unclassified surface waters that are tributaries to Class AA waters are classified Class AA. All other unclassified surface waters within the state are classified Class A. The water quality standards for Class AA and Class A and Lake Class waters are shown in Table 5-1, 5-2 and 5-3.

In addition to the water quality parameters listed in Table 5-1, concentrations of toxic substances, such as organic compounds and metals, must not exceed standards specified in WAC 173-201A-047. These standards are based in the U.S. Environmental Protection Agency (EPA) Quality Criteria for Water (1986), which are derived from federal water quality criteria based on aquatic toxicology.

The WAC defines both acute and chronic criteria for toxic substances. Acute toxicity criteria are based on death percentages of test organisms within 24 hours. Chronic toxicity criteria are defined as the concentration that causes long-term adverse effects on an organism's functions.

Water quality criteria for nutrients are not defined in federal or state regulations for surface water. However, because of their influence on algal growth in surface waters, nitrogen and phosphorus are the nutrients of greatest interest in stormwater runoff. Phosphorous is often the limiting nutrient for growth of plants in freshwater systems. Phosphorous enrichment can, therefore, result in the excessive algal blooms and associated nuisance conditions in streams and lakes. The general threshold for eutrophic conditions in lakes is 20 ug/l total phosphorous. Criteria for defining eutrophic thresholds in streams do not exist. However, soluble phosphorous in the range of 15 to 25 ug/l promotes nuisance conditions in streams.

TABLE 6-1

Water Quality Criteria for Class A Waters (WAC 173-201A-045(2))

Parameter	Criteria
Fecal coliform	Freshwater - fecal coliform organisms shall not exceed a geometric mean value of 100 organisms/100mL, with not more than 10 percent of samples exceeding 200 organisms 100/mL.
Dissolved oxygen	Freshwater - dissolved oxygen shall exceed 8.0 mg/L.
Total dissolved gas	Total dissolved gas shall not exceed 110 percent of saturation at any point of sample collection.
Temperature	Temperature shall not exceed 18.0 degrees C (freshwater) due to human activities.
pH	pH shall be within the range of 6.5 to 8.5 (freshwater) with a man-caused variation within a range of less than 0.2 units.
Turbidity	Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.
Toxic, radioactive, or deleterious material	Toxic, radioactive, or deleterious material concentrations shall be below those that may adversely affect characteristic water uses, cause acute or chronic conditions to the aquatic biota, or adversely affect public health.
Aesthetic values	Aesthetic values shall be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

TABLE 6-2

Water Quality Criteria for Class AA Waters (WAC 173-201A-045(1))

Parameter	Criteria
Fecal coliform organisms	Freshwater - fecal coliform organisms shall not exceed a geometric mean value of 50 organisms/100 mL, with not more than 10 percent of samples exceeding 100 organisms/100 mL.
Dissolved oxygen	Freshwater - dissolved oxygen shall exceed 9.5 mg/L.
Total dissolved gas	Total dissolved gas shall not exceed 110 percent of saturation at any point of sample collection.
Temperature	Temperature shall not exceed 16.0 degrees C (freshwater) due to human activities.
pH	pH shall be within the range of 6.5 to 8.5 (freshwater) with a man-caused variation within a range of less than 0.2 units.
Turbidity	Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.
Toxic, radioactive, or deleterious	Toxic, radioactive, or deleterious material concentrations shall be below those, which may affect material concentrations adversely, affect characteristic water uses, cause acute or chronic conditions to the aquatic biota, or adversely affect public health.
Aesthetic values	Aesthetic values shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

TABLE 6-3

Water Quality Criteria for Lake Class Waters (WAC 173-201A-045(1))

Parameter	Criteria
Fecal coliform	Freshwater - fecal coliform organisms shall not exceed a geometric mean value of 50 organisms/100 ml, with not more than 10 percent of samples exceeding 100 organisms/100 ml.
Dissolved oxygen	Freshwater - no measurable decrease from natural conditions.
Total dissolved gas	Total dissolved gas shall not exceed 110 percent of saturation at any point of sample collection.
Temperature	No measurable change from natural conditions.
pH	No measurable change from natural conditions.
Turbidity	Turbidity shall not exceed 5 NTU over background.
Toxic, radioactive, or deleterious	Toxic, radioactive, or deleterious material concentrations shall be below those that may material concentrations adversely affect characteristic water uses, cause acute or chronic conditions to the aquatic biota, or adversely affect public health.
Aesthetic values	Aesthetic values shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

Groundwater standards in the state of Washington are listed in Chapter 173-200 WAC. The standards establish criteria for maximum contaminant concentrations in terms of primary and secondary contaminants and radionuclides based on human health-based criteria. Special protection area can be designated because of wellheads and recharge areas that are vulnerable to pollution because of hydrogeologic characteristics and sole source aquifer status by federal designation. Currently, no special protection areas are recognized within the study area.

The general impacts of non-point sources on beneficial uses that are likely to be of concern to water bodies in or adjacent to the City of Ilwaco are indicated in Table 6-4.

TABLE 6-4

General Impact of Nonpoint Sources Likely to be of Concern in Ilwaco

Body	Key Pollutants	Affect on Water	Affected Uses
Lakes	Bacteria/viruses	Contamination	Contact recreation
	Phosphorus	Algae growth	Contact recreation, nuisance odors, visual pollution
	Sediment/suspended solids	Visual turbidity, creates shallows	Aesthetic pollution by silts, weed growth in shallow areas
	Metals	Bioaccumulation	Fishing
Streams	Sediment/suspended solids	Turbidity deposition in stream pools and wetlands	Loss of flood control capacity, fishing, loss of wetland cleaning ability, visual pollution
	Hydraulic erosion	Streambank loss sediment deposit downstream	Damage of private and public property
	Bacteria/viruses	Contamination	Swimming
Groundwater	Nitrates	Loss of use as a drinking water supply	
	Toxic organics	Cancer, related diseases	
	Bacteria/viruses	Contamination	

EXISTING BACKGROUND WATER QUALITY SURVEYS

The water quality of the Willapa Bay watershed has been studied for many years. Much of the interest in water quality in the bay has been focused on the presence of bacterial contamination. Willapa Bay produces at least 50% of the Washington State oyster crop. Oyster growers are concerned that contamination by fecal coliform bacteria will damage their crop. Bacterial pollution from human and animal fecal sources can limit the use of water for domestic water consumption, and primary and secondary contact recreation, as well as shellfish harvesting.

The Department of Ecology statewide 305(b) water quality reports in 1990 and 1992 identified Willapa Bay as "water quality limited" due to fecal coliform criteria violations. Water quality limited is defined in federal regulations as:

> ".... any (water body) segment where it is known that water quality does not meet applicable water quality standards, and/or is not

> expected to meet applicable water quality standards even after the application of the technology based effluent limitations required by 301(b) and 306 of the Clean Water Act" (40CFR 130.2(i)).

The same federal regulations require that DOE perform a total maximum daily load (TMDL) evaluation, and complete either or both a waste load allocation (WLA) for point sources and a load allocation (LA) for nonpoint sources in water quality-limited areas. The basic goal of the TMDL/WLA procedure is to bring water bodies back into standards compliance by limiting pollutant loading based on the characteristics of the water bodies, rather than by the limits capable from the usual source treatment processes.

Bacterial quality is one measure of a water's ability to provide beneficial uses. The potential sources of nonpoint coliform pollution include:

- on-site septic systems,
- urban stormwater run-off,
- boats and marina areas,
- livestock, and
- pets and wildlife.

In general, water quality problems in the vicinity of Ilwaco include summer high temperatures and low dissolved oxygen levels in the streams and lakes. The Department of Ecology's Clean Water Act Section 303 (d) List was reviewed as follows.

- High coliform bacteria levels are present in the Columbia River in the vicinity of the City of Ilwaco Wastewater Treatment Plant Outfall into Baker Bay and in rivers and sloughs entering Willapa Bay during high flow events.
- Water quality monitoring conducted by Beak Consultants in September of 1992 indicated that fecal coliform levels exceeded Department of Ecology Standards at the Wallacut River Site and at four sites within the marina area.
- Elevated levels of PCBs have been reported in mussel samples from the Columbia River.
- Dioxin levels in Dungeness crab at Astoria, and tissue samples from fall chinook salmon, largescale sucker and carp in the lower 45 miles of the Columbia have also exceeded the EPA criterion. A Total Maximum Daily Load (TMDL) was established for dioxin in the Lower Columbia River in 1991.
- Water quality monitoring conducted by Beak Consultants in 1992 indicated that low dissolved oxygen DO levels occur in Baker Bay and the estuary of the Columbia River during summer low flow periods when low

DO saltwater flows upstream during high tides. High BOD effluent from the City of Ilwaco's WWTP prior to the recent WWTP upgrade (with contributions from the local fish processor), lowered DO in the vicinity of the marina.

Water Quality Specific to the City of Ilwaco:

Ilwaco Harbor and West Channel Baker Bay are classified as Class A fresh waters. The Pacific Ocean is designated Class AA Marine water. According to water quality monitoring data collected by Beak Consultants in 1992, DO levels below the 7.0 mg/l standard for Class AA marine waters occur in waters near the bottom in the vicinity of the Ilwaco Marina near the WWTP outfall, to the west in Baker Bay, and in open ocean waters. Several sites within the marina and all coliform samples collected at the Wallacut River Site had fecal coliform levels in excess of the Washington State Department of Ecology Standard of 14 CFU/100ml.

Discharges flowing to Baker Bay:

- City of Ilwaco stormwater sewers discharge into the marina in a number of locations. The low level of road use in Ilwaco limits the metal and oil concentrations in runoff compared to similar roadways in more heavily traveled areas, such as Puget Sound.
- Occasional spills from fuel docks and the illegal disposal of fish waste, sanitary waste and oily bilge water from charter and pleasure vessels may represent other sources of discharge. It should be noted that discharges from the fish processing area located on the west end of Howerton Way is regulated under a wastewater NPDES permit.
- The City's main wastewater discharge is located outside the entrance to the marina.
- A seafood processing plant located near the northwest corner of the marina discharges into the sanitary sewer outfall, contributing to the overall BOD of the effluent during processing operations.

Due to the relatively light level of development in Ilwaco, impacts on water quality in Baker Bay associated with storm sewer overflows are limited. Dissolved oxygen and coliform bacteria levels do not always conform to Ecology Standards, however, flushing in the bay from tidal action and the flow of the Columbia River limits any adverse impacts on aquatic organisms in Baker Bay.

DOE issued a report in 1993 titled the *Willapa Bay Watershed Bacterial Evaluation and Preliminary Control Strategy*, which evaluated the bacterial problem in the Willapa Bay watershed and recommended an effective watershed control strategy. The Long Beach Peninsula lies within the area designated as Zone Three in the DOE study. The DOH

Shellfish Program collected approximately 17 fecal coliform water samples at each of 21 stations in the Nahcotta monitoring station area in Zone Three. Samples were collected during four surveys conducted between September 1989 and February 1992. One sample near Nahcotta Harbor exceeded the water quality standard of 43 cfu/100 ml.

The *Willapa Bay Watershed Bacterial Evaluation and Preliminary Control Strategy* determined problem areas in each of the zones. The problems identified in Zone Three included on-site septic systems, inundation of grazing pastures and residential areas by high water, and clearing of the drainage ditches which have reduced the ability of the ditches to treat stormwater runoff.

A CH2M Hill report, *Bacteriological Survey of Willapa Bay*, 1981, stated that the tourist season had no bacterial impact on water quality in the peninsula area. However, impacts from livestock were evident. Samples taken within livestock pasture areas behind closed tide gates had fecal coliform counts that exceeded fresh water criteria.

A CH2M Hill report, *Long Beach Peninsula Nonpoint Source Bacterial Pollution Analysis*, 1987, presents the results of a sanitary survey and a study of surface water quality that involved sampling along the eastern side of the Long Beach Peninsula. Seventeen stations were monitored to provide baseline information on possible bacterial loading to the nearby oyster growing grounds. The overall conclusion was that fecal coliform concentration in the drainages occasionally exceeded state criteria. The 1987 Long Beach Peninsula study of CH2M Hill included the recommendation to change the major west-to-east drainage patterns, which discharge into Willapa Bay.

There are no studies on the impact of stormwater runoff on the near-shore Pacific Ocean in the Ilwaco area. However, CH2M-Hill (1981) sampled the open ocean off the City of Long Beach and at the mouth of Willapa Bay. No measurable fecal coliform concentrations were found at either of the monitoring stations which, were located approximately one mile offshore.

SOURCES OF NONPOINT POLLUTANTS

The major types of nonpoint pollution sources in the Ilwaco area are related to urban development, agricultural activities, and transportation-related activities. Other important sources of nonpoint pollution may include illicit connections to the storm drain system, on-site sewage systems and improper waste storage and disposal practices.

URBAN DEVELOPMENT

Commercial development in the City includes full-service restaurants, a grocery store, motels, a fish processor and miscellaneous smaller business. Potential sources of pollution from these developments include oil and grease, suspended solids and metals

from the parking lots, bacterial loads and garbage from improper waste storage and disposal practices at the grocery stores and restaurants, oil and grease and petroleum hydrocarbons from boat yards and fertilizers, pesticides and herbicides from landscaping activities.

The runoff from the commercial establishments listed above is most likely contributing metals, such as cadmium and lead, to stormwater runoff. These contaminants are produced by dryfall from vehicle emissions, vehicle wear and tear, and chemical products. Other contaminants that may be associated with the commercial establishments in Ilwaco include toxic organic compounds such as pesticides and polyaromatic hydrocarbons (PAH). Volatile organic compounds such as solvents may also be present in urban runoff and are typically associated with spills and improper waste disposal activities. Improper chemical storage and waste disposal practices are common sources of contaminates migrating off-site from commercial and industrial establishments. The improper use of garbage dumpsters, such as exposing the contents to rain or depositing garbage on the ground rather than in the dumpster, are potential sources of stormwater pollution.

Throughout the City, undeveloped land is being converted to residential and commercial use. The construction-related activities of land clearing and site preparation are potential sources of stormwater pollution. Areas that have been cleared of vegetation are more prone to erosion and can significantly increase sediment loading to nearby water bodies. Sediments can be deposited in natural and constructed channels, thereby reducing the hydraulic capacity. The efficiency and capacity of associated stormwater control structures such as culverts, pipes, and detention facilities will also be affected by the deposition of sediment.

The amount of stormwater runoff usually increases during construction activities as vegetative cover is removed. Leaf interception and infiltration provide a natural detention benefit while plant roots generally improve a soil's water holding capacity. When vegetation is removed from an area, the total runoff volume and peak runoff rate increases, which can erode streambanks and accelerate channel scouring. This in turn can damage property, destroy riparian habitat and degrade water quality.

In addition to soil erosion, other pollutants can also be generated by building activities. Pesticides, fertilizers, petroleum products, cleaning solvents, paints, asphalt by-products, acids, and salts as well as solid wastes are potential sources of stormwater pollution if improperly handled on a construction site. The pouring and finishing of concrete on a construction site can also adversely affect water quality by potentially increasing the pH of the water to toxic levels which may threaten aquatic life.

The impact of increased development on stormwater pollution does not stop after construction. The volume of stormwater runoff and peak discharge rate increases as a

direct result of the increase in the amount of impervious area. Higher flow rates accelerate bank erosion and scour in the receiving systems, which result in an increase in sediment deposition further downstream. Higher flow rates can also cause localized flooding where the carrying capacity of natural streams and piped conveyance systems is exceeded. The pollutant load of stormwater in residential areas also increases as development increases. The potential pollutant sources in residential areas include fertilizers, pesticides and herbicides from landscaping activities, biological loads from pet wastes, waste oil disposal from vehicle maintenance activities, improper disposal of household and yard wastes and illegal connections of sanitary sewers to the storm sewer system.

Urban development can severely impact wetlands in several ways. Development often includes the filling in of wetlands. When increased stormwater flows due to development are directed to a wetland area the hydrologic regime of the wetland may be altered which may lead to the destruction of the wetland. Nutrient pollution from urban development may impact wetlands by promoting the growth of nuisance plants and pesticide, herbicide or fertilizer pollution from urban development may destroy wetland plants. Organic pollution from urban development may increase the oxygen demand in wetlands that may lead to destruction of existing ecosystems.

HIGHWAYS

Stormwater runoff from highways, as well as city arterials and residential streets can contain elevated concentrations of metals, suspended solids, and organic compounds such as petroleum hydrocarbons. Studies have shown that pollutant loading is directly related to the amount of vehicle traffic during the storm (Horner and Mar, 1982). Major highways with high vehicle use can be significant sources of nonpoint pollutant loading. Sanding in the winter further contributes sediment to the drainage system. Major thoroughfares in the City include SR 101.

DOMESTIC ACTIVITIES

Nonpoint pollution from domestic activities in the City consists primarily of pet waste and domestic gardens. Pet wastes are likely the most significant source of nonpoint pollution from residential activities. Runoff laden with animal wastes, fertilizers, pesticides or herbicides can contribute to non-point pollution.

In addition to the known water pollution/quality issues listed above, the following water quality issues are suspected:

- Lack of preventive maintenance of stormwater facilities.
- Bacterial loading from garbage storage at groceries and restaurants.
- Pollutant wash-off from car and truck parking areas.

- Dumping of used motor oil into the City's storm drainage system
- Nutrient loading due to excessive fertilizer usage.
- Bacterial contamination from pet wastes that are not "scooped".

CHAPTER 7

NONPOINT SOURCE POLLUTION CONTROL

The following sections discuss general considerations for the control of stormwater pollution from the sources identified in Chapter 6 and present some specific recommendations for the City of Ilwaco.

GENERAL CONSIDERATIONS IN URBAN STORMWATER QUANTITY AND QUALITY CONTROL

Each issue discussed in the previous chapter for stormwater quantity and quality problems represents a classic stormwater quantity or quality management problem. Stormwater management solutions to alleviate the stormwater problem areas must be sound from an engineering viewpoint. They must also comply with the current and proposed state and federal regulations as discussed in Chapter 3.

As the consequences of uncontrolled urban runoff have become more widely recognized and better understood, and as the alternatives available for control have increased, the complexity of stormwater management has grown. Several general considerations may be identified which provide a framework for consideration of issues that affect the method in which the City of Ilwaco handles their stormwater management program. The considerations are briefly discussed in the following paragraphs and include:

- Stormwater quality versus quantity control
- Construction phase versus long-term site operation phase
- Structural versus nonstructural controls
- Source control versus downstream treatment
- Control in new versus existing development
- Special sensitive area considerations

STORMWATER QUALITY VERSUS QUANTITY CONTROL

Stormwater management has traditionally been concerned with control of runoff quantities for the purpose of preventing flooding. Accordingly, most regulations and engineering design procedures represent this concern. Recently, runoff water quality control has become an added concern as it has been recognized that water quality goals often cannot be realized through control of point sources of water pollution alone.

Efforts at quantity and quality control are confronted with the same basic task: predict the amount of runoff resulting under various conditions and provide sufficient storage

capacity to achieve control objectives. In the case of quantity control, the objective is to release storm runoff at a rate that does not exceed stream channel capacity (which may not be the same as matching pre-development hydrologic conditions for a given site). For quality control the objective is to provide sufficient holding time for the effective operation of gravity settling or biochemical removal of pollutants. Because storage may benefit both quantity and quality, some of the same storage strategies, if correctly applied, can advance both goals. This discussion will emphasize the achievement of dual water quantity and quality control goals wherever possible.

CONSTRUCTION PHASE VERSUS LONG-TERM SITE OPERATION PHASE

In general, the types of potential water quality problems differ sufficiently between construction and the operation of a developed site. Therefore, these periods should be treated separately in stormwater management planning. At the same time, there should be awareness that some measures installed for the construction phase can be converted to permanent service.

STRUCTURAL VERSUS NONSTRUCTURAL CONTROLS

Control of water pollution from industrial and municipal discharges relies to a large extent on structural treatment devices. Grass swales, oil/water separators, and wet ponds could all be considered structural stormwater treatment devices. Much greater opportunities may exist for nonstructural stormwater quality controls. Nonstructural approaches may include enhanced maintenance programs, regulations, public involvement, land use controls and other measures. The most effective stormwater quality programs use a mix of structural and nonstructural alternatives.

SOURCE CONTROL VERSUS DOWNSTREAM TREATMENT

While the distinction is not perfect, a source control generally prevents pollutants from coming into contact with stormwater and is located at the site of pollutant generation, whereas downstream treatment is removed somewhat from the source. Source control measures (such as enclosing or covering a pollutant source) are usually applied at multiple locations, while a downstream treatment measure (such as an artificial wetland) often receives drainage from more than one individual source. In the extreme case, a single downstream treatment structure (such as a regional detention pond) can serve a relatively large area.

CONTROL IN NEW VERSUS EXISTING DEVELOPMENTS

New developments offer greater opportunities to apply stormwater management techniques than do existing developments. In particular, retroactively fitting structural techniques is generally difficult and expensive, if possible at all, in existing

developments. These measures often take substantial land, which may not be available in built-out areas. However, existing development areas are frequently amenable to a variety of nonstructural approaches (such as modified maintenance practices or public education).

CONTROL OF ACUTE VERSUS CHRONIC IMPACTS

If antifreeze were poured into a catch basin near a creek, a fish kill might result; this would be an example of an acute impact to water quality associated with the storm drainage system. Conversely, over time, more devastating impacts to a creek could result from loss of fish habitat associated with erosion and siltation. This would be termed a chronic impact. Reducing acute and chronic impacts requires distinct strategies in the overall stormwater quality management program.

SPECIAL SENSITIVE AREA CONSIDERATIONS

Areas sensitive to the potential impacts of urban stormwater include stream corridors, especially those with valuable fish habitat; flood plains; wetlands; steep slopes and groundwater aquifers. Some special considerations in stormwater management apply to these areas. These considerations will be brought into the discussion as appropriate.

STORMWATER QUANTITY AND QUALITY CONTROL: STRUCTURAL ALTERNATIVES

Stormwater management alternatives for the control of the quantity of stormwater runoff and the quality of the runoff are not mutually exclusive. The outdated method of designing stormwater conveyance systems that relied on curb and gutters to transport stormwater directly into pipes which discharged the stormwater directly into a stream, river or lake provided little in the way of stormwater quantity control and nothing in the way of stormwater quality control. As citizens, municipalities and designers are becoming more aware of the damaging effects of stormwater quantity and quality, the line between stormwater management alternatives which are strictly concerned with quantity issues and those concerned strictly with quality issues is becoming blurred. In the remainder of this Chapter stormwater management alternatives which will serve to limit the quantity of stormwater runoff and improve the quality of the runoff will be discussed.

The quantity of stormwater runoff can be controlled by storage and regulated release of stormwater or by site controls. Storage and regulated release of stormwater includes systems such as detention vaults or ponds with stormwater release orifices.

Site controls can minimize the quantity of stormwater released as well as provide water quality benefits. Site controls are generally those controls that attempt to reduce runoff

rate and volume at or near the point where the rainfall hits the ground surface. The following types of site controls are common:

- Low Impact Development
- Minimization of directly connected impervious area
- Swales and filter strips
- Porous pavement and parking blocks
- Infiltration devices, such as trenches and basins.

LOW IMPACT DEVELOPMENT

Low impact development is one method for controlling stormwater on a site. The primary goal of low impact development methods is to mimic the predevelopment site hydrology by using site design techniques that store, infiltrate, evaporate, and detain runoff. Use of these techniques helps to reduce off-site runoff and ensure adequate groundwater recharge. As mentioned in Chapter 2, the *Puget Sound Water Quality Management Plan* recommends that low impact development include the following:

- Maintain the pre-developed, undisturbed stormwater flows and water quality;
- Retain native vegetation and soils to intercept, evaporate and transpire stormwater on the site (rather than using traditional ponds and conveyances);
- Emphasize a higher standard of soil quality in disturbed soils (by using compost and other methods) to improve infiltration, reduce runoff and protect water quality;
- Cluster development and roads on the site and retain natural features that promote infiltration; and
- Reduce impervious surface area and use permeable surfaces instead.

Management practices used to accomplish low impact development goals include bioretention facilities, dry wells, filter/buffer strips, grass swales, rain barrels, cisterns and/or infiltration trenches. Low impact development is an efficient method at decreasing the amount of runoff associated with developing a site. However, as with many practices, maintenance in low impact developments is a concern and should be addressed prior to implementation.

STORAGE AND REGULATED RELEASE

Storage and regulated release of stormwater is not currently practiced in the City of Ilwaco, although detention does occur in the form of ponding in yards, vacant lots, and ditches. Storage and regulated release of stormwater requires the installation of detention

systems to insure that the rate of stormwater runoff leaving the site for the design storm event during the post-development condition is no greater than the pre-development rate for the same design storm event. This method of stormwater control minimizes downstream impact on the existing conveyance system.

Detention systems can be either wet or dry systems. Detention systems are widely used for runoff quantity control. However, if wet detention systems are properly sized they can act as effective runoff quality control devices as well.

A wet detention basin consists of 1) a permanent water pool, 2) an overlying zone with capacity to temporarily store the design runoff volume for release at the allowed peak discharge rate, and 3) a shallow littoral zone (the biological filter), which serves to treat the permanent volume between storm events. The permanent water pool volume and the vegetated littoral zone are of utmost importance for water quality enhancement. Wet detention ponds are often used in series with swale interconnectors. If properly designed and maintained, wet detention ponds can provide not only effective flood and water quality protection, but also ancillary benefits, such as enhanced aesthetics and wildlife habitat.

The removal of stormwater pollutants in a wet detention system is accomplished by a number of physical, chemical and biological processes. Gravity settling removes particles through the physical process of sedimentation. Chemical flocculation occurs when heavier sediment particles overtake and coalesce with smaller, lighter particles to form still larger particles. Biological removal of dissolved stormwater pollutants includes uptake by aquatic plants and metabolism by phytoplankton and microorganisms that inhabit the bottom sediments.

Dry detention basins are the most common type of detention basin used around the country for peak-flow attenuation. Dry detention systems perform very poorly as treatment devices for runoff. This is primarily due to short residence time and the fact that these basins do not remove any dissolved pollutants.

Design, sizing and maintenance criteria for detention facilities can be found in Chapter 3 of the DOE *Stormwater Management Manual for Western Washington*.

DIRECTLY CONNECTED IMPERVIOUS AREA

Directly connected impervious area (DCIA) is defined as the impermeable area that drains directly to the improved drainage system, *i.e.*, paved gutter, improved ditch, or pipe. The minimization of DCIA is an effective method of runoff quantity and quality control because it delays the concentration of flows into the improved drainage system and maximizes the opportunity for rainfall to infiltrate at or near the point at which it falls. Figure 7-1 illustrates the difference between an area where the DCIA is extensive

and one where DCIA has been minimized. The residential lot on the north side of the street has all impervious areas on the lot draining directly to the gutter. This drainage plan allows no opportunity for water falling on the impervious surfaces to infiltrate into the ground; in fact, the system is laid out so that the rain falling on the impervious areas is quickly concentrated and drained to the gutter. The result is a greatly increased peak runoff rate and runoff volume compared to the pre-development condition. The pollutants contained in the runoff from the rooftop, driveway, sidewalk and street are simply collected in the gutter and must be dealt with at some location further down in the drainage system.

In contrast, the drainage layout for the lot on the south side of the street has been designed to minimize DCIA. All impervious areas drain to a previous area before they reach the grassed swale that serves as the primary conveyance facility for runoff from the lot. The roof runoff drains to the lawn and sheet-flows across it, the driveway is sloped to drain to the lawn instead of the street, and the sidewalk and the street sheet-flow across a grass filter strip before reaching the water in the grassed swale. All of these techniques combine to provide maximum opportunity for infiltration and for retardation of the runoff rate. This approach to drainage system layout, which emphasizes peak-flow reduction and pollutant capture, is called stormwater management, in contrast with the north lot design, which is simply a drainage plan.

The majority of residences in Ilwaco, particularly the older homes, have been constructed with minimal DCIA. Commercial development and more recent multiple housing tends to exhibit greater DCIA. In the future, development within the Ilwaco area should address this issue.

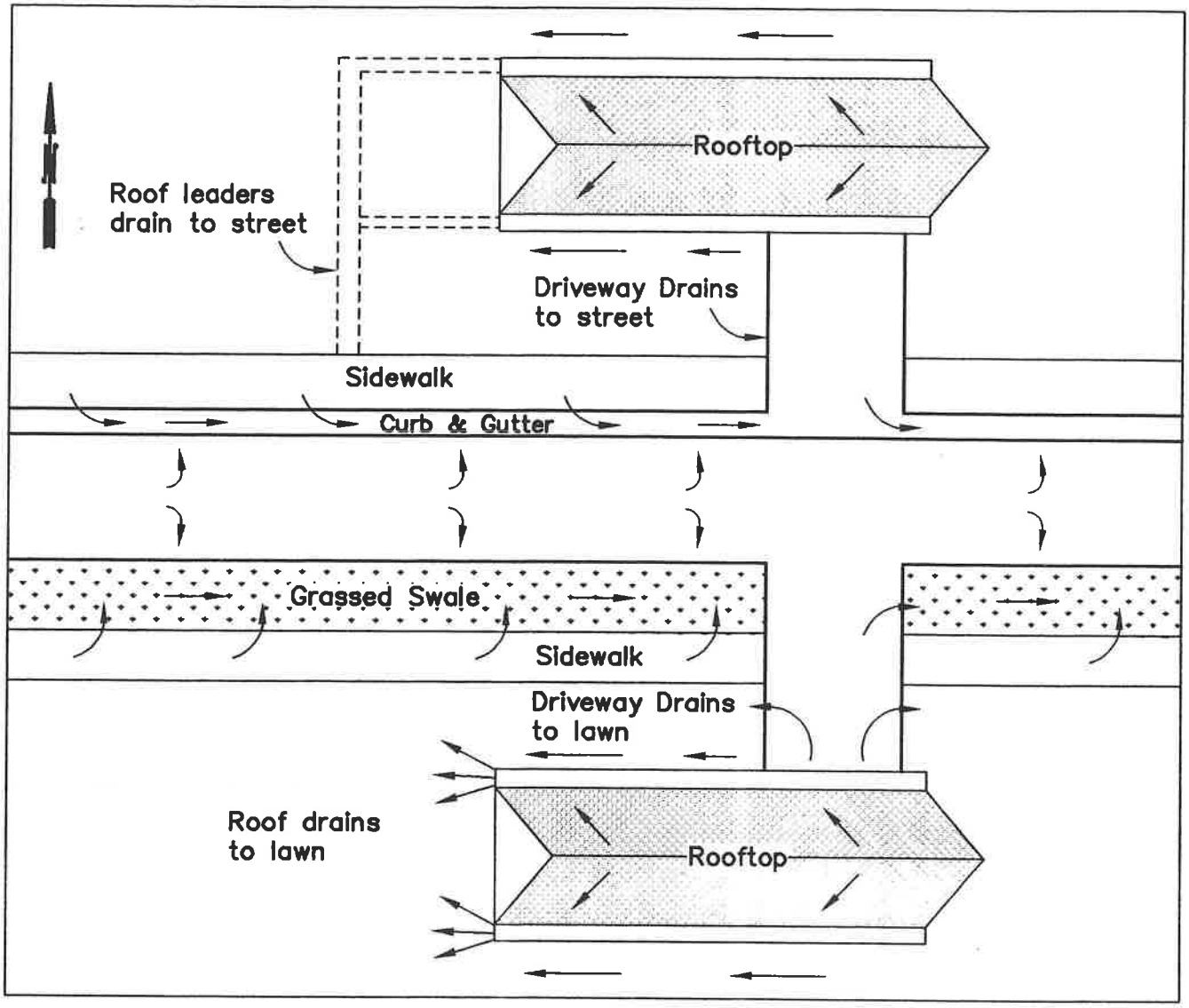
SWALES AND FILTER STRIPS

Swales, or grassed waterways, and filter strips are among the oldest stormwater control measures, having been used alongside streets and highways, as well as by the farmer, for many years. A swale is a shallow trench that has the following characteristics:

- Side slopes flatter than three feet horizontally to one foot vertically.
- Contiguous areas of standing or flowing water only following rainfall.
- Planted with or containing vegetation suitable for soil stabilization, stormwater treatment, and nutrient uptake.

A filter strip is simply a strip of land across which stormwater from a street, parking lot, rooftop, etc., sheet-flows over before entering adjacent receiving waters.

For small storms, both swales and filter strips remove pollutants from stormwater by 1) slowing the water and settling or filtering out solids as the water travels over the grassed area and 2) allowing infiltration into the underlying soil. Heavy metals are typically



EXAMPLES OF MAXIMIZING (North Lot AND MINIMIZING (South Lot) DIRECTLY CONNECTED IMPERVIOUS AREAS

CITY OF ILWACO

FIGURE 7-1
EXAMPLES OF DIRECTLY CONNECTED IMPERVIOUS AREAS

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\ILWACO\98789\V \FIG7-1.DWG

trapped in the upper regions of the soil column. In addition, the vegetation tends to function as fixed media to support growth of microorganisms, which can break down dilute concentrations of organics such as oil residues. In general, the higher the flow rate, the lower the efficiency. Thus, low velocity and shallow depth are key design criteria. A swale designed with a low bottom slope and check dams will perform much more efficiently than one without check dams. Raised driveway culverts can be effective as swale check dams. For maximum efficiency of pollutant removal during small storms, a trapezoidal swale with as large a bottom width as can be fitted into the site plan is desirable, since this will maximize the amount of runoff in contact with the vegetation and soil.

Design equations for swales and filter strips can be found in Chapter 3 of the DOE *Stormwater Management Manual for Western Washington*. Maintenance of both of these devices is an important consideration, for reasons of both aesthetics and hydraulic efficiency. In the case of the swale, care must be taken to insure that flows through a swale used for drainage purposes during large storms are not impeded by an overgrowth of vegetation. To prevent this, the vegetation planted in the channel should be suitable for mowing, and the channel designed so that mowing machines can be easily and efficiently operated along the swale. The swale should be mowed on a regular basis. For filter strips that are not part of the drainageway during large storms, maintenance is purely an aesthetic matter. These strips can be planted in grass and mowed, or natural vegetation can be used. Ground cover must be sufficiently dense to keep the overland flow from channeling and eroding rivulets through the filter strip.

PARKING BLOCKS

Parking blocks are a very effective site-control device. Parking blocks are hollow concrete blocks similar to but smaller than those used in construction. In commercial parking lots, the use of parking blocks in the less frequently used areas will give them an attractive appearance and will considerably reduce runoff quantity, flow rates, and pollution. This is also true for private driveways and parking areas where more than half of the area is used less than 20 percent of the time.

Parking blocks are put in place in rows, with soil surrounding each one. Soil areas are planted with appropriate vegetation. Runoff quantity reduction occurs as infiltration takes place in the planted areas. Greater flow resistance of the grassed areas retards the runoff rate, especially during small storms. Finally, the quality of the runoff is much enhanced over that from a normal parking lot because the pollutants, restrained by the vegetation matrix, will be more difficult to wash off than if they were simply lying on asphalt or concrete. Entrapped heavy metals are typically contained in the upper soil column, while microorganisms attached to the vegetation can act to break down low concentrations of organic pollutants.

In designing a parking block area, the block manufacturer should be consulted to determine the most suitable sub-base to use. Also, only the actual parking spaces should be paved with the blocks, since they do not hold up well under traffic. The traffic lanes through the lot should be paved in the normal fashion.

INFILTRATION DEVICES

Infiltration devices are those stormwater quality control measures that completely capture runoff from the design storm and allow it to infiltrate into the ground. The DOE *Stormwater Management Manual for Western Washington* provides design and sizing guidance in Chapter 7 of Volume V (Runoff Treatment BMPs)l. Infiltration systems provide groundwater recharge and pollutant removal, can be integrated into a site's landscaped and open areas, and if designed properly, can serve larger developments. Infiltration devices should be used only in situations where the captured volume of water can infiltrate into the ground before the next storm and where soils, slope and cover will not promote sloughing and mass wasting (landslides). **It should be noted that the applicability of infiltration systems in the Ilwaco area is seasonally limited due to the high ground water and soil conditions. Infiltration systems in this area may only be used if tests reveal that sufficient permeability exists within the soil.**

Infiltration devices can be classified into one of two categories: above-ground infiltration basins and buried infiltration trenches.

An infiltration basin is made by constructing an embankment or by excavating in or down to relatively permeable soils. The basin will temporarily store stormwater until it infiltrates through the bottom and sides of the system. The infiltration "basin" can actually be a landscaped depression within open areas or even a recreational area such as a soccer field. Infiltration basins generally serve areas ranging from a front yard to a 50-acre area.

Infiltration basins can be constructed on-line or off-line with respect to the normal drainage path. When a basin is located on-line, it will capture the water quality design storm entirely. When a larger storm occurs, runoff overflows the basin, which then serves as a detention pond for those larger events.

Off-line infiltration basins are designed to divert the more polluted first flush of stormwater out of the normal path and hold it for later water quality treatment. When the infiltration basin reaches capacity, the flow path for any additional stormwater returns to normal and is managed for drainage and flood control. The diverted first flush is not discharged to surface water. It is stored and gradually removed by infiltration, evaporation, and evapotranspiration. This is the most effective practice for enhancing the quality of stormwater. It also helps to reduce stormwater volume and to recharge groundwater.

Infiltration trenches, which can be located on the surface of the ground or buried beneath the surface, are usually designed to serve areas ranging up to five to ten acres in size and are especially appropriate in an urban area, where land costs are very high. An infiltration trench generally consists of a long, narrow excavation, ranging from three to twelve feet in depth, which is backfilled with stone aggregate, allowing for the temporary storage of the first-flush stormwater in the voids between the aggregate material. Stored runoff then infiltrates into the surrounding soil through either the trench bottom or the sides, depending on the elevation of the water table and soil properties. Soil type is also a consideration, since course soils overlying a shallow aquifer may provide a direct route for pollutants to contaminate groundwater.

There are two major types of trenches, surface trenches and underground trenches. The major differences between the two involve the amount of stormwater that can be handled and the ease of maintenance.

Surface trenches receive sheet-flow runoff directly from adjacent areas after a grass buffer has filtered the runoff. They are typically used in residential areas where relatively small loads of sediment and oil can be trapped in grass filter strips at least 20 feet wide. Sediments can clog infiltration devices. Once these devices are clogged, rehabilitation of the infiltrative surfaces requires significant effort.

Underground trenches can be used in many development situations, although discretion must be exercised in their application. While underground trenches can accept runoff from storm sewers, they require installation of special inlets to prevent coarse sediment and oils and greases from clogging the stone reservoir. These inlets should include trash racks, catch basins, and baffles to reduce blockage by sediment, leaves, debris, and oils and greases. In addition, pretreatment by routing the flow over grassed filter strips or vegetated swales is essential to protect the infiltration trench.

If properly constructed, with pretreatment practices in place to prevent heavy sediment loading, infiltration trenches can provide stormwater benefits without tremendous maintenance requirements. Since trenches are usually "out of sight, out of mind", getting property owners to maintain them can be difficult. Accordingly, a public commitment for regular inspection of privately owned trenches is essential, as are legally binding maintenance agreements and education of owners about the function and maintenance needs of trenches.

Inspection of trenches should occur frequently within the first few months of operation and once per year thereafter. Such inspections should be done after large storms, in order to check for water-ponding. Water levels in the observation wells should be recorded over several days to check drawdown. In addition, grass buffer strips should maintain a dense, vigorous growth of vegetation, which should receive regular mowing (with

bagging of grass clippings) as needed. Finally, pretreatment devices should be checked periodically and cleaned when the sediment reduces available capacity by more than 10%.

Structural Alternatives

The incorporation of runoff quality controls into urban landscape design is more an art than a science. However, if the design is developed with the following concepts in mind, a good water quality management system will result.

- Design runoff quality controls to capture small storms.
- Design to maximize sediment removal, and removal of other pollutants will generally be good.
- The most effective method for reducing urban runoff pollution is to minimize directly connected impervious area (DCIA).
- Infiltration devices are most efficient but are most difficult to maintain, and may not be used on sites with poor soil conditions.
- Dry detention is easiest to design and operate, but efficiency can be low.
- Wet detention is more difficult to design but more efficient than dry detention, and often more aesthetic.

With thoughtful planning and careful design, cost-effective runoff quality controls can be integrated into urban development plans to achieve the required level of pollutant reduction with minimal negative impact on aesthetics. The aesthetic character of a development site can often be enhanced by properly integrating runoff quality controls into the site plan.

STORMWATER QUANTITY AND QUALITY CONTROL: NON-STRUCTURAL ALTERNATIVES

Management of a stormwater system can be improved by strengthening various areas of city administration. The administrative issues, also termed non-structural issues, embrace a wide variety of measures, which include source controls.

Non-structural stormwater management alternatives include:

- Maintenance programs
- Staff Training
- Changes to the municipal codes or regulations
- Enforcement actions for non-compliance with stormwater regulations
- Public education
- Stormwater Best Management Practices

Source control measures are designed to minimize or eliminate contact of pollutants with stormwater at the site of origin. Regulation of development, such as requiring the enclosure of a pollutant source, physically segregating the pollutant source to prevent run-on of uncontaminated water and connecting directly to sanitary sewers are forms of source control. A requirement for erosion and sedimentation control during construction is a source control method for reducing pollutant load to receiving waters. Source control methods also include education of the public to prevent disposal of yard wastes, household chemicals and motor oil into drainage facilities. Source control measures that City staff can implement include the BMPs discussed in Volume IV Chapter 2 of the *Stormwater Management Manual for Western Washington* for landscaping and lawn/vegetation management; maintenance and repair of vehicles and equipment; maintenance of public and private utilities; and maintenance of roadside ditches and urban streets.

FACILITIES MAINTENANCE

The objective of a stormwater maintenance program is to assure the reliability and dependability of the stormwater system. A complete maintenance program includes more than the physical tasks of cleaning catch basins, pipes and open ditches; maintenance of vegetation in biological treatment structures; and proper disposal of debris from the maintenance activities. Maintenance programs also involve management items such as completing and maintaining a facilities inventory, maintenance scheduling, assessing costs for contract maintenance versus staff maintenance, and record keeping.

In order to perform maintenance at the appropriate time, a budget, staff and priority schedule needs to be established. Certain types of maintenance are more important than others. It is important that catch basins and conveyance facilities be inspected before the wet season to assure that debris has not blocked a channel or taken up capacity in a manhole. Street sweeping in the fall is important because leaves block catch basin grates which could result in overland flow across private property or flooding of roadways. Loss of vegetative cover in treatment swales and filter strips during summer drought conditions can result in reduced effectiveness during the "first flush" of autumn storms.

Reports and record keeping are important feedback mechanisms that enable management to compare actual versus planned costs, production and efficiency. Reports provide a database for improved budgeting and resource allocation. Records and reports should include man-hours, equipment hours, materials used and the unit of work completed.

Maintenance control establishes accountability for specific results within a specific time frame and budget. The maintenance program needs a control hierarchy to establish a chain of command to complete the work.

Appendix D identifies the requirements and guidelines for maintaining stormwater facilities. This appendix includes a table that describes potential problems and the necessary corrective actions for typical stormwater treatment, detention and conveyance facilities. The table also identifies a recommended period of time between routine inspections and routine maintenance activities. Of course, as these facilities are maintained the need may arise for maintenance at a level more (or less) than these typical values. It should also be noted that at the time of facility installation, the City should request a manual describing specific maintenance necessary for the facility. This, coupled with a routine schedule, will help ensure proper maintenance of the facility. One item of critical importance is the city's diligence in inspecting privately owned and maintained facilities. Some jurisdictions provide stormwater utility credits or refunds for those private facilities that are properly and routinely maintained. The City of Ilwaco does not currently have this capability. Therefore, with no financial incentive, it is even more critical that the City performs these inspections and issue notices of inspections to those private parties who are not maintaining their facilities. Because the proper operation and maintenance of stormwater facilities benefits the public as a whole, the City should utilize innovative solutions to accomplish the goals of stormwater management in those cases where a private entity will not, or cannot, maintain their facility, rather than enacting civil penalties for the sake of punishment. It is highly recommended that the City seek easements for those portions of the system that lie outside of the right-of-way.

The various stormwater facilities that require maintenance are described below.

1) Street Sweeping

Streets with concrete curb and gutter or thickened edges are part of the stormwater conveyance system. All streets accumulate vehicular emission particles, silt, and, leaves and other debris and pollutants that could enter the stormwater conveyance system. Street sweeping (not washing) is an important maintenance item to reduce pollution in the receiving waters and to reduce the potential for blocking of the conveyance system. High efficiency street sweepers are recommended due to the fact that they have evolved into a useful technique for picking up small particulates which accumulate pollutants along City streets. Street sweeping is recommended at least once per year in the fall, after the leaves have fallen.

2) Catch Basin Cleaning

Catch basins in the City include types with and without sumps. Sumps are important features that allow deposition of particulate matter carried in the stormwater. When sumps become filled to 60 percent of their volume, the efficiency of silt removal diminishes significantly. All catch basins should be inspected at least twice per year. Once a maintenance program is in place, the

City will be able to develop a history on particular areas to determine which basins require more frequent attention. Catch basins are normally cleaned with a vactor truck that removes the sediment from the basin. This sediment must be disposed of properly into an appropriate disposal site. Since a dedicated vactor waste facility is not located in Pacific County, the City may choose to use Peninsula Sanitation for proper disposal of sediment obtained from catch basins. For the purposes of this plan, catch basin cleaning is estimated to be required an average of twice a year.

3) Pipe Cleaning

Pipes in the City vary in size from 6-inch to 48-inch diameter. Pipe types include concrete, clay, corrugated metal and PVC. All pipes should be inspected annually and cleaned, at a minimum, every third year. A vacuum system is recommended for cleaning. If pipe flushing is used, adequate downstream siltation control must be in place.

4) Open Ditch Cleaning

Some roads in the City of Ilwaco are drained by means of roadside ditches. Ditches and swales can provide biofiltration, if vegetation is allowed to remain within the channel and on the sides. The primary pollutant removal mechanism of a bioswale (or ditch) involves filtration by grass blades which enhance sedimentation, as well as trapping and adhesion of pollutants to the grass and thatch. To be most effective, the vegetation within the ditch should be cut down to a height between 2 and 6 inches. Swales can be cleaned by the use of a horizontal auger. Ditches should be cleaned twice a year, preferably during the summer months to allow vegetation to grow back before the rainy season. The edges of the ditches should be mowed four times a year.

5) Detention System Cleaning

Upon installation of a detention system the City should request a manual regarding specific maintenance requirements for facilities such as detention ponds. At a minimum, when detention systems are installed in the City, they should be monitored annually for sediment accumulation. Removal of accumulated sediment is anticipated to be required once every five years.

6) Future Oil/Water Separators

Oil/water separators must be maintained in order to be effective. If deposited material is not removed on a periodic basis; it may be flushed downstream by winter storms. Inspection of oil/water separators should be scheduled bimonthly

and maintenance cleaning scheduled at least annually and more frequently if required.

All components of the stormwater system should be inspected at least twice per year. Additional inspections may be warranted in problem areas and also in areas where land development is occurring, due to the potential for erosion and sedimentation. Routine maintenance should be performed on all components based on these inspections. In general, most jurisdictions do not provide an appropriate level of maintenance for all portions of their system. Maintenance is often reactive, rather than proactive.

Several benefits can be realized by maintaining all portions of the stormwater system. With a well maintained system better treatment and flow control is accomplished, the public recognizes a well run maintenance program, it becomes easier to identify problems and resolve complaints, and problems such as flooding, icing of roadways, and damage to the system are minimized.

STAFF TRAINING

A fundamental part of the stormwater program includes training for city personnel on how to address stormwater issues. The City should ensure that the city staff is well trained on how to inspect and maintain best management stormwater practices as outlined in Section 4.6 of the *Stormwater Management Manual for Western Washington*. At a minimum, staff should be educated on how to maintain catch basins, detention ponds and control structures, bioswales/ditches, Stormfilter vaults, and any other best management practices implemented within the City. Staff shall also be knowledgeable in identifying pollutant sources and in understanding pollutant control measures, spill response procedures, and environmentally acceptable material handling practices. Ecology's "Stormwater Pollution Prevention Planning for Industrial Facilities" (WQ-R-93-015, 9/93) may be used as a training reference. The utilities supervisor may be designated as responsible for setting up training for new employees regarding these issues. Renewal training for all employees on a biannual basis is recommended as well.

Personnel must also be well trained on sediment and erosion control issues so they can properly investigate and advise contractors regarding problem areas during construction. Staff members should be certified through the "Construction Site Erosion and Sediment Control Certification Course" offered thought the year by the Associated General Contractors of Washington Education Foundation or an approved equivalent. Equivalent certificates include:

- WSDOT certification in Construction Site Erosion and Sediment Control.
- Certified Professional in Erosion and Sediment Control (CPESC) offered by the International Erosion Control Association (IECA).

Erosion and sediment control certification for staff members should be renewed every three years.

CHANGES TO MUNICIPAL CODES AND REGULATIONS

The federal, state and local rules, regulations and guidelines that govern stormwater have been discussed in Chapter 3 of this document.

In order to consolidate the various regulations and policy directives, a proposed Stormwater Management Ordinance is included in Appendix B. The proposed ordinance provides the ability for the City to adopt the *DOE Stormwater Management Manual for Western Washington*. Adoption of this manual will provide the City with a comprehensive technical support document for implementing erosion and sedimentation control facilities on development sites, allow establishment of technical requirements for best management practices (BMPs), and provide design criteria for structural stormwater management facilities.

ENFORCEMENT

City staffing levels must be sufficient to monitor construction activity, respond to surface water complaints, and provide periodic inspection of private stormwater treatment facilities such as oil/water separators and detention facilities. Existing staff should document the hours spent on site inspections, together with the frequency of inspection of construction sites and private stormwater facilities. From these records and the records of time spent responding to complaints, an understanding of the adequacy of the current staffing level can be gained.

PUBLIC INVOLVEMENT AND EDUCATION

An important element of a stormwater management plan is public involvement and education. The involvement of the public is necessary to insure the overall success of the stormwater management plan. For the public to be motivated to participate in stormwater management it must first be made aware of the existing surface water problems, what role the public has in causing surface water problems and what can be done about them.

The general public must be made aware of how their normal activities affect stormwater quality and quantity. Most citizens believe that stormwater management is someone else's problem. In order to educate the public it is necessary to identify those subjects that have local relevance and then design a program that addresses those issues. Public education programs in the Ilwaco area should focus on the following issues:

- Voluntary ditch maintenance
- Catch basin stenciling
- Citizen hotline
- Oil recycling center
- Newsletter articles
- Signs at stream crossings
- Neighborhood compost bin

1) Voluntary Ditch Maintenance

A voluntary drainage ditch maintenance program should be established that encourages property owners to mow and otherwise maintain the drainage ditches adjacent to their properties. Local groups, clubs, and service organizations can be recruited to provide maintenance for drainage features, which have a more community-wide significance. The efforts will need to be coordinated by the City, which must also provide a clearinghouse where information can be stored and distributed. The goal of the program is to insure that drainage ditches are maintained in a condition, which insures that ditches will be able to carry the full design capacity of stormwater when needed. The City may wish to consider an ordinance that requires property owners to maintain the ditches adjacent to their property. Such an ordinance would be similar to sidewalk maintenance ordinances used by other cities.

2) Catch Basin Stenciling

A program that encourages citizens and local service groups to stencil catch basins is needed to discourage the dumping of oil or other harmful substances and to inform citizens that materials dumped in the catch basins end up in waterbodies. The goal of this program is to have 100% coverage of catch basin stenciling.

Many if not most, people are unaware that storm drains usually discharge into nearby surface waters. By stenciling all catch basins within the City with an appropriate warning, citizens will be made aware that anything dumped into a catch basin will soon enter the Columbia River, Black Lake, or Willapa Bay.

3) Oil Recycling Center

This program will encourage a local business to become a drop-off point for waste oil to be recycled. The general public must be made aware of the location and hours for the local recycling station and the procedures for disposing of waste oil at the station.

The goal of this program will be to provide a suitable destination for waste oil. This will serve to provide alternatives to other practices that have been used in the past, such as dumping of waste oil down storm drains. An effort should be made to coordinate the establishment of the waste oil-recycling center with other nearby jurisdictions.

4) Newsletter

A community newsletter that addresses stormwater issues should be published. The newsletter can include articles containing relevant information of local interest to help citizens eliminate or minimize stormwater quantity or quality problems.

The goal of this program will be to place issues concerning activities affecting the watershed before citizens in a timely manner. Issues to be addressed include:

- Composting
- Fertilization practices
- Hazard household waste disposal
- Waste oil recycling
- Pesticide use
- Ditch maintenance
- Sensitive area protection
- Waterfowl feeding (adverse effects)
- Wetlands protection/maintenance
- Citizen hotline

An expected impact of this portion of the plan is to provide residents timely reminders of the role they play and the effect they have on water quality in the watershed.

5) Citizen Hotline

This portion of the program will establish and publish a phone number for use by citizens to report activities that could cause water quality problems. It would also be used for reporting surface water quality problems.

The goal of this program is to reduce the amount and types of external loading on local streams and water bodies. The impact of this program will be to reduce stormwater impacts and to assure that appropriate education of enforcement actions are undertaken.

6) Signs at Drainage Channel Crossings

This program will provide signs at the locations where roadways cross drainage channels. These signs are intended to mark the location of stormwater drainage features to provide an ongoing reminder to citizens of the community's efforts to improve and control surface water pollution. The goal of this program is to increase the public awareness of and familiarity with surface water resources.

7) Neighborhood Compost Bin

This program will survey available sites with the intent of establishing a community compost bin. The compost bin, when established, will provide a site for disposal of yard wastes for residents without sufficient space for a residential compost bin or for those whose properties are unsuitable for such use. The City will maintain and manage the compost bin and use the resulting compost in the City parks and public places.

The goal of this program is to insure that all yard wastes are disposed of in an environmentally sound manner. Side benefits of this program include the reduction of the quantity of yard wastes sent to landfills and provision of a source of landscaping material for the City.

BEST MANAGEMENT PRACTICES

In most communities a major source of stormwater contamination comes from sources that are lumped together and called non-point pollution. Non-point pollution sources can generally be defined as "pollution that does not have a single point of discharge." Non-point pollution discharges can be divided into commercial and residential categories.

The treatment of stormwater runoff prior to discharge to surface water or prevention of non-point pollution in stormwater should be accomplished by using Best Management Practices (BMPs). Best Management Practices are defined as physical, structural, and/or managerial practices, which when used singly or in combination, prevent or reduce pollution of water.

The DOE *Stormwater Management Manual for Western Washington* contains BMPs for urban land uses. Best Management Practices can be placed into two general groups: source control BMPs, and runoff treatment BMPs. The former group includes those BMPs, which keep a pollutant from ever coming in contact with stormwater; the latter group consists of various methods of treating stormwater. Source control BMPs are preferred as they are generally less expensive and frequently are very effective in eliminating the source of pollution prior to its entry into runoff.

The *DOE Stormwater Management Manual for Western Washington* lists many types of BMPs, and provides some general strategies for their use. The strategies are listed below in order of preference:

Alter the activity: The preferred option is to alter any practice that may contaminate surface water or groundwater by either not producing the pollutant to begin with or by controlling it in such a way as to keep it out of the environment. An example would be recycling used oil rather than dumping it down a storm drain.

Illicit or unintentional connection of indoor drains to the storm drain, rather than to the sanitary or process sewer is a significant source of stormwater contamination. It is important that these connections are identified and corrected.

Enclose the activity: If the practice cannot be altered, it should be enclosed in a building. Enclosure accomplishes two things. It keeps rain from coming into contact with the activity, and since drains inside a building must discharge to sanitary or process wastewater sewers or a dead-end sump, any contamination of runoff is avoided.

Cover the activity: Placing the activity inside a building may be infeasible or prohibitively expensive. A less expensive structure with only a roof may be effective although it may not keep out all precipitation. Internal drains must be connected to the sanitary sewer to collect water used to wash down the area as well as any rain that may enter along the perimeter.

Segregate the activity: Segregating an activity that generates more pollutants than other activities may lower the cost of enclosure or covering to a reasonable level.

If the segregated activity cannot be covered, it may be possible in certain situations to connect the area to the public sanitary sewer, subject to the approval of the City. Or, drains may be connected to a businesses' own process wastewater system if the business operates independently of the local authority.

Discharge stormwater to the process wastewater treatment system: Many industries have their own process wastewater treatment system with final disposal directly to the receiving water. In these cases, stormwater from areas of significant pollution sources can be plumbed to the process treatment system as long as its capacity is not exceeded.

Discharge small, high frequency storms to public sanitary sewer: This BMP would be limited to those few outside activities that contribute unusually high concentrations of pollutants and/or pollutants of unusual concern. Limited entry of these few special cases may not overtax the public sanitary sewer.

The entry of stormwater to the sanitary or combined sewer can be limited to the small high-frequency storms that carry off the majority of pollutants over time. Storm flows in excess of the hydraulic capacity of the sanitary or combined sewer would be discharged to the storm drain.

Discharge small, high frequency storms to a dead-end sump: This BMP would be limited to those few activities that contribute unusually high concentrations of pollutants and/or pollutants of unusual concern. This option would be used when discharge into a sanitary sewer or process wastewater treatment is not available or feasible. This option requires the capacity to pump out the sump regularly and to dispose of the pumpage in an appropriate manner.

Treat the stormwater with a stormwater treatment BMP: The treatment of stormwater is the least-preferred option for several reasons. Source control BMPs keep the pollutants completely away from stormwater. In contrast, stormwater treatment devices are not 100% effective. In fact, a highly effective BMP is considered successful if 80% of the pollutants are removed. Even after treatment, freshwater criteria may not be met for commercial areas.

Given the above strategies for use of BMPs, DOE has developed mandatory BMPs for many different business groups. Section 2.2 and Appendix IV-A of Volume IV in the DOE *Stormwater Management Manual for Western Washington* lists each group of business in the following way:

- Title of business group
- Standard Industrial Code (SIC)
- Description of business activities
- Potential pollution generating sources
- Pollutant Control Approach
- Applicable Operation BMPs
- Applicable Structural Control BMPs

The source control BMPs are found in Volume IV, in numerical order, in the DOE *Stormwater Management Manual for Western Washington.* Descriptions of regulations that are specifically referenced can be found in Appendix IV-D, and any stormwater treatment BMPs required can be found in Volume V, Runoff Treatment BMPs. Ecology has recently recommended implementing oil control measures for "high use areas". These areas include:

- An area of a commercial or industrial site subject to an expected average daily traffic count equal to or greater than 100 vehicles per 1,000 square feet of gross building area,

- An area of a commercial or industrial site subject to petroleum storage and transfer in excess of 1,500 gallons per year, not including routinely delivered heating oil,
- An area of a commercial or industrial site subject to parking, storage or maintenance of 25 or more vehicles that are over 10 tons gross weight,
- A road intersection with a measured average daily traffic count of 25,000 vehicles or more on the main roadway and 15,000 vehicles or more on any intersection roadway, excluding projects proposing primarily pedestrian or bicycle use improvements.

Providing treatment under the oil control menu is just one of four treatment menus that Ecology has provided in Chapter 3 of the Stormwater Manual. The other three include a basic, enhanced, and phosphorus treatment menu. However, as noted earlier, source control BMPs are preferred over treatment BMPs, if feasible.

CHAPTER 8

CAPITAL IMPROVEMENT PLAN

INTRODUCTION

The Capital Improvement Program (CIP) is based on a number of criteria. First, all known storm drainage problems identified by City staff were investigated. Capital improvements or other measures are recommended for these problems. In addition, the hydrologic/hydraulic modeling effort identified that some storm drainage facilities are inadequately sized to convey the runoff generated by the 25-year design storm event based on future land use conditions.

It is important to keep in mind that whenever an inadequate pipe or channel is replaced or reconstructed, the improvement may transfer the problem downstream. It is therefore **strongly** recommended that all new development provide on-site detention and water quality treatment, as described in the Washington State Department of Ecology's *Stormwater Management Manual for Western Washington*, especially in the steep, currently forested area west of downtown Ilwaco.

The cost estimates provided herein, do not include such items as permitting costs, sales tax, utility relocations, trench dewatering, or traffic control. They are however, conservative in nature and should be considered adequate for planning purposes. Also, as stated in Chapter 5, since no survey was conducted throughout the compilation of this plan, any recommended capital improvement projects resulting from this plan need to include surveys to ensure the most accurate and effective design for the project. All recommended projects assume that the existing pipe slope will be utilized in the future. However, the most optimum slope should be analyzed in order to provide maximum pipe capacity. Table 8-1 summarizes all of the recommended capital improvements (See Figure 8-1). Costs estimates are detailed in Appendix E.

TABLE 8-1

Recommended Capital Improvements

	Project	Priority Year	Estimated Cost (2002 Dollars)
1.	2001 Stormwater Comprehensive Plan	2002	$60,000
2.	South Howerton Way Improvements	2002	$68,000
3.	Ditch Rehabilitation	2003	$7,000
4.	North Howerton Avenue Improvements	2004	$90,000
5.	Replace Willow Ditch with 24" Pipe	2005	$41,000

SIX YEAR CAPITAL IMPROVEMENT PLAN

DITCH REHABILITATION

Maintenance of ditches belonging to both the City and the Port of Ilwaco is critical in reducing flooding within Ilwaco. Areas of particular concern include those ditches located along 2nd Avenue, the intersection of Highway 101 and Maryann St., and the series of ditches located along the north edge of the Port property. According to Public Works personnel, flooding occurs approximately once per year at the homes located along Eagle Creek (2nd Ave). Modeling results revealed that both 36-inch pipes (one crosses under 2nd Avenue; the other crosses under Eagle Street) are adequate to handle the flows resulting from a 25-year storm. Therefore, to reduce flooding impacts, it is recommended that the ditch be cleaned and maintained on a regular basis. All ditches should be inspected and maintained as described in the maintenance program in Appendix D. To facilitate this maintenance on a regular basis, it is highly recommended that the City obtain easements for all stormwater systems (including pipes and ditches) lying within private property. Maintenance of these systems involves clearing ditches of trash and debris, removing sediment that exceeds 20% of the ditch's depth, and ensuring that existing vegetation allows free movement of water throughout the ditch. Side slopes shall also be checked for erosion hazards and repaired on an as-needed basis. Since the first cleaning will be more involved than future ones, the estimated cost of the first phase of this project is $7,000 with an estimated cost of $1,000 per year following the initial cleaning.

SOUTH HOWERTON WAY IMPROVEMENTS

Historically, the area north of Howerton Way has been prone to significant flooding. As described earlier, this flooding is most likely due to undersized pipes and poorly maintained ditches. This area consists of a number of conveyance systems where each system ends in an outfall to the marina. The flow gathered from both Myrtle Street and William Street is collected and eventually released through a 15-inch pipe. To reduce the risk of flooding during the 25-year storm event, it is recommended that approximately 600 lineal feet of this pipe be upgraded to 24-inches in diameter. In light of the road improvements planned for Howerton Way this year, approximately 200 lineal feet of this project can be constructed during these improvements. The estimated cost for this portion of the replacement totals $68,000.

REPLACE WILLOW DITCH WITH 24" PIPE

The current drainage system along Willow Street (east of Quaker Avenue) overflows during high intensity storms and poses a potential flooding concern to neighboring properties. To alleviate these problems, the replacement of the ditch with approximately 200 linear feet of 24-inch diameter pipe is recommended. Installation of this pipe will direct stormwater away from the yards located along Willow Street. The estimated cost of the project is $34,000.

Missing Figure 8-1.

WILLOW DITCH REPLACEMENT W/ 24-INCH PIPE

NORTH HOWERTON IMPROVEMENTS

SOUTH HOWERTON IMPROVEMENTS

SCALE
1" = 200'

AREA OF DETAIL

STORM LINE
DITCH LINE
PARCEL LINE
RECOMMENDED PIPE REPLACEMENT

NOTES:
① PIPE SIZE AND/OR LOCATION COULD NOT BE CONFIRMED IN FIELD VISITS. (OCTOBER 2000)

CITY OF ILWACO

FIGURE 8-1
CAPITAL IMPROVEMENT PROJECTS

JN DATE: 01/22/01 PATH: L:\ILWACO\99789\BASEMAP\FIGURE 8-1.DWG

NORTH HOWERTON WAY IMPROVEMENTS

The area north of Howerton Way has been prone to significant flooding as described earlier. This project involves the replacement of approximately 400 lineal feet of 15" pipe with 24" pipe between Main Street and Howerton Way. The replacement of two 8" pipes with 12" pipes would take place as well. These pipes (extending a total of 320 lineal feet) currently drain the ditches lying between Pearl and Advent Avenue. A significant component of this project involves the routine maintenance of the ditches along the north side of the Port property. Increasing the pipe sizes as recommended here will help alleviate current flooding problems but it is also important that stormwater is effectively conveyed through the ditches so that it can reach these pipes. The stormwater model mentioned throughout this plan involved assumptions pertaining to the size of the ditches located along the north Port property. A detailed survey of this area should be conducted to verify the current geometry of the ditches and, if properly maintained, that these ditches will be adequate to convey the 25-year storm. The total estimated cost of the project is $90,000.

OTHER RECOMMENDED PROJECTS

Vandalia Improvements

Another improvement project was identified through discussions with Public Works personnel. The homes along the northwest side of the Vandalia neighborhood are often prone to flooding throughout the year. City personnel indicated that this area floods quite frequently due to the overtopping of the bank by the portion of the Wallacut River bordering these properties. The development was built within the 100-year flood plain. The Federal Emergency Management Agency (FEMA) recommends that all structures within a 100-year flood plain be built a minimum of one foot above the flood plain elevation. Although the project is not included in the 6-year Capital Improvement Plan, it is suggested that the City may want to undertake this project when funding becomes available. The City should also mandate that all new and redevelopment within the area comply with this one-foot standard in the future. In addition, the City will want to readdress the issues within this Plan in 2008 when the 6-year planning horizon has been completed.

Stormwater Utility Formation

Municipalities may fund a storm drainage system's operation, maintenance, and capital improvement expenditures from a street fund or a stormwater utility fund. Formation of a stormwater utility provides a method for collection of service charges and connection fees to maintain and operate storm or surface water drains, channels, outfalls, and other facilities. The formation of a stormwater utility involves the following:

1. Analysis of revenue requirements / Identification of stormwater expenses

2. Distribution of costs identified above (i.e. Determination of a rate structure and necessary system development charges)

3. Inform public of proposed stormwater utility and address any concerns that may arise

4. City Council adopts an ordinance that creates the Utility and details its structure

Utility revenue may potentially be generated from utility charges and connection charges. All revenue collected through the service charge would be deposited in the Stormwater Management Utility Fund. The fund can pay for the costs of data collection, planning, design, construction, acquisition, maintenance and operation, and improvements of the drainage utility facilities, whether such facilities are natural, constructed, or both. The cost of administering the Utility would also be covered by this fund.

Once the revenue sources and expenses are identified, the next step involves distributing the costs to residential and commercial properties throughout the City. The utility would collect a monthly service charge from all existing developed properties (properties with impervious area) on a per Equivalent Residential Unit (ERU) basis. An ERU is defined for the City of Ilwaco as 2,000 square feet of impervious area. In order to determine this ERU or the typical square footage of impervious area for a single family residence, the impervious area for 50 homes was calculated using an aerial photo obtained from Walker and Associates in August, 2000. The areas were then averaged, resulting in a typical value of 2,000 square feet of impervious area per single family parcel. In order to calculate the number of commercial ERUs present within the City limits, the same aerial photograph from Walker and Associates was used to calculate impervious areas for commercial parcels. Utilizing this information under the current conditions, the City could begin billing a total of 1,343 ERUs within the City, with 335 ERUs pertaining to single family homes and 1,008 ERUs pertaining to commercial sites. In addition, the utility may collect a General Facility Charge per ERU for all properties that are improved by constructing or installing any structure or surface treatment that increases the amount of impervious area.

Once the rate structure has been determined, public meetings will be held to inform city residents and businesses of the proposed rates. Any concerns or issues surfacing from these meetings will be addressed. Upon public and City Council acceptance, the City can finalize the rate structure and proceed to adopt an ordinance forming the Utility.

The estimated cost involved with the formation of a stormwater utility as defined here is $15,000. This cost may include assessment of all commercial properties to determine the number of ERUs attributable to each property; development of the utility formation and

rate structure ordinances; legal review of the utility ordinances; public hearings; and investigation and implementation of billing software.

GENERAL RECOMMENDATIONS

It is recommended that the City continues to develop the stormwater system base map and inventory, and that this base map be updated at least once per year. It is recommended that the City eventually survey and map the entire stormwater system. Several areas may require TV inspection in order to verify the configuration of the system. On an annual basis, if it is feasible, the City may choose to utilize summer employees to perform these tasks and preliminary inspections.

It is recommended that the City enact a complete maintenance program that includes not only the physical task of cleaning catch basins, pipes, and open ditches, but also involves items such as completing and maintaining a system inventory, maintenance scheduling, assessing costs for contract maintenance versus staff maintenance, and record keeping. In order to ensure that maintenance will be provided on a regular basis throughout the entire City, it is highly recommended that the City obtain easements for those portions of the stormwater system that exist on private property.

It is recommended that during the course of review of development proposals, the City strictly enforce the development codes with respect to steep slope buffers, stormwater flow control, erosion hazards buffers, and habitat assessments.

It is also recommended that during the course of review of development proposals, the city enforce the provisions in the Washington State Department of Ecology Manual with respect to downstream analysis. If the analysis identifies conveyance problems, the City should require additional mitigation as a condition of approval.

CHAPTER 9

FINANCING ANALYSIS

INTRODUCTION

This chapter discusses methods of providing financing for the stormwater system operation and maintenance program and capital improvement projects which were recommended in Chapter 8, Capital Improvement Plan.

Funding for the capital improvements listed in Chapter 8 is an essential requirement for the implementation of the recommendations. The financial resources available to the City for the implementation of stormwater capital improvement projects, other than service charges and connection charges, include grant and loan funds, debt financing, and improvement districts. All financial resources are discussed below.

ERUs, SERVICE CHARGES

Service charges are the primary means of funding ongoing maintenance programs, repair or replacement of existing systems, and administration of the stormwater utility. In addition, service charges can be used to repay debt service for loan or bond indebtedness for the utility.

A stormwater utility would collect a monthly service charge from all existing developed properties in an amount to be determined based upon the services stated above and the number of ERUs within the City as described in Chapter 8.

As stated earlier, all revenue collected through the service charge can be deposited in a Stormwater Management Utility Fund. The fund can pay for the costs of data collection, planning, design, construction, acquisition, maintenance and operation, and improvements of the drainage utility facilities, whether such facilities are natural, constructed, or both. The cost of administering the Utility may also be covered by this fund.

FUTURE STORMWATER UTILITY OPERATING EXPENSES

Future stormwater utility operation and maintenance expenses are estimated using input from staff, previous maintenance expenditures, and current sub-contracting rates. The majority (74%) of the estimated stormwater utility O&M expenses are due to administrative and maintenance labor costs.

The City currently does their own catch basin cleaning, jetting, and street sweeping. The year 2002 estimated cost for cleaning catch basins is based on a crew of 2 people/day for 13 days (170 catch basins total at 14 catch basins per day). Therefore, at a labor rate of $220/day/person, the total cost estimated for conducting catch basin cleaning twice a year is $11,000 (in 2002 dollars). Pipe jetting is approximated at 1,500 lineal feet per day for a 3 person crew. Since the City has their own jet truck, only labor costs are involved with jetting the pipes. With 14,000 lineal feet of stormwater pipe in the city, the estimated cost for jetting the pipes on an annual basis is $6,160 (= [14,000 ft/ 1,500 ft/day] x [3 people/ x $220/person/day]). The City also sweeps their own streets on a weekly basis. Using the same labor rate, the approximated cost for street sweeping once a week for a full eight-hour day is $11,440 (=$220/day x 52 days).

In addition to these services, it is recommended that the City conduct annual maintenance on ditches located within Ilwaco. A "spider" (or walking backhoe) may be needed to clean and reshape major ditches. The rental cost approximated for this machinery is $300/hour. Assuming it takes one day to clean the ditches on an annual basis with a three person crew, the annual cost is estimated at approximately $1,000.

Under miscellaneous expenses are the annual cost of stormwater utility supplies and equipment. According to City personnel, $10,000 is currently budgeted for stormwater supplies and equipment. We lowered this to $5,000 per year and for rate analysis, the cost is adjusted at 4% per year for inflation (see Table 9-2). A $5,000 administration expense was also added to the total stormwater utility operation and maintenance costs.

Table 9-1 shows a budget projection for annual stormwater operation and maintenance expenses for the years 2002 through 2007. All expenses are increased by a 4.0% annual inflation factor in the rate analysis (see Table 9-3).

TABLE 9-1

Future Stormwater Utility Operation & Maintenance Expenses

Activity	Quantity	Rate (per day)	Frequency (per year)	Crew (# persons)	Estimated Annual Cost
Catch Basins	170	14	2	2	$11,000
Streetsweeping	---	All streets	52	1	$11,440
Clean/Jet Pipes	14,000 LF	1,500 LF	1	3	$6,160
Maintain Ditches	4,000 LF	4,000 LF	1	3	$960
Drainage Supplies	---				$5,000
Administration	---				$5,000
Total:					$39,560
Total (Rounded):					**$40,000**

FUTURE STORMWATER UTILITY REVENUES

For this analysis, it is assumed that the City implements a stormwater utility and collects monthly service rates staring in January 2002. Future stormwater utility revenues are generated from monthly service rates and operating balances. The monthly service rate revenue projected for the year 2002 is based on the number of ERUs which were identified; 1,343 multiplied by the rate of $4.00 to $5.00 per month per ERU. Estimates of monthly service rate revenues for the years 2003 through 2007 are based on the number of ERUs being billed at the start of the year 2002 and increased by an annual growth factor of 0.58% from 2002 to 2005 and 0.59% from the year 2006 to 2007. It was necessary to increase the rate in 2005 from $4.00/month to $5.00/month to ensure sufficient funds were available in subsequent years. Table 9-2 shows projected stormwater utility revenues for the years 2002 through 2007.

TABLE 9-2

Future Stormwater Utility Revenues

Revenues	2002	2003	2004	2005	2006	2007
ERUs	1,343	1,351	1,359	1,366	1,374	1,383
Monthly Service Rates	$ 4.00	$ 4.00	$ 4.00	$ 5.00	$ 5.00	$ 5.00
Total Service Charge Revenue	$64,464	$64,848	$65,232	$ 81,960	$82,440	$82,980
Port of Ilwaco Stormwater Plan Contribution	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	
Total Operating Revenues	**$66,464**	**$66,848**	**$67,232**	**$ 83,960**	**$ 84,440**	**$ 82,980**

FUTURE REVENUES MINUS OPERATING EXPENSES

Using the projected stormwater utility operating expenses and revenues detailed in Tables 9-1 and 9-2, net operating income (before funding capital projects) can be calculated. Table 9-3 shows total stormwater utility operating expenses (not including capital improvement expenditures) minus total revenues. As can be seen from Table 9-3, after the start up year of 2002, net revenues range from approximately $22,000 to $39,000 per year.

TABLE 9-3

Stormwater Utility Revenues Minus Expenses (Not Including Capital Improvements)

Cash Flows	2002	2003	2004	2005	2006	2007
Total Operating Revenues	$66,464	$66,848	$67,232	$ 83,960	$ 84,440	$ 82,980
Minus Operation & Maintenance Expenses	($40,000)	($41,600)	($43,264)	($44,995)	($46,794)	($48,666)
Total Revenue Minus Total Operating Expenses	**$24,464**	**$23,248**	**$21,968**	**$38,965**	**$37,646**	**$34,314**

CAPITAL IMPROVEMENT FINANCING

The recommended capital improvements for the stormwater utility are detailed in Chapter 8. The list of projects, recommended schedule for implementation, their costs in year 2002 dollars, and their costs adjusted for a 4% annual inflation factor for the year they are scheduled to be constructed are shown in Table 9-4.

TABLE 9-4

Recommended Capital Improvements

No.	Project	Priority	Estimated Cost (2002 Dollars)	Estimated Cost in Year of Construction
1.	2001 Stormwater Comprehensive Plan	2002	$60,000	$60,000
2.	South Howerton Way Improvements	2002	$68,000	$68,000
3.	Ditch Rehabilitation	2003	$7,000	$7,280
4.	N. Howerton Improvements	2004	$90,000	$97,345
5.	Replace Willow Ditch with 24" Pipe	2005	$41,000	$46,120

As was shown in Table 9-3, the stormwater utility is expected to generate sufficient annual net revenues to pay for the capital improvement projects listed in the six-year plan from monthly service rate revenues. Table 9-5 shows a summary of total operating revenues and expenses, and annual capital reserve fund balances if capital improvement projects from Table 9-4 are funded from monthly service rates, a low interest loan from either the State or Federal Government, or through private debt financing instruments such as a revenue bond. Both the State and Federal Government offer low interest rate

loans and grant funds. Use of these low cost loans may be financially favorable to self-financing as long as the interest costs of the loans are less than the interest that can be earned from reserve funds. These programs are discussed in detail in the next section.

TABLE 9-5

Projected Cash Flows and Rate Impacts Through 2007

RATES	2002	2003	2004	2005	2006	2007
ERUs[1]	1,343	1,351	1,359	1,366	1,374	1,383
Monthly Service Rate	$4.00	$4.00	$4.00	$5.00	$5.00	$5.00
PROJECTED REVENUES	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Annual Stormwater Rate Revenues	$64,464	$64,848	$65,232	$81,960	$82,440	$82,980
Other Revenue						
Port of Ilwaco Stormwater Plan Contribution	$2,000	$2,000	$2,000	$2,000	$2,000	
Grant for S. Howerton Improvements[2]	$68,000					
TOTAL REVENUES	$134,464	$66,848	$67,232	$83,960	$84,440	$82,980
PROJECTED EXPENSES	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Annual O&M - Supplies/Equipment[3]	$5,300	$5,512	$5,732	$5,962	$6,200	$6,448
Annual O&M – Labor and Admin[3]	$34,700	$36,088	$37,532	$39,033	$40,594	$42,218
Capital Projects - Cash Financed						
Stormwater Utility Formation	$15,000					
Enhanced Maintenance of Ditches		$7,280				
South Howerton Way Improvements	$68,000					
Capital Projects[4] - Debt Service						
2001 Stormwater Comprehensive Plan[5]	$5,460	$5,460	$5,460	$5,460	$5,460	$5,460
Replace Willow Ditch w/ 24" Pipe[6]				$9,650	$5,038	$5,038
North Howerton Way Improvements[6]			$9,734	$10,708	$20,442	$20,442
TOTAL EXPENSES	$128,460	$54,340	$58,458	$70,813	$77,735	$79,607
Revenues Minus Expenses	$6,004	$12,508	$8,774	$13,147	$6,705	$3,373
Reserves available for capital projects	$6,004	$18,512	$27,286	$40,433	$47,138	$50,511

(1) ERU increase based on projected OFM population growth estimates (2.88% from 2000- 2005, 2.96% from 2006-2010)

(2) Assume S. Howerton Improvements will be completed as part of the 1st Ave / Howerton Way Improvement Project

(3) O&M Labor and supplies increased at 4% per year

(4) Project costs are adjusted for inflation at 4% per year.

(5) State Revolving Fund Loan for 20 years with 4.1% interest rate.

(6) Assume Public Works Trust Fund Loan where 10% is required during year of construction with 1% interest thereafter. Pay 10% in 2005 and 20% in 2006 & 2007.

ALTERNATIVE CAPITAL FINANCING SOURCES

GRANT AND LOAN FUNDS

Within the State of Washington there are several grant and loan funds available for capital improvements. Among these are the Public Works Trust Fund (PWTF), Centennial Clean Water Fund (CCWF), and the State Revolving Fund (SRF). There are other state and federal agencies that offer funding for wetlands protection and flood control. These include the Flood Control Assistance Account Program (FCAAP) through the Department of Ecology and the Aquatic Lands Enhancement Account (ALEA) through the Department of Natural Resources. None of these programs can be counted on to consistently provide revenue for stormwater improvements and therefore, should be considered secondary avenues of funding. In addition, grant funding is extremely limited. Therefore, loans are the more likely source for outside funding.

PUBLIC WORKS TRUST FUND

The Public Works Trust Fund (PWTF) is a revolving loan fund designed to help local governments finance needed public works projects through low-interest loans and technical assistance. The PWTF, established in 1985 by legislative action, offers loans substantially below market rates, payable over periods ranging up to 20 years.

Interest rates are 0.5 percent, 1.0 percent, or 2.0 percent, with the lower interest rates providing an incentive for a higher financial share. The local community, to qualify for a 2.0 percent loan, must provide a minimum of 5 percent local matching funds of the project's costs. A 10 percent local share qualifies the applicant for a 1.0 percent interest rate and a 15 percent local share qualifies for a 0.5 percent loan. The useful life of the project determines the loan term, with a maximum term of 20 years.

To be eligible, an applicant must be a local government such as a city, town, county, or special purpose utility district, and have a long-term plan for financing its public work needs. If the applicant is a town, city, or county, it must adopt the ¼ percent real estate excise tax dedicated to capital purposes. Eligible public works systems include streets and roads, bridges, storm sewers, sanitary sewers, and domestic water. Loans are presently offered only for purposes of repair, replacement, rehabilitation, reconstruction or improvement of existing service users. A recent change has now made projects intended to meet reasonable growth (as detailed in a twenty-year growth management plan) eligible for PWTF funding.

CENTENNIAL CLEAN WATER FUND

The Centennial Clean Water Fund (CCWF) is administered by the Department of Ecology and provides loans and grants for projects that enhance water quality. Eligible stormwater projects include water quality treatment facilities and projects or facilities that address non-point pollution problems. Projects which only address flood control or wetlands purchase are not eligible under CCWF. Under its grant program, water quality facilities construction projects may receive 50% of the eligible cost. The design and construction of water quality facilities are also eligible for 100% loans. Recent loan terms have been 4.5 to 5% interest rate for 20 years. Eligibility for grants is based on a rating system that includes such factors as seriousness of the water quality problem, public health impacts, and beneficial impact of the project on water quality.

STATE REVOLVING FUND

The State Revolving Fund (SRF) program will provide loans for stormwater related projects. The Department of Ecology administers the SRF program. Projects that are eligible for funding under this program must have a component that contributes to the improvement of water quality. Flood control projects are not eligible. Loan terms vary depending on the payback period. Recent loan terms are 1.5% interest on loans for 20 years, 0.5% interest on loans paid back in 5 years. Loans can cover 100% of the project cost.

FLEXLINE

Flexline is a low cost cooperative program offered by the Association of Washington Cities (AWC) and Washington State Association of Counties (WSAC) in cooperation with U.S. Bank of Washington. Cities, Towns and Counties may pool debt of up to $500,000 per jurisdiction per issuance into one larger certificate of participation (COPs). The cooperation financing alternative may be used to purchase equipment, real property, or other debt-financed projects.

The COPs have the appearance of a bond or note and are tax exempt. Typically, Flexline debt is non-voted or non-utility backed revenue debt. To receive Flexline financing a municipality needs to submit an application, and pass an ordinance or resolution for financing. Funding is usually provided after the ordinance or resolution becomes effective. Interest rates are determined in the open market.

FLOOD CONTROL ASSISTANCE ACCOUNT PROGRAM

The Flood Control Assistance Account Program (FCAAP) was established by the state of Washington in 1984 to assist local jurisdictions with comprehensive flood planning and maintenance efforts to reduce flood damages. The program is administered through the

Department of Ecology in association with the Department of Fish and Wildlife and County engineers. Funding for the program is approximately $4.0 million each biennium. Operations, maintenance, and capital improvement projects are all eligible for grant assistance as long as the public entity has a certified comprehensive flood control management plan in place. The FCAAP are generally written through the County. This means that the all projects within the County are ranked and compete for the portion of the total FCAAP funds available to the County.

AQUATIC LANDS ENHANCEMENT ACCOUNT

The Aquatic Lands Enhancement Account (ALEA) was established in 1994 to provide grants to cities, towns, counties, and port districts for preservation or improvement of wetlands, natural systems, waterfront redevelopment plus some aquatic-land related planning. The maximum grant is $100,000 and the project must be associated with state-owned aquatic lands. A storm project that redirects or treats runoff and thus improves state-owned aquatic lands would be an eligible project under this program.

DEBT FINANCING

Two forms of debt financing are available for capital improvements including general obligation (G.O.) bonds and revenue bonds. General obligation bonds are backed by the "full faith and credit of the City" and are paid for through property tax levies. These bonds require voter approval before they can be implemented. A less common means of financing capital improvements associated with stormwater projects is through the use of revenue bonds. The City, like other municipalities, is capable of issuing tax-exempt bonds. The principal and interest of such bonds are repaid from revenue generated from a water, sewer, or stormwater utility. This type of funding may be offered without voter approval. However, in order to qualify to sell revenue bonds, the City must establish that its net operating income, gross income less expenses, is equal to or greater than its debt coverage factor (typically 1.3-1.4) times the annual principal and interest due for all outstanding bonded indebtedness. Essentially, utility rates have to be set high enough to ensure revenue bond repayment.

DEVELOPER FEES

The City may require improvements for service to a property within new plats or commercial improvements to be financed by the developer. The developer, for example, is usually required to construct detention facilities in accordance with City standards or pay into a fund for construction of an off-site facility to service multiple properties. The alternative approach allows the City to develop facilities in a planned and cost effective manner. However, several developments are generally required before the City has available funds to construct a regional facility. The City has little control over the scheduling of such facilities unless alternative funding sources such as service charge

revenues are utilized on a short-term basis to fund initial construction and are then repaid as developer fees are collected.

IMPROVEMENT DISTRICTS AND SPECIAL ASSESSMENTS

Levying of special assessments on benefited properties has been used throughout the state for stormwater improvements. Projects funded through special assessments must have an identifiable benefit to the properties included in the assessment area, and charges for each parcel must be consistent with the relative benefit to each property. In Washington, municipalities can establish a local improvement district (LID) or utility local improvement district (ULID). These approaches require an assessment against benefited property owners within the district boundaries. In order to establish the district and implement this approach, a minimum percentage of property owners within the proposed district must vote their approval.

The $4 monthly service assessment recommended in Table 9-5 is based on revenue needed to cover operation and maintenance costs as well as capital improvement projects in the future. In comparison, Long Beach assesses their residents $7.08 per ERU on a monthly basis whereas Ocean Shores charges $9.56 per month for each of its residents.

The use of LIDs to fund stormwater projects is complicated by the difficulty in quantifying benefits for individual property owners. For water and sewer improvements, for example, the benefits are generally easy to identify. With drainage improvements, however, upstream or hillside properties which could contribute significantly to runoff may actually benefit little from improvements because of their protected location. One result may be to narrowly establish the boundaries of the LID, which may be counterproductive to comprehensive stormwater management. Another problem with LIDs is that they place heavy administrative burdens on City staff to maintain the improvements in the district.

RECOMMENDATIONS

- Whenever possible, utilize low cost alternative (State or Federal) fund sources for financing major capital improvements.

- Re-evaluate the six-year budget as actual operation and maintenance expenses become available.

APPENDIX A

Citizen's Guide to the 4(d) Rule for Threatened Salmon and Steelhead on the West Coast

A Citizen's Guide to the 4(d) Rule

For

Threatened Salmon and Steelhead on the West Coast

National Marine Fisheries Service
Northwest and Southwest Regions
June 20, 2000

Table of Contents

Introduction

In June 2000, the National Marine Fisheries Service (NMFS) adopted a rule prohibiting the "take" of 14 groups of salmon and steelhead listed as threatened under the Endangered Species Act (ESA). NMFS adopted the take rule under section 4(d) of the ESA. This rule prohibits anyone from taking a listed salmon or steelhead, *except* in cases where the take is associated with an approved program. The 4(d) rule approves some specific existing state and local programs, and create a means for NMFS to approve additional programs if they meet certain standards set out in the rule.

State and local governments, tribes and others throughout the Northwest have stepped forward and assumed leadership roles in saving these species. Efforts include the Oregon Plan for Salmon and Watersheds, the State of Washington's Extinction is Not an Option Plan, Metro's Functional Plan, the Puget Sound Tri-County Initiative, the Lower Columbia Fish Recovery Board, the Eugene, Oregon-area Metro ESA Coordinating Team, and the Willamette Restoration Initiative. NMFS believes it is these local efforts that will ultimately save the salmon. A central goal of this 4(d) rule is to encourage such state and local efforts by providing the means for NMFS to approve local efforts and limit liability under the ESA.

Background

Purpose of this Guide

This *Citizen's Guide to the 4(d) Rule* introduces and explains the rule. It complements the final rule published in the *Federal Register* in June of 2000 by providing a more user-friendly description of why the rule is needed, what it contains, how it will affect citizens, and how to get more information. This Guide is not binding Federal language or regulation. Individuals should refer to the Federal register notice for the regulatory language governing activities under the rule.

Salmon in Decline

In 1994, in response to growing concerns about salmon health on the West Coast, NMFS began the most thorough scientific review of Pacific salmon ever undertaken. The review looked at salmon and steelhead from desert-like areas in California to coastal rain forests, and from the high mountains of central Idaho to lowland basins within sight of the Pacific Ocean. The review identified 52 distinct populations, known as Evolutionarily Significant Units (or ESUs) of Pacific salmon in Oregon, Washington, Idaho, and California. Of these populations, 26 have been listed as threatened or endangered under the ESA and most others are in decline or at very low levels.

These populations of salmon and steelhead are likely to become endangered species within the foreseeable future and their current threatened status cannot be explained by ocean cycles or other natural events. NMFS has concluded that these species are at risk of extinction primarily due to human activities. Salmon and steelhead populations have been depleted by over-fishing, past and ongoing habitat destruction, hydropower development, hatchery practices, degraded water quality and other causes.

Chum Salmon: Populations are down throughout Oregon and Washington. Summer-run chum have disappeared from many Hood Canal streams, and numbers in the Columbia Basin have declined to less than one percent of their former abundance.

Chinook Salmon: Only two of 13 different stocks in Puget Sound are considered healthy. Only slightly more an 1,000 fish return annually to the entire Willamette Basin. Recent returns of spring-run Chinook to the Upper Columbia have averaged only 5,000 naturally-produced fish and are the lowest on record.

Steelhead: Willamette River fish are in steep decline and returns during 1995 were the lowest in 30 years of record keeping. Returns have dropped to as low as 500 fish in the middle Columbia rivers like the Yakima and Umatilla, and steelhead are extinct in the Crooked and Metolius rivers in Oregon.

A species is considered *endangered* when it is "in danger of extinction throughout all or a significant portion of its range" and *threatened* when it is "likely to become endangered within the foreseeable future throughout all or a significant portion of its range." Copies of these studies are available to the public and can be obtained by calling any of the NMFS offices listed at the end of this Guide, or one of our websites at www.nwr.noaa.gov or swr.ucsd.edu.

Saving the Salmon

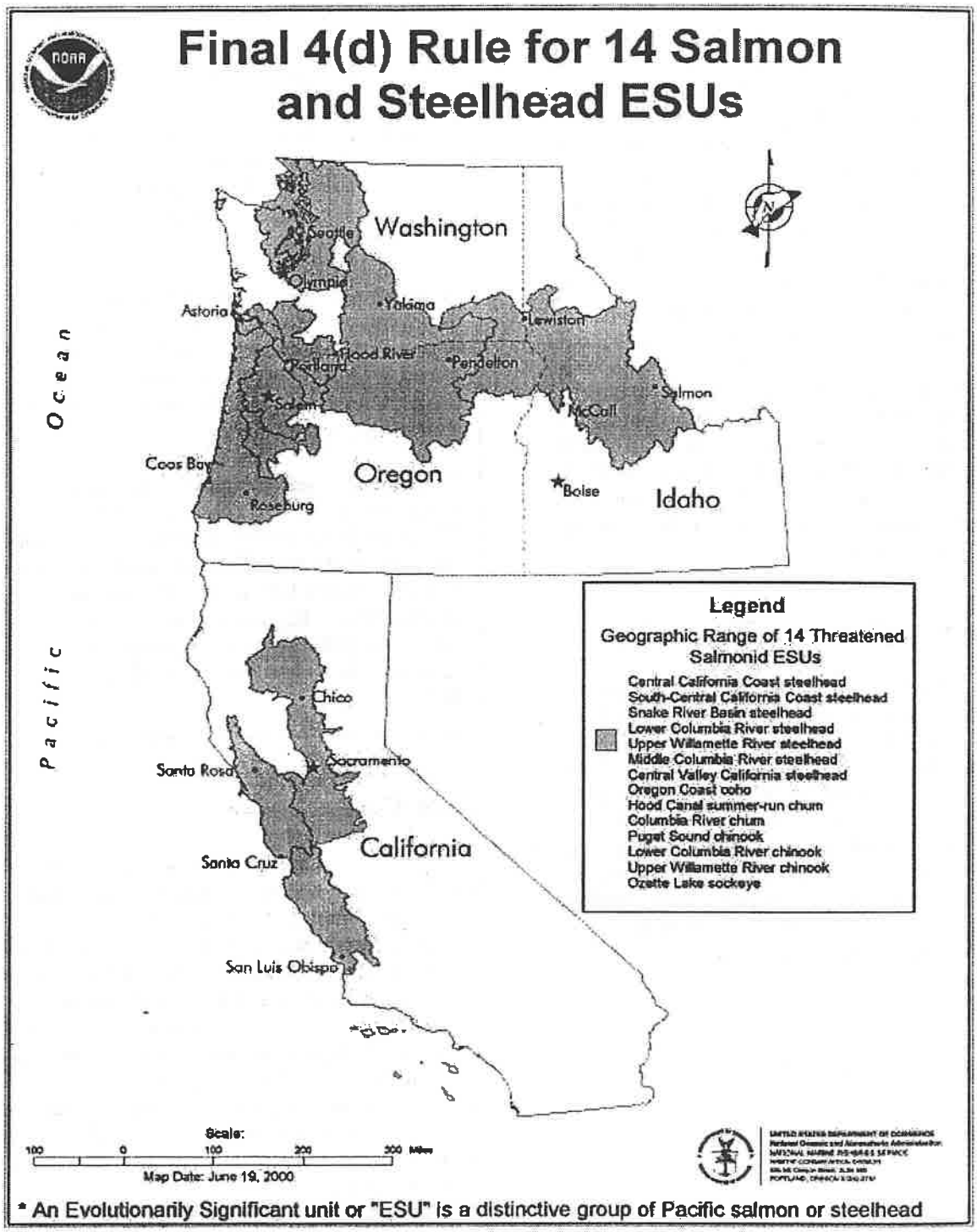
The ESA provides a variety of tools for saving species threatened with extinction. Under section 7 of the ESA, no Federal agency may fund, permit or carry out any activity that will jeopardize their continued existence. In many cases, this restriction on Federal activity is not enough by itself to recover threatened species. When the activities of state and local governments and private citizens harm listed species, section 4(d) of the ESA requires that harm be controlled so it does not lead to extinction.

Section 4(d) requires NMFS to issue regulations deemed "necessary and advisable to provide for the conservation of the species." NMFS must establish protective rules for all species now listed as threatened under the ESA. These protective rules for threatened species may apply any or all of the ESA section 9 protections that automatically prohibit take of species listed as endangered. The rules need not prohibit all take. There may be an "exception" from the prohibitions on take so long as the take occurs as the result of a program that adequately protects the listed species and its habitat. In other words, the 4(d) rule can "limit" the situations to which the take prohibitions apply.

Incorporating such "limits" into a 4(d) rule can be good for NMFS, state agencies, government entities, private citizens, and the fish. Activities carried out in accordance with 4(d) rule limits can help protect threatened species and their habitats while relieving state agencies, government entities, tribes and others from liability for take that results from those activities. By providing limitation from take liability, NMFS encourages governments and private citizens to adjust their programs and activities to be "salmon safe." NMFS anticipates that programs and activities included as a 4(d) rule limit will ultimately be incorporated into ESA Recovery Plans for listed salmon and steelhead.

What does the 4(d) Rule do?

This rule protects 14 ESUs of salmon and steelhead in Idaho, Washington, Oregon, and California (depicted in the map on the following page). The rule follows the standard practice of prohibiting the killing or injuring of a threatened species (i.e. "take") without specific written authorization; that is its principal function.


Final 4(d) Rule for 14 Salmon and Steelhead ESUs
Washington
Oregon
California
Idaho
Seattle
Olympia
Yakima
Lewiston
Astoria
Hood River
Portland
Pendleton
Salem
Salmon
McCall
Coos Bay
Roseburg
Boise
Chico
Sacramento
Santa Rosa
Santa Cruz
San Luis Obispo
Ocean
Pacific
Legend
Geographic Range of 14 Threatened Salmonid ESUs
Central California Coast steelhead
South-Central California Coast steelhead
Snake River Basin steelhead
Lower Columbia River steelhead
Upper Willamette River steelhead
Middle Columbia River steelhead
Central Valley California steelhead
Oregon Coast coho
Hood Canal summer-run chum
Columbia River chum
Puget Sound chinook
Lower Columbia River chinook
Upper Willamette River chinook
Ozette Lake sockeye
Scale:
100 0 100 200 300 Miles
Map Date: June 19, 2000
* An Evolutionarily Significant unit or "ESU" is a distinctive group of Pacific salmon or steelhead

The rule applies to ocean and inland areas, and to any authority, agency, or private individual subject to U. S. jurisdiction. Activities or development not likely to kill or harm protected species will not be affected by the rule. The rule does not prohibit actions or programs—it prohibits illegal take. Activities that do not kill or injure protected salmon and steelhead do not require any special authorization. Limits can be thought of as "exceptions" to the take prohibitions. These limits represent programs or activities, or criteria for future programs or activities, for which NMFS will not apply the take prohibitions. This is because NMFS has determined that these programs or activities minimize impacts on threatened salmon and steelhead enough so that additional Federal protections are not needed to conserve the ESU. NMFS will monitor the activities that have been granted a limit to make certain there is no unexpected take or harm.

What is Take?

The ESA makes it illegal for any person subject to the jurisdiction of the United States to take any species of fish or wildlife that is listed as endangered (ESA section 9[a][1]) without specific authorization. The final 4(d) rule puts in place the same take prohibitions for threatened salmon and steelhead, except for certain limits that apply to the activities specified in the rule. This prohibitions applies within the United States and its territorial waters as well as on the high seas.

"Take" is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct" (ESA section 3[19]). It is also illegal under ESA section 9 to possess, sell, deliver, carry, transport, or ship any species that has been taken illegally (ESA section 9[a][1]). Violating the take prohibitions may result in civil or criminal penalties.

"Harass" is defined as an intentional or negligent act that creates the likelihood of injuring wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns such as breeding, feeding, or sheltering (50 CFR 17.3).

"Harm" is defined as an act that actually kills or injures a protected species (50 CFR 222.102 (64FR 60727)). Harm can arise from significant habitat modification or degradation where it actually kills or injures protected species by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering.

Take Guidance

The likelihood that an action will take a listed species must be evaluated on a case-by-case basis. NMFS has described the kinds of activities (e.g., blocking fish from reaching spawning and rearing areas, illegal fishing etc.), that are likely to injure or kill threatened salmon and steelhead in a "Take Guidance" section in the Federal Register Notice. ***This guidance is not regulatory.*** Rather it provides guidance on what actions are very likely to take threatened species and identifies where NMFS will focus its enforcement actions. This is not a list of prohibited activities.

Based on available information, NMFS believes the categories of activities listed below are those activities that, as a general rule, are most likely to harm listed fish. NMFS wishes to

emphasize at the outset that the potential for these activities to harm listed salmon and steelhead depends entirely upon the facts and circumstances of each case. The mere fact that an activity may fall within one of these categories does not automatically mean that it causes harm. These types of activities are, however, those most likely to cause harm and thereby violate this rule. NMFS' ESA enforcement will focus on these categories of activities.

A. Constructing or maintaining structures like culverts, berms, or dams that eliminate or impede a listed species' ability to migrate or gain access to habitat.

B. Discharging pollutants, such as oil, toxic chemicals, radioactivity, carcinogens, mutagens, teratogens, or organic nutrient-laden water (including sewage water) into a listed species' habitat.

C. Removing, poisoning, or contaminating plants, fish, wildlife, or other biota that the listed species requires for feeding, sheltering, or other essential behavioral patterns.

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

E. Removing water or otherwise altering streamflow in a manner that significantly impairs spawning, migration, feeding, or other essential behavioral patterns.

F. Releasing non-indigenous or artificially propagated species into a listed species' habitat or into areas where they may gain access to that habitat.

G. Constructing or operating dams or water diversion structures with inadequate fish screens or passage facilities.

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

I. Conducting timber harvest, grazing, mining, earth-moving, or other operations that substantially increase the amount of sediment going into streams.

J. Conducting land-use activities that may disturb soil and increase sediment delivery to streams—such as logging, grazing, farming, and road construction—in riparian areas and areas susceptible to mass wasting and surface erosion.

K. Illegal fishing. Harvest that violates fishing regulations will be a top enforcement concern.

L. Various streambed disturbances may trample eggs or trap adult fish preparing to spawn. The disturbance could be mechanical disruption caused by constructing push-up dams, removing gravel, mining, or other work in a stream channel. It may also take the form of egg trampling or smothering by livestock in the streambed or by vehicles or equipment being driven across or down the streambed (as well as any similar physical disruptions).

M. Illegal interstate and foreign commerce dealing in, imports, or exports listed salmon or steelhead.

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

O. Shoreline and riparian disturbances (whether in the river, estuary, marine, or floodplain environment) may retard or prevent the development of certain habitat characteristics upon which the fish depend (e.g., removing riparian trees reduces vital shade and cover, floodplain gravel mining, development, and armoring shorelines reduces the input of critical spawning substrates, and bulkhead construction can eliminate shallow water rearing areas).

P. Filling or isolating side channels, ponds, and intermittent waters (e.g., installing tide gates and impassable culverts) can destroy habitats that the fish depend upon for refuge during high flows.

This list is not exhaustive. It is simply intended to help people avoid violating the ESA and to encourage efforts to save the species. Determining whether take has actually occurred depends on the circumstances of a particular case. Many activities that may kill or injure salmon are regulated by state or Federal rules such as fill and removal authorities, National Pollutant Discharge Elimination System or other water quality permitting, pesticide use, and the like. For those types of activities, NMFS would not tend to focus enforcement efforts on those who operate in conformity with current permits. Rather, if the regulatory program does not provide adequate protection, NMFS will work with the responsible agency to make necessary changes in the program.

For example, concentrations of pesticides may affect salmon behavior and reproduction. Current EPA label requirements were developed without information about some of these subtle but real impacts on aquatic species such as salmon. And they were not developed with the intent of protecting or recovering threatened salmon. Where new information indicates that label requirements do not adequately protect salmon, NMFS will work with EPA through the section 7 consultation process to develop more protective use restrictions, and thereby provide the best possible guidance to all users. Similarly, where water quality standards or state authorizations lead to pollution levels that may cause take, NMFS intends to work with the state water quality agencies and EPA to bring those standards (or permitting programs) to a point that does protect salmon.

Those who believe their activities are likely to injure or kill salmon are encouraged to immediately change that activity to avoid take (or adequately limit any impacts on the species) and seek NMFS' authorization for incidental take under either (a) an ESA section 10 incidental take permit; (b) an ESA section 7 consultation; or (c) a limit on the take prohibitions provided in this rule. The public is encouraged to contact NMFS (see contact list) for help in determining whether circumstances at a particular location (involving these activities or any others) constitute a take in violation of the 4(d) rule.

Take of listed fish resulting from actions in compliance with a permit issued by NMFS under section 10 of the ESA do not violate this rule. Section 10 permits may be issued for research activities, activities that enhance a species' survival, or to authorize incidental take occurring in the course of an otherwise lawful activity. In addition, NMFS consults—under section 7 of the ESA—on a broad range of activities conducted, funded, or authorized by Federal agencies. These include fish harvest, hatchery operations, silviculture activities, grazing, mining, road construction, dam construction and operation, fill material discharge, and stream channelization and diversion. Federally funded or approved activities for which ESA section 7 consultations have been completed will not constitute violations of this rule—provided the activities are conducted in accord with all reasonable and prudent measures and the terms and conditions stated in the incidental take statement.

Evaluating Potential ESA Take Liability

The June, 2000 4(d) rule's prohibitions on take applies to the activities of everyone—every state, city, and county government, every business, and every citizen. The Take Guidance provides information about what types of activities may be most likely to cause harm and thus violate the 4(d) rule. However, each activity and circumstance must be evaluated on a case by case basis to determine if it is likely to cause a take. After reviewing the take guidance, many governmental entities, businesses, and individuals may question how the 4(d) rule and its take guidance affects them. Any governmental entity, business or individual can use the following risk assessment evaluation steps:

(1) Identify the program or activity (for state and local governments, this may include activities it funds, authorizes, or carries out);
(2) Evaluate whether the program or activity is likely to take or harm listed fish;
(3) If the program or activity is not likely to take or harm listed fish, then there is no need to modify the activity, or to contact NMFS;
(4) If, however, after reviewing the program or activity, it seems likely it will take or harm listed fish, or there is uncertainty about whether take or harm may occur, the acting agency, entity, or individual should contact NMFS to seek more information on evaluating the activity's impacts and determining ways to avoid harming the fish and violating the ESA.

There are many sources of information on improved best management practices to avoid take or harm and to reduce ESA liabilities. In addition, professional associations, state and Federal resource management agencies that provide technical information to landowners and others, watershed councils and non-governmental organization can be important sources of information about how to modify activities to avoid or reduce impacts on threatened salmon and steelhead.

Effective Dates

State, tribal, and local governments, stakeholder groups, and citizens across four states need to familiarize themselves with the guidance provided in the rule, assess the consequences of their individual authorities and activities, and make any necessary adjustments to protect the fish. After sufficient time to review the new rule, NMFS will hold a number of public forums in rural and metropolitan communities to engage interested parties in constructive discussion about salmon recovery. For these reasons, the 4(d) rule for chinook, coho, chum, and sockeye salmon will take effect 180 days after it is published in the *Federal Register*. Those in the range of threatened steelhead have had more notice that efforts to save the fish are needed, so the 4(d) rule for steelhead will take effect 60 days after publication.

A 1997 interim 4(d) rule (published in 1997) remains in place for the Southern Oregon/Northern California Coast (SONCC) coho ESU. The SONCC 4(d) rule included several limitations based on adequately protective state programs in Oregon and provided a model for developing the three 4(d) rules proposed in January of 2000. The final 4(d) rule for 14 additional threatened ESUs does not affect this earlier rule.

Useful Concepts for Understanding the Limits

The final rule incorporates two scientific concepts NMFS will use when determining whether particular programs may receive limits on the take protections. The first applies primarily to harvest and hatchery activities, and is described in a scientific paper entitled *"Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units"* (NMFS 2000). The Viable Salmonid Population (VSP) paper describes the importance of identifying individual populations within an ESU, and the importance of identifying abundance levels and other characteristics that may be considered "critical" (where abundance is so low the population requires special protections) or "viable" (where abundance is high enough the population may be considered healthy). Generally, programs and activities will receive a 4(d) limit only if they do not increase the risks to critical populations, and if they do not preclude populations from attaining or maintaining viability.

The second concept applies to programs and activities that affect salmon habitat. For habitat, NMFS uses the concept of Proper Functioning Condition (PFC). Properly functioning habitat is habitat that provides for the biological requirements of the fish. PFC is defined in terms of the natural processes and functions that lead to habitat conditions that will

meet the biological requirements of the fish. NMFS offers 4(d) limits only for those programs or activities that will not impair properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or will not retard the long-term progress of impaired habitat toward PFC.

The concepts of VSP and PFC are described in more detail at the end of this guide.

The 13 Limits

When the final 4(d) rule becomes effective, the take prohibitions will apply to actions carried out by state, tribal, and local governments and private parties that take listed salmon and steelhead, except take that is associated with those activities that come under one of the 4(d) limits and those already permitted under other sections of the ESA. The take prohibitions would be limited for the programs and activities identified in the 4(d) rule because NMFS has determined that they impacts on threatened fish sufficiently that additional Federal protections are not needed.

The final rule describes two types of limits on the take prohibitions. One type includes specific programs NMFS has already reviewed and determined will minimize harm to threatened fish or contribute to their conservation. The other type includes general categories of programs that NMFS may evaluate in the future. For this second type of limit, the 4(d) rule sets out the standards NMFS will use when it reviews activities and programs for inclusion in the rule, how the public will be given notice in the *Federal Register* of the opportunity to review the program being submitted and, if the limit is determined to sufficiently conserve the listed species, how it will be approved by the Northwest or Southwest Regional Administrator, whichever is appropriate. NMFS has also established a process for periodically evaluating the limits, making recommendations for adjusting the programs, and alerting the public in cases when the limit would be withdrawn and take prohibitions re-applied.

Some of the broad categories of activities covered by limits in the final rule are:

- Scientific research conducted or supervised by, or coordinated with, state fishery agencies
- Fish harvest activities
- Artificial propagation programs
- Habitat restoration based on watershed plans
- Properly screened water diversions
- Routine road maintenance
- Municipal, residential, commercial, and industrial development and redevelopment
- Forest management practices in the State of Washington

NMFS is not requiring states, local governments or private parties to change their practices to conform to any of the take limits described in the final rule. The limits provide one way to be sure an activity or program does not risk violating the take prohibitions. Simply because a program is not within a limit *does not* mean that it automatically violates the ESA or the 4(d) rule. However, it *does* mean that any program or jurisdiction would risk ESA penalties if the activity in question takes a listed fish. By receiving a limit, governments and individuals receive assurance that their activities do not violate the take prohibitions and will not be subject to enforcement.

Description of the Limits

Limit No. 1 – ESA Permits

This limit recognizes that those holding permits under section 10 of the ESA (or receiving other exemptions under the ESA) are free of the take prohibitions so long as they act in accordance with the permit or applicable law. Land management activities associated with a habitat conservation plan and scientific research are examples of activities for which a section 10 permit may be issued.

Limit No. 2 – Ongoing Scientific Research

This final rule does not restrict ongoing scientific research that affects threatened ESUs for up to eight months (i.e., through February 2001) provided an application for a research or enhancement permit reaches the Assistant Administrator for Fisheries, NOAA, within 90 days after the rule is published. The take prohibitions will extend to these activities if the Assistant Administrator rejects an application as insufficient, if a permit is denied, or if six months have elapsed since the effective date of the final rule, whichever occurs earliest. It is in the interest of conservation to not disrupt ongoing research and conservation projects, some of which are of long duration. This limit on the take prohibitions ensures there will be no unnecessary disruption of those activities yet provides NMFS with the ability to halt the activity if it will have unacceptable impacts on a listed ESU.

Limit No. 3 – Rescue and Salvage Actions

This limit relieves certain agency and official personnel (or their designees) from the take prohibitions when they are acting to aid an injured or stranded fish or salvage a dead fish for scientific study. Each agency acting under this limit is to report the numbers of fish handled and their status on an annual basis. This limit on the take prohibitions will conserve the listed species by preserving life or furthering our understanding of the species' biology.

Limit No. 4 – Fishery Management

NMFS believes recreational, commercial, and tribal fisheries can be managed to protect salmon and steelhead listed under the ESA and allow them to recover. The 4(d) rule provides a way to permit the "take" of listed fish in fisheries. A fishery management agency can develop a Fisheries Management and Evaluation Plan (FMEP) and seek NMFS' approval for it. Some of the benefits of the FMEP approach are long-term management planning, more public involvement, less government paperwork, and more certainty that there will be fishing opportunities in the future.

NMFS will use the same standard to evaluate FMEPs as those used for section 10 permits: the fisheries must not jeopardize listed salmon and steelhead, nor lessen the protection they receive. In the FMEPs, fisheries will be managed according to the listed fishes' status. This will be determined by using the concept of "Viable Salmonid Populations." Fisheries will be scaled to the degree of risk the listed fish face. When a listed population is at a "critically" low level, harvest impacts will be strictly controlled. Once a population achieves a "viable" level, fisheries could be less restrictive.

An FMEP must address the specific criteria outlined in the 4(d) rule. An FMEP must (1) define its objectives and management area, (2) define the populations within the affected ESUs, (3) establish the populations' "critical" and "viable" threshold levels, (4) set escapement objectives or maximum harvest rates, (5) demonstrate that the fisheries will not jeopardize listed fish, (6) establish the monitoring and evaluation process to assess how the FMEP is working and set conditions for revising management, and (7) be consistent with tribal trust obligations. All of these criteria were developed to answer the following questions: Where and how should the fisheries occur? What are their impacts on listed fish? How can it be demonstrated that an FMEP conserves listed fish and allows their recovery?

FMEPs are developed and approved in the following manner: A fish management agency, such as a state department of fish and wildlife, develops an FMEP that meets the 4(d) rule criteria. They send it to NMFS who then requests public review and comment. The public input is used to revise the FMEP, if necessary. Once the FMEP is deemed sufficient, NMFS writes a letter of approval to the agency that developed the FMEP. The FMEP is then implemented and the fisheries addressed in the FMEP will be covered under the ESA. NMFS then monitors and evaluates the FMEP to ensure that the listed fish are recovering.

Limit No. 5 – Artificial Propagation

NMFS believes hatcheries can be managed in a manner that conserves and recovers salmon and steelhead listed under the ESA. Therefore, the 4(d) rule provides a way to permit the "take" of listed fish for a variety of hatchery purposes. A state or Federal hatchery management agency can develop a Hatchery and Genetics Management Plan (HGMP) and seek NMFS' approval. Some of the benefits of the HGMP approach are long-term management planning, more public involvement, and less government paperwork.

NMFS will use the same standard to evaluate HGMPs as those used for section 10 permits: the hatchery program must not jeopardize listed salmon and steelhead, nor lessen the protection they receive. In the HGMPs, hatcheries will be managed according to the listed fishes' status. This will be determined using the concept of "Viable Salmonid Populations." Hatchery activities will be scaled to the degree of risk the listed fish face. When a listed population is at a "critical" level, broodstock collection will be strictly controlled. Once a population achieves a "viable" level, broodstock collection could be less restrictive.

An HGMP must address the specific criteria outlined in the 4(d) rule. An HGMP must (1) specify the goals and objectives for the hatchery program, (2) the donor population's "critical" and "viable" threshold levels, (3) prioritize broodstock collection programs in a manner that benefits listed fish, (4) specify the protocols that will be used for spawning and raising the fish in the hatchery, (5) determine the genetic and ecological effects arising from the hatchery program, (6) describe how the hatchery operation relates to fisheries management, (7) ensure that the hatchery facilities can adequately accommodate listed fish if they are collected for the program, (8) monitor and evaluate the HGMP to ensure that it accomplishes its objectives, and (9) be consistent with tribal trust obligations.

HGMPs are developed and approved in the following manner: A fish management agency, such as a state department of fish and wildlife, develops an HGMP that meets the 4(d) rule criteria. They send it to NMFS who then requests public review and comment. The public input is used to revise the HGMP, if necessary. Once the HGMP is deemed sufficient, NMFS writes a letter of approval to the agency that developed the HGMP. The HGMP is then implemented and the hatchery program addressed in the FMEP will be covered under the ESA. NMFS then monitors and evaluates the HGMP to ensure that the listed fish are recovering.

Limit No. 6 – Joint Tribal/State Plans Developed under the *United States v. Washington* or *United States v. Oregon* Settlement Processes

Non-tribal salmonid management in the Puget Sound and Columbia River areas is profoundly influenced by the fishing rights of numerous Indian tribes and must be responsive to the court proceedings that interpret and define those tribal rights. Various orders of the *United States v. Washington* court, such as the Puget Sound Salmon Management Plan (originally approved by the court in 1977; recently amended in *United States v. Washington*, 626 F. Supp. 1405, 1527 (1985, W.D. Wash.)), mandate that many aspects of fishery management, including but not limited to harvest and artificial production actions, be jointly coordinated by the State of Washington and the Western Washington Treaty tribes. The State of Washington, affected tribes, other interests, and Federal agencies are all working toward an integrated set of management strategies and strictures that respond to the biological, legal, and practical realities of salmon management in Puget Sound. Similar principles apply in the Columbia River basin where the States of Oregon, Washington, and Idaho and five treaty tribes work within the framework and jurisdiction of *United States v. Oregon*.

NMFS includes this limit on the take prohibitions to accommodate any resource management plan developed jointly by the States and the Tribes (joint plan) under the jurisdiction of *United States v. Washington* or *United States v. Oregon*. Such a plan would be developed and reviewed under the government-

to-government processes outlined in the final 4(d) rule for Tribal Resource Management Plans. Before any joint plan receives a limit on the take prohibitions, the Secretary must, after taking into account any public comment on the plan, determine that it will not appreciably reduce the likelihood of the listed species' survival and recovery. The Secretary shall publish in the Federal Register notice of any determination regarding a joint plan; the notice will include a discussion of the biological analysis underlying the determination.

NMFS will evaluate joint plans on a regular basis to determine if they sufficiently protect and conserve the listed fish.

Limit No. 7 – Scientific Research

In carrying out their responsibilities, state fishery management agencies in Washington, Oregon, Idaho, and California conduct or permit a wide range of scientific research activities on various fisheries. These include monitoring programs and other studies of the 14 ESUs affected by the final rule. In general, NMFS finds that such activities will help conserve the listed species by furthering our understanding of the species' status, risks, life history, and biological requirements, and that state biologists and cooperating agencies carefully consider the benefits and risks entailed in proposed research before approving or undertaking such projects. NMFS concludes it is not necessary and advisable to impose additional protections on such research by imposing of Federal take prohibitions, and NMFS will not apply take prohibitions to scientific research activities that have received written approval from NMFS' Northwest or Southwest Regional Administrator.

Limit No. 8 – Habitat Restoration Limits on the Take Prohibitions

Habitat restoration activities are likely to help conserve listed fish without incurring significant risks, and NMFS concludes it is not necessary and advisable to impose take prohibitions on those activities provided the activity is part of a watershed conservation plan. NMFS considers a "habitat restoration activity" to be an activity whose primary purpose is to restore natural aquatic or riparian habitat processes or conditions; it is an activity that would not be undertaken but for its restoration purpose. Projects planned and carried out based on at least a watershed-scale analysis and conservation plan and, where practicable, a sub-basin or basin-scale analysis and plan, are likely to be the most beneficial. NMFS strongly encourages those involved in watershed restoration to conduct assessments that identify the factors impairing watershed function, and to plan watershed restoration and conservation activities based on those assessments. Without the overview a watershed-level approach provides, habitat efforts are likely to focus on "fixes" that may prove short-lived (or even detrimental) because the underlying processes causing a particular problem may not be addressed.

The final rule provides that take prohibitions will not apply to habitat restoration activities found to be part of, and conducted pursuant to, a watershed conservation plan that the state of Washington, Oregon, Idaho, or California has certified to be consistent with the state's watershed conservation plan guidelines. The state in which the activity occurs must certify in writing whether a watershed plan has been formulated in accordance with NMFS-approved state watershed conservation plan guidelines. NMFS will periodically review state Watershed Conservation Plan certifications to ensure that the Plans adhere to approved watershed conservation plan guidelines.

For this limit to apply, NMFS must find that the state's watershed conservation plan guidelines generate plans that: (1) Take into account the proposed activities' potential direct, indirect, and cumulative impacts in terms of their effect on listed species and populations; (2) will not reduce the likelihood of either survival or recovery of listed species in the wild; (3) ensure that any taking will be incidental; (4) minimize and mitigate any adverse impacts; (5) put in place effective monitoring and adaptive management programs; (6) use the best available science and technology, including watershed analysis; (7) provide for public and scientific

review and input; (8) include any measures that NMFS determines are necessary or appropriate; (9) include provisions that clearly identify those activities that are part of plan implementation; and (10) control risk to listed species by ensuring that the plan components are funded and implemented.

Before approving watershed conservation plan guidelines, NMFS will publish notification in the Federal Register announcing the availability of the proposed guidelines for public review and comment. Such an announcement will provide for a comment period of no less than 30 days.

The proposed 4(d) rules identified interim provisions for habitat restoration activity categories to which the take prohibitions would not be applied for two years while watershed conservation plans were being developed. Based on the misunderstandings generated by that proposal, the interim provisions were dropped from the final rule.

NMFS strongly encourages jurisdictions, entities, and citizens to use the habitat restoration guidelines and technical manuals listed below as readily available techniques to reduce the risks of harming or injuring the listed stocks.

Applicable state guidance includes:

- *Oregon Road/Stream Crossing Restoration Guide*, Spring 1999, selected portions of *the Oregon Aquatic Habitat Restoration and Enhancement Guide* (1999);
- Oregon Department of Forestry and Department of Fish and Wildlife's *A Guide to Placing Large Wood in Streams*, May 1995;
- Washington Department of Fish and Wildlife, (WDFW) Habitat and Lands Environmental Engineering Division's *Fish Passage Design at Road Culverts*, March 3, 1999;
- Washington Administrative Code rules for Hydraulic Project Approval; and Washington's *Integrated Streambank Protection Guidelines*, June, 1998;
- *Stream Corridor Restoration, Principles, Processes and Practices* by the Federal Interagency Stream Restoration Working Group, October, 1998; and,
- *California Salmonid Stream Habitat Restoration Manual*, January, 1998.

These documents are available through the NMFS web page or directly from the relevant agencies.

Limit No. 9 – Water Diversion Screening

Operating water diversions without adequate screening is a widely recognized cause of mortality among salmon and steelhead. Juveniles may be sucked or attracted into diversion ditches where they later die from a variety of causes, including stranding. Adult and juvenile migration may be blocked by diversion structures such as push-up dams. Juveniles are often injured and killed when caught in pumping facilities or forced against screens.

State laws and Federal programs have long recognized these problems in varying ways, and encouraged or required adequate screening of diversion ditches and structures. Nonetheless, large numbers of diversions are not adequately screened and remain a threat, particularly to juvenile fish. Eliminating that source of injury or death is vital to conserving listed stocks.

The final rule encourages all diverters to move quickly to provide adequate screening or other protections for their diversions. The rule does not apply take prohibitions provided that NMFS' engineering staff—or any resource agency or tribal representative NMFS designates as an authorized officer—has agreed in writing that the diversion facility is screened, maintained, and operated in compliance with NMFS' Juvenile Fish Screening Criteria (NMFS 1996) or, in California, in compliance with NMFS Southwest Region's Fish Screening Criteria for Anadromous Salmonids (NMFS 1997) or any subsequent revision. If a diversion is screened, operated, and maintained in a manner consistent with those criteria, adequate safeguards will be in place and no additional Federal protection is necessary or advisable for conserving listed fish.

The final rule also provides that NMFS or its authorized officer may review and approve for a take limit a proposed juvenile fish screen design and construction plan. The plan must describe interim operation measures that will avoid taking threatened fish.

Limit No. 10 – Routine Road Maintenance

NMFS does not find it necessary or advisable to apply take prohibitions to routine road maintenance activities provided that: (1) The activity constitutes routine road maintenance conducted by Oregon Department of Transportation (ODOT) employees or agents that complies with ODOT's *Transportation Maintenance Management System Water Quality and Habitat Guide* (July, 1999); or (2) it is conducted by employees or agents of a state, county, city, or port under a program that complies substantially with that contained in the ODOT Guide and has been determined to meet or exceed the protections provided by the ODOT Guide; or (3) by employees or agents of a state, county, city, or port that complies with a routine road maintenance program that maintains or attains proper functioning condition (PFC).

The ODOT's maintenance and environmental staff have worked with NMFS in developing a routine road maintenance program that works well within the mandates of the ESA and the Clean Water Act, while carrying out the agency's fundamental mission to provide a safe and effective transportation system. That work has resulted in a program that greatly improves protections for listed fish that might be affected by a range of routine maintenance activities by minimizing the activities' impacts on streams.

For a state, city, county or port program that is equivalent to the ODOT program (or any of its amendments) to receive a limit it must get written approval from the NMFS Northwest or Southwest Regional Administrator, whichever is appropriate. Any jurisdiction desiring its routine road maintenance activities to be within this limit must first commit in writing to apply management practices that provide protection equivalent to or better than those provided by the ODOT Guide.

Limit No. 11 – Portland Parks Integrated Pest Management

The City of Portland, Oregon, Parks and Recreation Department (PP&R) operates a diverse system of city parks representing a full spectrum of urban habitat from intensively managed recreation, sport, golf, and garden sites to largely natural, unmanaged parks, including the several thousand acre, wooded, Forest Park. The PP&R has been operating and refining an integrated pest management program for 10 years, with a goal of reducing its use of pesticides. The program's "decision tree" places first priority on preventing pests (weeds, insects, disease) through policy, planning, and avoidance measures (design and plant selection). Cultural and mechanical practices, trapping, and biological controls form the second priority. The use of biological products and, finally, chemical products, is to be considered last. The overall program affects only a small proportion of the land base and waterways in Portland, and serves to minimize any impacts on listed fish from chemical applications associated with that specific, limited land base. NMFS believes it would help conserve listed fish if jurisdictions would broadly adopt a similar approach to eliminating and limiting chemical use in their parks and in other areas.

After carefully analyzing PP&R's integrated program for pest management, NMFS concludes that it addresses potential impacts and provides adequate protection for listed fish with respect to the limited use the program may make of the listed chemicals. NMFS does not find it necessary or advisable to apply additional Federal protections in the form of take prohibitions to PP&R activities conducted under the Pest Management Program. Take prohibitions would not meaningfully increase the level of protection the listed fish receive.

Confining the limit on take prohibitions to a specified list of chemicals does not mean NMFS has determined that other chemicals PP&R employs will necessarily harm salmon and steelhead. NMFS intends to continue working with PP&R on the use of any other herbicide or pesticide.

The PP&R program includes a variety of monitoring commitments and a yearly

assessment schedule. If, at any time, monitoring information, new scientific studies, or new techniques cause PP&R to amend its program or if PP&R and NMFS wish to change the list of chemicals receiving limits on take prohibitions, PP&R must provide NMFS with a copy of the proposed change(s) for review. NMFS will publish notification in the *Federal Register* requesting public comment on the proposed changes. The comment period will be no less than 30 days; at its conclusion, NMFS will make a final determination on whether the changes will conserve listed salmon and steelhead.

Limit No. 12 – Municipal, Residential, Commercial and Industrial Development and Redevelopment (MRCI)

As a general matter, MRCI development (and redevelopment) have a significant potential to degrade habitat and injure or kill salmon and steelhead in a variety of ways. With appropriate safeguards, MRCI development can be specifically tailored to minimize impacts on listed fish to the extent that additional Federal protections would not be needed to conserve the listed ESU. Through the final rule, NMFS identifies a mechanism whereby cities, counties, and regional governments can ensure that MRCI development and redevelopment authorized within those areas are consistent with ESA requirements. Developers and their authorizing jurisdictions alike would benefit from the assurance that their actions conserve listed salmon and steelhead.

One example of an authorizing entity working toward the sort of plan envisioned in this limit is found in the fact that urban development in the Portland, Oregon metropolitan area may not occur outside of an adopted urban growth boundary (UGB). Metro, the regional governing body, is in the process of bringing some large areas currently designated as urban reserve areas into the UGB. Before development may commence in these newly included areas, the jurisdiction within which the area lies must prepare and adopt comprehensive plan amendments for urban reserve areas consistent with all provisions of the Metro Urban Growth Management Functional Plan. The amendments must show what development will be allowed and the conditions to be placed upon development.

NMFS will not apply take prohibitions to (1) MRCI development or redevelopment governed by and conducted in accordance with city, county, or regional government ordinances or plans that NMFS has found to adequately protect listed species; or (2) once NMFS has determined that Metro's Functional Plan is adequately protective, activities conducted under Metro's jurisdiction that are pursuant to ordinances that Metro has found comply with its Urban Growth Management Functional Plan. NMFS must agree in writing that the MRCI development ordinances and plans, including the Functional Plan, ensure that the plans and the development activities complying with them will conserve listed salmon and steelhead. NMFS will individually apply the following 12 evaluation considerations when determining whether MRCI development ordinances or plans adequately conserve listed fish:

(1) An MRCI development ordinance or plan ensures that development will avoid inappropriate areas such as unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites. Activities such as development, timber harvest, or other soil disturbance should be sited in appropriate areas—avoiding unstable slopes, wetlands, areas already in a proper functioning condition, areas that are more functional than neighboring sites, and areas with the potential to be fully restored. A description of particularly sensitive areas is included in the Fish and Forest Report cited elsewhere in this guidance. Those sites include but are not limited to soils perennially saturated from a headwall or a sideslope seep or spring, the permanent initiation point of perennial flow of a stream, an alluvial fan, and the intersection of two perennial streams.

(2) An MRCI development ordinance or plan adequately prevents stormwater discharge impacts on water quality and quantity and stream flow patterns in the watershed—including peak and base flows in perennial streams. Stormwater management programs

must require development activities to avoid impairing water quality and quantity. These activities must preserve or enhance stream flow patterns so they are as close as possible to the historic peak flows, base flows, durations, volumes, and velocities. This can be accomplished by reducing impervious surfaces and maintaining forest cover and natural soils. These conditions will, in turn, maintain essential habitat processes such as natural water infiltration rates, transpiration rates, stormwater run-off rates, sediment filtering, and provide hydrographic conditions that maintain and sustain aquatic life.

(3) An MRCI development ordinance or plan protects riparian areas well enough to attain or maintain PFC around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Compensatory mitigation is provided, where necessary, to offset unavoidable damage to PFC in riparian management areas. Activities should be quite limited in areas adjacent to all perennial and intermittent streams and waters supporting listed salmon and steelhead in order to avoid soil disturbance and maintain vegetated riparian corridors. The existence of native vegetation along stream corridors is a condition that can support essential habitat processes such as temperature control, bank stability, stream complexity over time, the filtering of pollutants, or contributions of large logs and other woody debris to a stream.

Limiting activities in riparian areas helps protect or restore the condition and quality of soil and ensure that a diversity of plants and trees of all ages is well-distributed across a riparian area. Such conditions on the landscape contribute to the natural succession of riparian forest trees and protect the water quality and flow conditions necessary to meet salmonid habitat needs downstream. In urban areas, the riparian areas often face the added challenge of intercepting large amounts of nutrients, pesticides and sediment so that they do not directly enter a stream.

NMFS' determinations are significantly influenced by science indicating that essential habitat functions are affected to varying (but significant) degrees by streamside activities conducted within a distance equal to the height of the tallest tree that can grow on that site (known as the site potential tree height). The distance is measured not from the stream itself, but from the edge of the area within which a stream naturally migrates back and forth over time (the channel migration zone).

When the scope of an activity includes modifying a riparian site that has existing, non-native vegetation, it may be important to restore native vegetation on the site in order to recover the essential habitat functions discussed above.

(4) An MRCI development ordinance or plan avoids stream crossings—whether by roads, utilities, or other linear development—wherever possible and, where crossings must be provided, minimize impacts. One method of minimizing stream crossings and their associated disturbances is to optimize transit opportunities to and within newly developing urban areas. A plan should consider whether potential stream crossings can be avoided by redesigning the access. Where a crossing is unavoidable, the plan or ordinance should minimize its affect by preferring bridges over culverts; sizing bridges to a minimum width; designing bridges and culverts to pass at least the 100-year flood (and associated debris), and meet Oregon Department of Fish and Wildlife or Washington Department of Fish and Wildlife criteria (*ODFW's Oregon Road/Stream Crossing Restoration Guide, Spring, 1999 and WDFW's Fish Passage Design at Road Culverts, March 3, 1999*). In addition, all crossings must be regularly monitored and maintained and intermittent and perennial streams should not be closed over.

(5) An MRCI development ordinance or plan adequately protects historic stream meander patterns and channel migration zones and avoids hardening stream banks and shorelines. Any MRCI development should be designed to allow streams to meander in historic patterns of channel migration. Activities on the landscape must protect conditions that allow gradual bank erosion, flooding, and channel meandering in the zone within which it would naturally occur. This natural channel migration promotes gravel recruitment, geomorphic diversity, and habitat development. If an adequate number of riparian

management areas are linked to the channel migration zone, there should be no need for bank erosion control in all but the most unusual situations. In most circumstances, activities that call for hardening stream banks are not consistent with PFC.

If unusual circumstances require bank erosion to be controlled, it should be accomplished through vegetation or carefully bioengineered solutions. Rip-rap blankets or similar hardening techniques would not be allowed, unless particular site constraints made bioengineered solutions impossible. NMFS finds that the Washington Department of Fish and Wildlife's publication, "*Integrated Streambank Protection Guidelines*" (June, 1998) can provide sound guidance, particularly regarding mitigation for gravel recruitment.

The Fish and Forest Report, cited elsewhere in this guidance, includes a detailed description of the types of channel migration zones found in most geomorphic settings. Further, the Washington State Forest Practices Board has published its *Standard Method for Measuring Physical Parameters of Streams and Channel Migration Zones (March, 2000)*. Though it is designed for the forested environment, NMFS finds the document a useful aid in determining channel migration zones in any setting.

(6) An MRCI development ordinance or plan adequately protects wetlands, wetland buffers, and wetland function—including isolated wetlands. Activities on the landscape must protect wetlands and the vegetation surrounding them to avoid disturbing soils, vegetation, and local hydrology. Such conditions on the landscape contribute to the natural succession of wetlands, and protect wetland functions necessary to meet salmonid habitat needs such as food chain support, shoreline protection, water purification, storm and flood storage, and groundwater recharge. These conditions are also necessary to protect the freshwater, marine, and estuarine wetland systems that provide specialized habitat for rearing and migrating salmon and steelhead.

(7) An MRCI development ordinance or plan adequately preserves permanent and intermittent streams' ability to pass peak flows. Activities that decrease a stream's hydrologic capacity by filling in its channel for road crossings or other development will increase water velocities, flood potential, and channel erosion, as well as degrade water quality, disturb soils, and groundwater flows, and harm vegetation adjacent to the stream. Preserving hydrologic capacity will provide conditions on the landscape necessary for maintaining essential habitat processes such as water quantity and quality, streambank and channel stability, groundwater flows, and succession of riparian vegetation. In combination with the riparian management areas or set-back provisions described above, this means that dredge and fill should be avoided unless they are conducted in conjunction with a necessary stream crossing whose impacts are mitigated to the greatest extent possible.

(8) An MRCI development ordinance or plan stresses landscaping with native vegetation to reduce the need to water and apply herbicides, pesticides, and fertilizer. Plans must describe the techniques local governments will use to encourage planting with native vegetation, reducing lawn area, and lowering water use. These provisions will maintain essential habitat processes by helping conserve water and reduce flow demands that compete with fish needs. They will also reduce applications of chemicals that contribute to water pollution in streams and other water bodies supporting salmon and steelhead.

(9) An MRCI development ordinance or plan contains provisions to prevent erosion and sediment run-off during (and after) construction and thus prevent sediment and pollutant discharge to streams, wetlands and other water bodies that support listed fish. These provisions, at a minimum, should include detaining flows, stabilizing soils, protecting slopes, stabilizing channels and outlets, protecting drain inlets, maintaining best management practices (BMPs), and controlling pollutants. These goals can be accomplished by applying seasonal work limits, phasing land clearing activities, maintaining undisturbed native top soil and vegetation, etc.

These stipulations will help maintain natural runoff rates and protect water quality.

(10) An MRCI development ordinance or plan ensures that demands on the water supply can be met without affecting—either directly or through groundwater withdrawals—the flows salmon need. A plan must ensure that any new water diversions are positioned and screened in a way that does not injure or kill fish.

(11) An MRCI development ordinance or plan provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Moreover, formal plan evaluations should take place at least once every five years. The plan should make a commitment to (and assign responsibility for) regular monitoring and maintenance activities for any detention basins, erosion and sediment control measures, and other management tools over the long term. Practices should be adopted as needed based on monitoring results. In addition, to ensure that development activities comply with the ordinance or plan and that PFC is attained or maintained, commitments must be made for regular funding, enforcement, reporting, implementation, and plan evaluations. These commitments are necessary to lead to conditions that will maintain the whole suite of essential habitat processes for salmon and steelhead.

(12) An MRCI development ordinance or plan complies with all other state and Federal environmental and natural resource laws and permits.

NMFS concludes that development governed by ordinances or plans that fulfill the listed considerations will address the potential negative impacts on salmon and steelhead associated with development and redevelopment. In such circumstances adequate safeguards will be in place that NMFS does not find it necessary or advisable to impose additional Federal protections through the take prohibitions.

Limit No. 13 – Forest Management in Washington

In the State of Washington, NMFS has worked with timber industry representatives, tribes, state and Federal agencies, and various interest groups for many months. The purpose of these discussions was to develop a set of forest practices that could be included in Washington Governor Locke's salmon recovery plan. The product of those discussions is the April 29, 1999, Forests and Fish Report (FFR) to Governor Locke. It provides important improvements in forest practice regulation which, if approved by the Washington Forest Practices Board in a form at least as protective as it is laid out in the FFR, will substantially protect and conserve listed fish in that state. The FFR also mandates that all existing forest roads be inventoried for their potential to affect salmon and steelhead and that all needed improvements be completed within 15 years. The impacts that inadequately sited, constructed, or maintained forest roads have on salmonid habitat are well-documented. This feature alone will help a great deal in conserving listed ESUs in Washington.

After carefully considering the above features—as well as others described in greater detail below—NMFS has determined it is not necessary to apply take prohibitions to non-Federal forest management activities conducted in the State of Washington. These activities may go forward provided that: (1) The action complies with forest practice regulations the Washington Forest Practices Board has adopted and implemented and that NMFS has found to protect habitat functions at least as well as the regulatory elements of the FFR; and (2) the activity also implements all non-regulatory elements of the FFR. It should also be noted that actions taken under alternative plans may be included under this limit provided the Washington Department of Natural Resources (WDNR) finds the alternate plans protect physical and biological processes at least as well as the state forest practices rules and that NMFS, or any resource agency or tribe NMFS designates, has the opportunity to review each alternate plan at every stage of its development and implementation. Given these conditions,

NMFS concludes that the FFR package conserves salmon and their habitat well enough that it is neither necessary nor advisable to impose take prohibitions.

NMFS believes that to conserve listed fish, it is important to rapidly adopt and implement improved forest practice regulations such as those found in the FFR. NMFS will provide an opportunity for the public to review and comment on all regulations developed to implement the FFR before making any determinations about how well they conserve listed fish.

Although NMFS will continue working with Washington (and other states) on broadening this limit, at this time NMFS lacks information to determine that pesticide provisions in the FFR package, sufficiently protect and conserve listed fish. Therefore, this limit does not extend to the use of herbicides, pesticides, or fungicides.

Elements of the FFR that protect and conserve listed salmon and steelhead are summarized below:

(1) It accurately classifies water bodies and makes stream typing information broadly available. It is tailored to protect and reinforce the functions and roles of different stream classes in the continuum of the aquatic ecosystem. These include fish-bearing streams—which may have either perennial or seasonal flow; perennial, non-fish-bearing streams—which include spatially intermittent streams; and seasonal, non-fish-bearing streams—which have a defined channel that contains flow at some time during the year.

(2) It lays out a plan for properly designing, maintaining, and upgrading existing and new forest roads. As stated previously, this is an important means of maintaining and improving water quality and instream habitats. The FFR provisions address: Road construction and reconstruction in riparian areas and on potentially unstable slopes; the potential for new and reconstructed roads to affect hydrologic connections between stream channels, ground water, and wetlands, and to add sediment to aquatic systems; the ability for road structures (e.g., culverts and bridges) to pass fish, 100-year flows, and instream debris; a plan to assess (within 5 years) the condition of all forest roads and to determine the need to repair, reconstruct, maintain, control access, abandon or obliterate them with work to be completed within 15 years; and BMPs for all other aspects of forest road operation.

(3) It protects unstable slopes from increased failure rates and volume.

(4) It allows properly functioning condition to be achieved in riparian areas along fish-bearing waters. Proper function refers to the suite of riparian and instream functions that affect both instream habitat conditions and the vigor and succession of riparian forest ecosystems. The functions include stream bank stability, shade, litterfall and nutrient input, large woody debris recruitment, and microclimate factors such as air and soil temperature, windspeed, and relative humidity. The FFR ensures properly functioning condition by establishing variable-width management zones within which silvicultural treatments are allowed. These treatments are prescribed through forestry guidelines that NMFS has determined will set a riparian forest stand on a growth and succession pathway toward a desired future condition (DFC) of a mature riparian forest. Once the stand is on the proper trajectory toward DFC, it must remain there without further harvest or silvicultural treatment. Riparian management includes the following provisions:

- Continuous riparian management zones along all fish-bearing streams.
- A core zone at least 50 ft (15 m) wide west of the Cascades and 30 ft (9 m) on the east side, within which no harvest or salvage occurs. This width is measured horizontally from edge of the bankfull channel, or where channel migration occurs, from the outer edge of the channel migration zone.
- An inner zone that varies in width depending on the timber harvest strategy.
- An outer zone extending to a site tree height (100 year base) that provides a

minimum of 20 conifer trees per acre that are greater than 12 inches (0.30m) in diameter at breast height.

- Overstory canopy disturbance along a stream is limited to 20% for roads and yarding corridors and ground disturbance is limited to 10%.
- A mature riparian forest is the DFC. Generally, mature riparian forest conditions are achieved after 80 to 200 years. Once this DFC trajectory has been achieved the riparian stand will be allowed to grow without further harvest or treatment.
- A method for applying riparian prescriptions in the field so that DFC will be achieved.
- Riparian conservation zone widths that provide bank stability, litterfall and nutrients, shade, large woody debris, sediment filtering, and microclimate functions in the near and long-term.
- Mitigation for the effects permanent road systems near stream channels have on riparian function, water quality, and fluvial (floodplain) processes.
- Treatment guidelines—by tree species, stand age and condition, and region—that address stocking levels, tree selection, spacing, and other common forest metrics needed to achieve DFC.
- Guidelines for converting certain hardwood-dominated riparian areas to forest stands that can achieve the pathway toward DFC.
- A strategy for conserving fluvial processes and fish habitats in the channel migration zone.
- Guidelines for salvaging dead or downed timber in the inner and outer riparian zones.
- Provisions for managing riparian areas along perennial and seasonal non-fish-bearing streams to achieve a large measure of riparian function.

(5) It sets up a process for evaluating the effects of multiple forest practices on the watershed scale.

(6) It ensures that any alternative plan would provide a functionally equivalent level of conservation.

(7) It includes a monitoring and adaptive management process that managers will use to determine how well the practices are being implemented, how well they comply with regulation, and how effective the regulations themselves are to assess implementation compliance with, and effectiveness of, current regulations, measured against a baseline data set. Over time, some forest practices will likely need to be replaced or adjusted as new information comes in. Whenever new information leads the state forest practice agency to amend a program under this limit, NMFS will publish a notification in the *Federal Register* announcing the availability of those changes for review and comment. Such a notice will provide for a comment period of not less than 30 days, after which NMFS will make a final determination on how well the changes conserve listed fish and thus whether they may be included under this limit on the take prohibitions.

Regular Evaluation of Limits on Take Prohibitions

In determining that it is neither necessary nor advisable to impose take prohibitions on certain programs or activities described in the final rule, NMFS is mindful that new information may require that conclusion to be reevaluated at some future point. NMFS will evaluate all of the limits on the take prohibitions described in the final rule on a regular basis to determine the program's effectiveness in protecting and conserving the listed fish. If the program is not sufficiently protective, NMFS will identify ways in which it needs to be altered or strengthened. Changes may be identified if the program does not protect desired habitat functions or, even if the program supports the originally targeted habitat characteristics and functions, the habitat does not uphold population productivity levels needed to conserve the ESU.

If any jurisdiction conducting activities that fall under a given limit does not make changes to respond adequately to the new

information in the shortest amount of time feasible—and in no case taking more than one year—NMFS will publish notification in the Federal Register announcing its intention to withdraw the limit and apply the take prohibitions to the program. Such an announcement would provide a comment period of at least 30 days, after which NMFS would make a final determination whether to subject the activities to the ESA section 9(a)(1) take prohibitions.

Other ESA Mechanisms

Section 10 of the ESA provides another mechanism for NMFS to permit take when it is the incidental result of carrying out an otherwise lawful activity. Applicants for an Incidental Take Permit must submit a Conservation Plan (CP) that identifies (a) the impacts expected from any take associated with activities covered by the plan, and (b) the steps that will be taken to monitor, minimize, and mitigate those impacts. For more information on CPs, see the publication entitled "*A Habitat Conservation Plans and the Incidental Take Permitting Process*," available on the U.S. Fish and Wildlife Service web site, at http://www.fws.gov/r9endspp/hcp/hcpplan.html, or speak with one of the NMFS contact people listed below.

Section 7 of the ESA requires that Federal agencies consult with NMFS on activities they authorize, fund, or carry out to ensure they are not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of their critical habitat. This includes Federally funded projects such as road construction, stormwater management, rural and urban development, and many other activities conducted, permitted, or funded by Federal agencies.

How NMFS Decides What May Be Included In a 4(d) Rule Limit

Whether take prohibitions or other protective regulations are necessary and advisable depends largely upon the biological status of the species and the potential impacts of various activities on it. If programs contribute to conserving the species or adequately limit the impacts on the species, NMFS may find it is not necessary or advisable to impose the Federal take prohibitions. NMFS expects to continue to work with various entities after the final rule is published, and we will continue to incorporate other conservation efforts in future amendments or through other ESA mechanisms.

In assessing the impacts of a proposed action or program on a species= freshwater or estuarine habitat, NMFS considers the following factors:

- Will the action or program degrade existing habitat processes or functions?
- Will the action or program help restore degraded habitat processes or functions?

The limits in the current rule provide examples of how activities that may harm salmon and steelhead can be adequately controlled to minimize impacts and contribute to the conservation of salmon and steelhead.

All development activities need adequate funding and legal mechanisms for implementing, monitoring, maintenance, enforcement, and reporting in order to ensure that they comply with approved policies, ordinances, and permitting procedures. NMFS expects that programs proposed for a limit will be sufficiently described, guided, or governed by an applicable authority (other than just the ESA itself). These authorities could include state laws, county regulations, metropolitan master plans, local ordinances, official operating manuals, or other regulating mechanisms. In order to qualify for a limit, these mechanisms and the entities implementing them must provide a high degree of assurance that covered activities are being conducted in compliance with the specifications NMFS has analyzed and approved.

To be approved for a limit from ESA take prohibitions, a program must conserve salmon and meet their biological requirements. This criterion is the same for any program. These species span the entire West Coast, from coastal rainforests to arid inland areas to high

mountain regions nearly a thousand miles from the ocean. Specific requirements will differ from place to place. Some jurisdictions have asked for NMFS' help in learning how to avoid or limit adverse impacts on these species. In response, we have created this Guide and amended the final rule to make clear what must be done to protect and conserve listed fish.

Submitting a Program for 4(d) Limit

Any activity or program seeking a limit under a 4(d) rule should contain the following features.

- Descriptions of the activity or program being proposed, the geographic area within which the proposed action/program will apply or be carried out, and the jurisdiction or entity responsible for overseeing the action/program.
- A description of the listed species and habitat that will be affected by the action. This information should include fish distribution and abundance in the affected area and a description of the type, quantity, and quality of habitat in the affected area.
- A description of the environmental baseline. This information should describe existing habitat conditions in terms of water quality, access, riparian areas, stream channels, flow, and watershed health indicators such as total impervious area and any existing high quality habitat areas.
- A description of the anticipated short-term and long-term impacts the action is expected to have on the species (including all life-cycle stages) and its habitat. This description should include both positive and negative impacts and describe how any adverse impacts will be avoided, mitigated, or minimized.
- A discussion of the likelihood that the program or action will be implemented as described. Some questions that would need to be answered are: What commitment has been made to carry out the action or program? Are the legal authorities needed to carry out the program in place? Is implementation funding available and adequate? Is staffing available and adequate? What is the schedule for implementation? If the program is currently being implemented, what is its record of implementation and effectiveness to date?
- A program for monitoring both the action's implementation and effectiveness; it should include a schedule for conducting monitoring and submitting reports.
- A method for using monitoring information to change actions when needed—adaptive management.

Contact Information

The table below identifies the appropriate division and individual staff member at NMFS to contact regarding inquiries about initiating the process to receive a 4(d) limit or to identify other ESA permitting options:

TOPIC/TYPE OF ACTIVITY	NMFS DIVISION	FOR MORE INFORMATION
Ongoing Scientific Research Permit	Protected Resources	Leslie Schaeffer (503/230-5433)
Fishery Management	Sustainable Fisheries	http://www.nwr.noaa.gov/1fmep/index.html or Stephen Smith (503/230-5427) or Peter Dygert (206/526-6734)
Hatchery and Genetic Management Programs	Sustainable Fisheries	http://www.nwr.noaa.gov/1hgmp/hgmptmpl.htm or Stephen Smith (503/230-5427)
Scientific Research Conducted by States	Protected Resources	Leslie Schaeffer (503/230-5433)
Screened Water Diversions	Hydropower Program	http://www.nwr.noaa.gov/1hydroweb/ferc.htm or Bryan Nordlund (503/231-6816)
• Joint Tribal/State Plans • Routine Road Maintenance Activities • City of Portland Integrated Pest Management • Municipal, Residential, Commercial and Industrial Development (and Redevelopment) • Section 10 Incidental Take Permit • Section 7 Consultation	Habitat Conservation	**State of Washington** – Steve Landino (360/753-6054) **State of Oregon, but not including Snake River Basin** – Michael Tehan (503/231-2224) **State of Idaho, and the Snake River Watershed in Oregon** – Ted Meyers (208/378-5698) **State of California** – Craig Wingert (562/980-4021)

Additional Information on the Final 4(d) Rule

Please visit the NMFS Northwest Region Web Site at http://www.nwr.noaa.gov or the Southwest Region Web Site http://swr.ucsd.edu for additional information on the final 4(d) rule for salmon and steelhead. The sites contain the *Federal Register* notice, fact sheets, maps of threatened salmon and steelhead ESUs, press releases, copies of question and answer fact sheets, and documents referenced in the rule. The sites also contain a great deal of information on listed species in general: *Federal Register* notices, species maps, status reviews, fact sheets, and more. In addition, the following NMFS staff members can provide information on the final rule:

TOPIC/GEOGRAPHIC AREA	CONTACT
Final 4(d) Rule	Rosemary Furfey (503/231-2149) Rosemary.Furfey@noaa.gov
Puget Sound	Elizabeth Babcock (206/526-4505) Elizabeth.Babcock@noaa.gov
Upper Columbia Basin	Mike Grady (206/526-4645) Michael.Grady@noaa.gov
Mid-Columbia Basin	Kate Vandemoer (503/230-5422) Kate.Vandemoer@noaa.gov
Lower Columbia Basin	Rob Jones (503/230-5429) Rob.Jones@noaa.gov
Willamette Basin or Oregon Coast	Patty Dornbusch (503/230-5430) Patty.Dornbusch@noaa.gov
California Coast	Greg Bryant (707/825-5162) Greg.Bryant@noaa.gov

Effective Dates of Final 4(d) Rule

Species	Effective Date of 4(d) Rule
Threatened Steelhead ESUs	60 days after the final 4(d) rule is published
Threatened Salmon ESUs	180 days after the final 4(d) rule is published

Finding Your Way Around the 4(d) Rule

The proposed 4(d) rule included a preamble in which NMFS provided technical guidance, descriptions of the scientific principles upon which the limits were based, and descriptions of the limits' background and content. The proposed regulatory language was in a separate Code of Federal Regulation (CFR) section.

The final 4(d) rule for salmon and steelhead is divided into two sections—the preamble and the CFR language. The preamble includes the following sections:

- A summary of the final rule and its effective dates
- Supplementary Information—including the rule's background and a description of its content
- A list of the threatened ESUs affected by the final rule
- Notice of availability of documents referenced in the final rule
- A summary of the comments received in response to the proposed rules
- A section identifying the changes to the proposed 4(d) rule made in response to public comment
- Take Guidance
- A section detailing how the rule complies with the Regulatory Flexibility Act and various Executive Orders

The last section of the final rule includes the regulatory language that applies the section 9 take prohibitions to the 14 threatened ESUs listed below and creates 13 limits on those prohibitions. The regulations section describes each limit.

The following is a list of the 14 threatened ESUs covered in the final 4(d) rule:

Threatened Steelhead ESUs
- Central California Coast
- South-Central California Coast
- Snake River Basin
- Lower Columbia River
- Central Valley, California
- Upper Willamette River
- Middle Columbia River

Threatened Chum ESUs
- Hood Canal summer-run
- Columbia River

Threatened Chinook ESUs
- Puget Sound
- Lower Columbia River
- Upper Willamette River

Threatened Coho ESUs
- Oregon Coast

Threatened Sockeye ESUs
- Ozette Lake

Technical Issues: Aids for Understanding the 13 Limits in the 4(d) Rule

Viable Salmonid Populations

NMFS uses the Viable Salmonid Population (VSP) concept primarily in evaluating hatchery and harvest activities. NMFS defines populations following Ricker's (1972) definition of a "stock." Thus, a population is a group of fish of the same species spawning in a particular lake or stream (or portion thereof) at a particular season which to a substantial degree does not interbreed with fish from any other group spawning in a different place or in the same place at a different season. This definition is widely accepted and applied in the field of fishery management.

An independent population is an aggregation of one or more local breeding units that are closely linked by exchange of individuals among themselves, but are sufficiently isolated from other independent populations that exchanges of individuals among populations do not appreciably affect the population dynamics or extinction risk of the populations over a 100-year time frame. Such

populations are generally smaller than their entire ESU, and they generally inhabit geographic ranges on the scale of whole river basins or major sub-basins that are relatively free of outside migration. For several reasons, NMFS believes it important to identify population units within established ESUs and individually evaluate their extinction risk. First, many of the biological processes that can drive a species to extinction operate at the population level, so it is appropriate to manage at that scale. In addition, by identifying and assessing impacts at the population level, managers can gain a better understanding of the important biological diversity contained within each ESU—a factor considered in NMFS' ESU policy (Waples 1991). Further, given an ESU's scale and complexity, it is typically a more practical undertaking to assess impacts at the population level. Finally, assessing impacts at the population level helps ensure that listed salmon and steelhead are treated consistently across a diverse geographic and jurisdictional range.

NMFS will use four primary biological parameters to evaluate population status: (1) Abundance, (2) population growth rate, (3) population spatial structure, and (4) diversity. The relevance of these parameters to salmonid population status is discussed in a variety of scientific documents (e.g., Nehlsen et al. 1991; Burgman et al. 1993; Huntington et al. 1996; Caughley and Gunn 1996; Myers et al.,1998). Population abundance is important to evaluate because smaller populations experience relatively greater genetic, environmental, and demographic risks. Genetic risks associated with low population size include inbreeding depression, harmful mutation accumulation, and loss of genetic diversity. Demographic risks associated with low population size include random effects associated with environmental events.

Population productivity may be thought of as the population's ability to increase or maintain its abundance. It is important to assess productivity because negative trends in productivity over sustained periods may lead to the genetic and demographic impacts associated with small population sizes. Population spatial structure reflects the number, size, and distribution of habitat patches and the condition of the migration corridors that provide linkages among these patches. Population structure affects demographic processes and extinction risk in ways that may not be readily apparent from studies of abundance and population growth rate. In addition, spatial structure affects evolutionary processes and may affect a population's ability to respond to environmental changes or stochastic events.

Population diversity is important because it helps buffer a species against short-term environmental change and stochastic events. Population diversity may be assessed by examining life history traits such as age, and run and spawn timing distributions. Also, DNA analysis may provide an indication of diversity.

In applying the concepts discussed here to harvest and hatchery actions, NMFS relies on two functional thresholds of population status: (1) Critical population threshold, and (2) viable population threshold. The critical population threshold refers to a minimal functional level below which a population's risk of extinction increases exponentially in response to any additional genetic or demographic risks. The viable population threshold refers to a condition where the population is self-sustaining and not at risk of becoming endangered in the foreseeable future. This threshold reflects the desired condition for individual populations and encompasses their contribution to recovering the ESU as a whole. Proposed actions must not preclude populations from attaining this condition.

Properly Functioning Condition

The final rule limits the take prohibitions for certain land and water management activities that NMFS has determined will conserve listed salmonids' habitat even though they may incidentally take individual listed fish. To make these determinations, NMFS evaluated whether the activities would allow properly functioning habitat condition to be attained and persist. The NMFS defines properly functioning condition (PFC) as the sustained presence of natural habitat-forming processes (e.g., hydraulic runoff, bedload transport, channel migration,

riparian vegetation succession) that are necessary for the long-term survival and recovery of the species (*The Habitat Approach*, NMFS, 1999). Thus, PFC constitutes a species' habitat-based biological requirements—the essential physical features that support spawning, incubation, rearing, feeding, sheltering, migration, and other behaviors. Such features include adequate instream flow, appropriate water temperature, loose gravel for spawning, unimpeded fish passage, deep pools, and abundant large tree trunks and root wads.

There is more than one scientifically credible analytical framework for determining an activity's effects. However, NMFS has developed a default analytical method (*Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale*, NMFS, 1996). It is often referred to as the "Matrix of Pathways and Indicators," or MPI. In the MPI framework, the pathways for determining the effect of an action are represented as six conceptual groupings (e.g., water quality, channel condition) of 18 habitat condition indicators (e.g., temperature, width/depth ratio). Indicator criteria (mostly numeric, though some are narrative) are provided for three levels of environmental baseline condition: properly functioning, at risk, and not properly functioning. The effect of the action upon each indicator is classified by whether it will restore, maintain, or degrade the indicator.

Although the indicators used to assess habitat condition may entail instantaneous measurements, they are chosen, using the best available science, to detect the health of underlying processes, not static characteristics. "Best available science" advances through time, thus allowing PFC indicators to be refined, new threats to be assessed, and species status and trends to be better understood. Aquatic habitats are inherently dynamic, and the PFC concept recognizes that natural patterns of habitat disturbance will continue to occur. Floods, landslides, windstorms, and fires result in spatial and temporal variability in habitat characteristics, as do human activities. Indicators of PFC vary between different landscapes based on unique physiographic and geologic features. For example, aquatic habitats on timberlands in glacial mountain valleys are controlled by natural processes operating at different scales and rates than are habitats on low-elevation coastal rivers. The MPI provides a consistent but geographically adaptable framework for making effect determinations. The pathways and indicators, as well as the ranges of their associated criteria, are amenable to alteration through the process of watershed analysis.

Regardless of the analytical method used, if a proposed action is likely to impair properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat toward PFC, it cannot be found to be consistent with the conservation of the species. If a program preserves existing habitat function levels and allows natural progression towards PFC where habitat is impaired, NMFS may determine that it qualifies for a limit on the take prohibitions. The NMFS has added language to the limits for road maintenance, pesticide management, municipal, residential, commercial and industrial (MRCI) development, and forestry that defines PFC and identifies how NMFS will evaluate programs with regard to meeting this biological standard. Specific criteria for applying this conservation standard are listed in each habitat-related limit.

The scope of any given activity is important to NMFS' effects analysis. The scope of the activity may be such that only a portion of the habitat forming processes in a watershed are affected by it. For NMFS to find that an activity is consistent with conserving listed fish, only the effects on habitat functions that are within the scope of that activity will be evaluated. For example, an integrated pest management program may affect habitat forming processes related to clean water, but have no effect on physical barriers that prevent fish from gaining access to a stream.

APPENDIX B

APPENDIX B

Stormwater Management Ordinance

ILWACO STORMWATER MANAGEMENT ORDINANCE

CONTENTS

SECTION 1: FINDINGS OF FACT, NEED AND PURPOSE

1.1 Findings of Fact

The City Council of the City of Ilwaco hereby finds that:

A. Stormwater pollution is a problem associated with land utilization and development and the common occurrence of potential pollutants such as pesticides, fertilizers, petroleum products, pet wastes and numerous others.

Land utilization and development is also known to increase both the volume and duration of peak flows. The resulting erosion, scouring, and deposition of sediment affect the ecological balance in the stream.

Sedimentation and stormwater pollution cause diversity of species to decrease and allows more tolerant (and usually less desirable) species to remain.

Stormwater pollution can cause or contribute to closures of shellfish beds and swimming beaches and other restrictions on public use of the waters within Ilwaco.

B. An expanding population and increased development of land have led to:

water quality degradation through discharge of nutrients, metals, oil and grease, toxic materials, and other detrimental substances including, without limitation, insect and weed control compounds;

drainage and storm and surface water runoff problems within the City; and

safety hazards to both lives and property posed by uncontrolled water runoff on streets and highways.

C. Continuation of present stormwater management practices, to the extent that they exist, will lead to water quality degradation, erosion, property damage, and endanger the health and safety of the inhabitants of the City.

D. In the future such problems and dangers will be reduced or avoided if existing properties and future developers, both private and public, provide for stormwater quality and quality controls.

E. Stormwater quality and quality control can be achieved when land is developed or redeveloped by implementing appropriate best management practices (BMPs).

F. Best management practices can be expected to perform as intended only when properly designed, constructed and maintained.

1.2 Need

The City Council finds that this ordinance is necessary in order to:

A. Minimize or eliminate water quality degradation.

B. Prevent erosion and sedimentation in creeks, streams, ponds, lakes and other water bodies.

C. Protect property owners adjacent to existing and developing lands from increased runoff rates which could cause erosion of abutting property.

D. Preserve and enhance the suitability of waters or contact recreation, fishing, and other beneficial uses.

E. Preserve and enhance the aesthetic quality of the water.

F. Promote sound development policies which respect and preserve City surface water, ground water and sediment.

G. Ensure the safety of Ilwaco roads and right-of-way.

H. Decrease stormwater-related damage to public and private property from existing and future runoff.

I. To protect the health, safety and welfare of the inhabitants of the City.

1.3 Purpose

The provisions of this ordinance are intended to guide and advise all who conduct new development or redevelopment within Ilwaco. The provisions of this ordinance establish

the minimum level of compliance which must be met to permit a property to be developed or redeveloped within the City.

It is the purpose of this Ordinance to:

A. Minimize water quality degradation and sedimentation in streams, ponds, lakes, wetlands and other water bodies;

B. Minimize the impact of increased runoff, erosion and sedimentation caused by land development and maintenance practices;

C. Maintain and protect groundwater resources;

D. Minimize adverse impacts of alterations on ground and surface water quantities, locations and flow patterns;

E. Decrease potential landslide, flood and erosion damage to public and private property;

F. Promote site planning and construction practices that are consistent with natural topographical, vegetational and hydrological conditions;

G. Maintain and protect the City stormwater management infrastructure and those downstream;

H. Provide a means of regulating clearing and grading of private and public land while minimizing water quality impacts in order to protect public health and safety; and

I. Provide minimum development regulations and construction procedures which will preserve, replace or enhance, to the maximum extent practicable, existing vegetation to preserve and enhance the natural qualities of land, wetlands and water bodies.

SECTION 2: DEFINITIONS

For the purpose of this ordinance, the following definitions shall apply:

a. "Administrator" means the City Staff member responsible for overseeing the Stormwater Management Program.

b. "American Public Works Association" or "APWA" means the adopted edition of the Washington State Chapter of the American Public Works Association.

c. "Approval" means the proposed work in the submitted plans or completed work conforms to this ordinance in the opinion of the Administrator.

d. "As-graded" means the extent of surface conditions on completion of grading.

e. "Basin plan" means a plan and all implementing regulations and procedures including but not limited to land use management adopted by ordinance for managing surface and storm water quality and quantity management facilities and features within individual sub-basins.

f. "Bedrock" means the more or less solid rock in place either on or beneath the surface of the earth. It may be soft, medium, or hard and have a smooth or irregular surface.

g. "Bench" means a relatively level step excavated into earth material on which fill is to be placed.

h. "Best Management Practice" or "BMP" means the schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State.

i. "Civil engineer" means a professional engineer licensed in the State of Washington in Civil Engineering.

j. "Civil engineering" means the application of the knowledge of the forces of nature, principles of mechanics and the properties of material to the evaluation, design and construction of civil works for the beneficial uses of mankind.

k. "Clearing" means the destruction and removal of vegetation by manual, mechanical, or chemical methods.

l. "Commercial agriculture" means those activities conducted on lands defined in RCW 84.34.020(2), and activities involved in the production of crops or livestock for wholesale trade. An activity ceases to be considered commercial agriculture when the area on which it is conducted is proposed for conversation to a nonagricultural use or has lain idle for more than five (5) years, unless the idle land is registered in a federal or state soils conversation program, or unless the activity is maintenance of irrigation ditches, laterals, canals, or drainage ditches related to an existing and ongoing agricultural activity.

m. "Compaction" means the densification, settlement, or packing of soil in such a way that permeability of the soil is reduced. Compaction effectively shifts the performance of a hydrologic group to a lower permeability hydrologic group. For example, a group B hydrologic soil can be compacted and be effectively converted to a group C

hydrologic soil in the way it performs in regard to runoff. It can also mean the densification of a fill by mechanical means.

n. "Critical Areas" means all wetlands, frequently flooded areas, aquifer recharge areas, fish and wildlife habitat conservation areas, geologically hazardous areas, and shellfish, kelp, eelgrass, herring, and smelt spawning areas as defined in the City's Critical Areas Ordinance (Ordinance 614)..

o. "Design Storm" means a prescribed hyetograph and total precipitation amount (for a specific duration recurrence frequency) used to estimate runoff for a hypothetical storm of interest or concern for the purpose of analyzing existing drainage, designing new drainage facilities or assessing other impacts of a proposed project on the flow of surface water. (A hyetograph is a graph of percentages of total precipitation for a series of time steps representing the total time the precipitation occurs.)

p. "Detention" means the release of stormwater runoff from the site at a slower rate than it is collected by the stormwater facility system, the difference being held in temporary storage.

q. "Detention facility" means an above or below ground facility, such as a pond or tank, that temporarily stores stormwater runoff and subsequently releases it at a slower rate than it is collected by the drainage facility system. There is little or no infiltration of stored stormwater.

r. "Drainage basin" means a geographic and hydrologic subunit of a watershed.

s. "Earth material" means any rock, natural soil or fill and/or any combination thereof.

t. "Ecology" means the Washington State Department of Ecology.

u. "Engineering geologist" means a geologist experienced and knowledgeable in engineering geology.

v. "Engineering geology" means the application of geologic knowledge and principles in the investigation and evaluation of naturally occurring rock and soil for use in the design of civil work.

w. "Erosion" means the wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. Also, detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of water erosion:

- Accelerated erosion - Erosion much more rapid than normal or geologic erosion, primarily as a result of the influence of the activities of man or, in some cases, of the animals or natural catastrophes that expose bare surfaces (e.g., fires).
- Geological erosion - The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing away of mountains, the building up of floodplains, coastal plains, etc. Synonymous with natural erosion.
- Gully erosion - The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from 1 to 2 feet to as much as 75 to 100 feet.
- Natural erosion - Wearing away of the earth's surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc., undisturbed by man. Synonymous with geological erosion.
- Normal erosion - The gradual erosion of land used by man which does not greatly exceed natural erosion. See Natural erosion.
- Rill erosion - An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils. See Rill.
- Sheet erosion - The removal of a fairly uniform layer of soil from the land surface by runoff.
- Splash erosion - The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not be subsequently removed by surface runoff.

x. "Excavation" means the mechanical removal of earth material.

y. "Experimental BMP" means a BMP that has not been tested and evaluated by the Department of Ecology in collaboration with local governments and technical experts.

z. "Fill" means a deposit of earth material placed by artificial means.

aa. "Forest practice" means any activity conducted on or directly pertaining to forest land and relating to growth, harvesting, or processing timber, including but not limited to:

(1) Road and trail construction.
(2) Harvesting, final and intermediate.
(3) Precommercial thinning.
(4) Reforestation.
(5) Fertilization.
(6) Prevention and suppression of disease and insects.
(7) Salvage of trees.
(8) Brush control.

bb. "Frequently flooded areas" means the 100-year floodplain designations of the Federal Emergency Management Agency and the National Flood Insurance Program.

cc. "Geologically hazardous areas" means areas that because of their susceptibility to erosion, sliding, earthquake or other geological events, are not suited to the siting of commercial, residential or industrial development consistent with public health or safety concerns.

dd. "Grade" means the slope of a road, channel, or natural ground. The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared for the support of construction such as paving or the laying of a conduit.

(1) Existing Grade. The grade prior to grading.

(2) Rough Grade. The stage at which the grade approximately conforms to the approved plan.

(3) Finish Grade. The final grade of the site which conforms to the approved plan.

ee. "Gradient terrace" means an earth embankment or a ridge-and-channel constructed with suitable spacing and an acceptable grade to reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a stable nonerosive velocity.

ff. (To) "Grade" means to finish the surface of a canal bed, roadbed, top of embankment or bottom of excavation.

gg. "Ground water" means water in a saturated zone or stratum beneath the surface of land or a surface water body.

hh. "Hydroperiod" means the seasonal occurrence of flooding and/or soil saturation; it encompasses depth, frequency, duration, and seasonal pattern of inundation.

ii. "Illicit discharge" means all non-stormwater discharges to stormwater drainage systems that cause or contribute to a violation of state water quality, sediment quality or ground water quality standards, including but not limited to sanitary sewer connections, industrial process water, interior floor drains, car washing and greywater systems.

jj. "Impervious surface" means a hard surface area which either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development, and/or a hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow 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 stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces.

kk. "Interflow" means that portion of rainfall that infiltrates into the soil and moves laterally through the upper soil horizons until intercepted by a stream channel or until it returns to the surface for example, in a wetland, spring or seep. Interflow is a function of the soil system depth, permeability, and water-holding capacity.

ll. "Land disturbing activity" means any activity that results in a change in the existing soils cover (both vegetative and nonvegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to demolition, construction, clearing, grading, filling, excavation and compaction.

mm. "Mitigation" means, in the following order of preference:

(a) Avoiding the impact altogether by not taking a certain action or part of an action;

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;

(c) Rectifying the impact by repairing, rehabilitating or restoring the affected environment;

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

(e) Compensation for the impact by replacing, enhancing, or providing substitute resources or environments.

oo. "Natural location" means the locations of those channels, swales, and other non-manmade conveyance systems as defined by the first documented topographic contours existing for the subject property, either from maps or photographs, or such other means as appropriate.

pp. "New Development" means the following activities: land disturbing activities, structural development, including construction, installation or expansion of a building or other structure; creation of impervious surfaces; Class IV - general forest practices that are conversions from timber land to other uses; and subdivision and short subdivision of land as defined in RCW 58.17.020. All other forest

practices and commercial agriculture are not considered new development.

qq. "Permanent Stormwater Quality Control (PSQC) Plan" means a plan which includes permanent BMPs for the control of pollution from stormwater runoff after construction and/or land disturbing activity has been completed.

rr. "Person" means any individual, partnership, corporation, association, organization, cooperative, public or municipal corporation, agency of the state, or local government unit, however designated.

ss. "Pollution" means contamination or other alteration of the physical, chemical, or biological properties, of water of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the state 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.

tt. "Pollution-generating impervious surface" (PGIS) means those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities; or storage of erodible or leachable materials, wastes or chemicals are those substances which, when exposed to rainfall, measurably alter the physical or chemical characteristics of the rainfall runoff. Examples include erodible soils, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, and garbage dumpster leakage. Metal roofs are also considered to be PGIS unless they are treated to prevent leaching.

A surface, whether paved or not, shall be considered subject to vehicular use if it is regularly used by motor vehicles. The following are considered regularly-used surfaces: roads, unvegetated road shoulders, bike lanes within the traveled lane of a roadway, driveways, parking lots, unfenced firelanes, vehicular equipment storage yards, and airport runways.

The following are not considered regularly-used surfaces: road shoulders primarily used for emergency parking, paved bicycle pathways, bicycle lanes adjacent to unpaved or paved road shoulders primarily used for emergency parking, fenced firelanes and infrequently used maintenance access roads.

uu. "Pollution-generating pervious surface" (PGPS) means any non-impervious surface subject to use of pesticides and fertilizers or loss of soil. Typical PGPS include lawns, landscaped areas, golf courses, parks, cemeteries, and sports fields.

vv. "Redevelopment" means, on an already developed site, the creation or addition of impervious surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including an increase in gross floor area and/or exterior construction or remodeling; replacement of impervious surface that is not part of a routine maintenance activity; land disturbing activities associated with structural or impervious redevelopment; and any change in use that has the potential to release new pollutants from the site. New pollutants means a pollutant that was not discharged at that location immediately prior to the change in use, as well as a pollutant that was discharged in less quantities immediately prior to the change in use.

Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics are not considered redevelopment.

ww. "Regional retention/detention system" means a stormwater quality control structure designed to correct existing excess surface water runoff problems of a basin or sub-basin. The area downstream has been previously identified as having existing or predicted significant and regional flooding and/or erosion problems. This term is also used when a detention facility is used to detain stormwater runoff from a number of different businesses, developments or areas within a catchment. The use of regional detention facilities may be more efficient than on-site stormwater treatment although the preferred option is to include some on-site stormwater treatment through the use of grassy swales etc. even when regional detention facilities are used.

xx. "Retention/detention facility (R/D)" means a type of drainage facility designed either to hold water for a considerable length of time and then release it by evaporation, plant transportation, and/or infiltration into the ground; or to hold surface and stormwater runoff for a short period of time and then release it to the surface and stormwater management system.

yy. "Site" means the portion of a piece of property which is subject to development.

zz. "Slope" means the degree of deviation of a surface from the horizontal; measured as a numerical ratio, percent, or in degrees. Expressed as a ratio, the first number is the horizontal distance (run) and the second is the vertical distance (rise), as 2:1. A 2:1 slope is a 50 percent slope. Expressed in degrees, the slope is the angle from the horizontal plane, with a 90° slope being vertical (maximum) and 45° being a 1:1 or 100 percent slope.

aaa. "Soil" means the unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

bbb. "Source control BMP" means a BMP that is intended to prevent pollutants from entering stormwater. For purposes of this ordinance, source control BMPs include

"operational source control BMPs," "structural source control BMPs," and many types of erosion and sediment control BMPs.

ccc. "Stormwater" means that portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, channels or pipes into a defined surface water channel, or a constructed infiltration facility.

ddd. "Stormwater drainage system" means constructed and natural features which function together as a system to collect, convey, channel, hold, inhibit, retain, detain, infiltrate, divert, treat or filter stormwater.

eee. "Stormwater facility" means a constructed component of a stormwater drainage system, designed or constructed to perform a particular function, or multiple functions. Stormwater facilities include, but are not limited to, pipes, swales, ditches, culverts, street gutters, detention basins, retention basins, constructed wetlands, infiltration devices, catchbasins, oil/water separators, and sediment basins.

fff. "Stormwater Management Manual" or "Manual" means the Manual adopted by reference and prepared by Ecology that contains BMPs to prevent or treat pollution in stormwater and reduce other stormwater-related impacts to waters of the State. The Manual is intended to provide guidance on measures necessary in western Washington to control the quantity and quality of stormwater runoff from new development and redevelopment.

ggg. "Stormwater Site Plan" means a comprehensive report containing all of the technical information and analysis necessary for regulatory agencies to evaluate a proposed new development or redevelopment project for compliance with stormwater requirements. Contents of the Stormwater Site Plan will vary with the type and size of the project, and individual site characteristics. It includes a Construction Stormwater Pollution Prevention Plan (Construction SWPPP) and a Permanent Stormwater Quality Control Plan (PSQC).

hhh. "Toe of slope" means a point or line of slope in an excavation or cut where the lower surface changes to horizontal or meets the exiting ground slope.

iii. "Top of slope" means a point or line on the upper surface of a slope where it changes to horizontal or meets the original surface.

jjj. "Treatment BMP" means a BMP that is intended to remove pollutants from stormwater. A few examples of treatment BMPs are detention ponds, oil/water separators, biofiltration swales constructed wetlands.

kkk. "Unstable slopes" means those sloping areas of land which have in the past exhibited, are currently exhibiting, or will likely in the future exhibit, mass

movement of earth.

lll. "Vegetation" means all organic plant life growing on the surface of the earth.

mmm. "Water body" means surface water including rivers, streams, lakes, marine waters, estuaries, and wetlands.

nnn. "Watersheds" means a geographic region within which water drains into a particular river, stream, or body of water as identified and numbered by the State of Washington Water Resources Inventory Areas (WRIAs) as defined in Chapter 173-500 WAC.

ooo. "Wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. This includes wetlands created, restored or enhanced as part of a mitigation procedure. This does not include constructed wetlands or the following surface waters of the state intentionally constructed from sites that are not wetlands: Irrigation and drainage ditches, grass-lined swales, canals, agriculture detention facilities, farm ponds, and landscape amenities.

SECTION 3: GENERAL PROVISIONS

3.1 Abrogation and greater restrictions

It is not intended that this ordinance repeal, abrogate, or impair the Critical Areas Ordinance No. 614 or any existing regulations, easements, covenants, or deed restrictions. However, where this ordinance imposes greater restrictions, the provisions of this ordinance shall prevail.

3.2 Interpretation

The provisions of this ordinance shall be held to be minimum requirements in their interpretation and application and shall be liberally construed to serve the purpose of this ordinance.

SECTION 4: APPLICABILITY

When any provision of any other ordinance of the City conflicts with this ordinance, that which provides more environmental protection shall apply unless specifically provided otherwise in this ordinance.

The City is authorized to adopt written procedures for the purpose of carrying out the provisions of this ordinance. Prior to fulfilling the requirements of this ordinance, the City shall not grant any approval or permission to conduct a regulated activity including but not limited to the following:

> building permit; conditional use permit; right-of-way permit; site plan approval, preliminary plat approval, grading and clearing permit; shoreline substantial development permit; utility and other permit; or any subsequently adopted or required approval not expressly exempted by this ordinance.

Regulated activities shall be conducted only after the City approves a Stormwater Site Plan.

SECTION 5: REGULATED ACTIVITIES AND ALLOWED ACTIVITIES

5.1 Regulated activities

Consistent with the minimum requirements contained in this ordinance, the City shall approve or disapprove the following activities, unless exempted in Section 5.2 below:

A. New Development

(1) land disturbing activities;

(2) structural development, including construction; installation or expansion of a building or other structure;

(3) creation of impervious surfaces;

(4) Class IV general forest practices that are conversions from timber land to other uses;

(5) subdivision, short subdivision and binding site plans, as defined in Ch.58.17.020 RCW.

B. Redevelopment

(1) on an already developed site, the creation or addition of impervious surfaces: the expansion of a building footprint or addition or replacement of a structure; Structural development including an increase in gross floor area and/or exterior construction or remodeling; replacement of impervious surface that is not part of a routine maintenance activity, land disturbing activities associated with structural or impervious redevelopment.

Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics are not considered redevelopment.

5.2 Exemptions

Forest practices regulated under Title 222 WAC, except for Class IV General forest practices that are conversions from timber land to other uses, are exempt from the provisions of this ordinance.

Commercial agriculture practices involving working the land for production are generally exempt. However, the conversion from timberland to agriculture, and the construction of impervious surfaces are not exempt.

All other new development and redevelopment is subject to the minimum requirements of this ordinance.

SECTION 6: GENERAL REQUIREMENTS

6.1 Stormwater management manual adopted

The latest edition of Ecology's 2001 Stormwater Management Manual, as may be amended is hereby adopted by references and is hereinafter referred to as the Manual.

6.2 Stormwater best management practices (BMPs)

General: BMPs shall be used to control pollution from stormwater. BMPs shall be used to comply with the standards in this Ordinance. BMPs are in the Manual.

Experimental BMPs: In those instances where appropriate BMPs are not in the Manual, experimental BMPs should be considered. Experimental BMPs are encouraged as a means of solving problems in a manner not addressed by the Manual in an effort to improve stormwater quality technology. Experimental BMPs must be approved in accordance with the approval process outlined in the Manual.

6.3 Illicit discharges

Illicit discharges to stormwater drainage systems are prohibited.

SECTION 7: APPROVAL STANDARDS

7.1 New Development Minimum Requirements

The following new development shall be required to comply with Minimum Requirements 1 through 5 below:

- Creation or addition of 2,000 square feet of impervious surface area or greater. Land disturbing activities of 7,000 square feet or greater.

Projects not exceeding those thresholds shall apply only Minimum Requirement #2.

All new development that:

- Creates or adds 5,000 square feet, or greater, of new impervious surface area, or
- Converts ¾ acres of pervious surfaces to lawn or landscaped areas, or
- Converts 2.5 acres of forested area to pasture

shall comply with Minimum Requirements #1 through #10 as listed below.

7.1.1 Minimum Requirement #1 – Preparation of Stormwater Site Plan

All projects shall prepare a stormwater site plan for the Administrator's review.

7.1.2 Minimum requirement #2 – Construction of Stormwater Pollution Prevention (SWPPP)

All new development and redevelopment shall comply with Construction SWPP Elements #1 through #12 below. Projects that add or replace 2,000 square feet or more of impervious surface or clear more than 7,000 square feet must prepare a Construction SWPPP that is reviewed by the Administrator. Each of the twelve elements must be considered and included in the Construction SWPPP unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative of the SWPPP. Projects that add or replace less than 2,000 square feet of impervious surface or clearing projects of less than 7,000 square feet are not required to prepare a Construction SWPPP, but must consider all of the twelve Elements of Construction Stormwater Pollution Prevention and develop controls for all elements that pertain to the project site.

Element 1: **Mark Clearing Limits**

- Prior to beginning earth disturbing activities, including clearing and grading, all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area should be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts.
- Plastic, metal, or stake wire fence may be used to mark the clearing limits.

Element 2: **Establish Construction Access**

- Construction vehicle access and exit shall be limited to one route if possible.
- Access points shall be stabilized with quarry spall or crushed rock to minimize the tracking of sediment onto public roads.
- Wheel wash or tire baths should be located on-site if the action of the vehicle traveling over the gravel construction entrance is not sufficient to remove the majority of the mud from the tires.
- Public roads shall be cleaned thoroughly at the end of each work day. Sediment shall be removed from roads by shoveling or street sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner.

- Street wash wastewater shall be controlled by pumping back on-site, or otherwise be prevented from discharging into systems tributary to state surface waters.

Element 3: **Control Flow Rates**

- Properties and waterways downstream from development sites shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site, as required by the City.
- Downstream analysis is necessary if changes in offsite flows could impair or alter conveyance systems, streambanks, bed sediment or aquatic habitat.
- Stormwater detention facilities shall be constructed as one of the first steps in grading. Detention facilities shall be functional prior to construction of site improvements (e.g. impervious surfaces).
- The City may require pond designs that provide additional or different stormwater flow control if necessary to address local conditions or to protect properties and waterways downstream from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.
- If permanent infiltration ponds are used for flow control during construction, these facilities should be protected from siltation during the construction phase.

Element 4: **Install Sediment Controls**

- The duff layer, native top soil, and natural vegetation shall be retained in an undisturbed state to the maximum extent practicable.
- Prior to leaving a construction site, or prior to discharge to an infiltration facility, stormwater runoff from disturbed areas shall pass through a sediment pond or other appropriate sediment removal BMP. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Element #3, bullet #1. Full stabilization means concrete or asphalt paving; quarry spalls used as ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion. The City shall inspect and approve areas stabilized by means other than pavement or quarry spalls.
- Sediment ponds vegetated buffer strips, sediment barriers or filters, dikes, and other BMPs intended to trap sediment on-site shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Element #5.

Element 5: **Stabilize Soils**

- All exposed and unworked soils shall be stabilized by application of effective BMPs, that protect the soil from the erosive forces of raindrop impact and flowing water, and wind erosion.
- From October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. This condition applies to all soils on site, whether at

final grade or not. These time limits may be adjusted by the Administrator if it can be shown that the average time between storm events justifies a different standard.

- Applicable practices include, but are not limited to, temporary and permanent seeding, sodding, mulching, plastic covering, soil application of polyacrylamide (PAM), and the early application of gravel base on areas to be controlled for dust and eventually paved.
- Soil stabilization measures selected should be appropriate for the time of year, site conditions, estimated duration of use, and potential water quality impacts that stabilization agents may have on downstream waters or ground water.
- Soil stockpiles must be stabilized and protected with sediment trapping measures.
- Work on linear construction sites and activities, including right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall not exceed the capability of the individual contractor for his portion of the project to install the bedding materials, roadbeds, structures, pipelines, and/or utilities, and to re-stabilize the disturbed soils, meeting the timing conditions (From October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days).

Element 6: **Protect Slopes**

- Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion.
- Consider soil type and its potential for erosion.
- Reduce slope runoff velocities by reducing the continuous length of slope with terracing and diversions, reduce slope steepness, and roughen slope surface.
- Divert upslope drainage and run-on waters from off-site with interceptors at top of slope. Off-site stormwater should be handled separately from stormwater generated on the site. Diversion of off-site stormwater around the site may be a viable option. Diverted flows shall be redirected to the natural drainage location at or before the property boundary.
- Contain downslope collected flows in pipes, slope drains, or protected channels.
- Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.
- Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.
- Check dams shall be placed at regular intervals within trenches, which are cut down a slope.
- Stabilize soils on slopes, as specified in Element #5.

Element 7: **Protect Drain Inlets**

- All storm drain inlets made operable during construction shall be protected so that stormwater runoff shall not enter the conveyance system without first being filtered or treated to remove sediment.
- All approach roads shall be kept clean, and all sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to a water of the State.

***Element 8:* Stabilize Channels and Outlets**

- All temporary on-site conveyance channels shall be designed, constructed and stabilized to prevent erosion from the expected velocity of flow from a 2 year, 24-hour frequency storm for the developed condition.
- Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent streambanks, slopes and downstream reaches shall be provided at the outlets of all conveyance systems.

***Element 9:* Control Pollutants**

- All pollutants, including waste materials and demolition debris, that occur on-site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater.
- Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste).
- Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.
- Wheel wash, or tire bath wastewater, shall be discharged to a separate on-site treatment system or to the sanitary sewer.
- Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations shall be followed for application rates and procedures. Management of pH-modifying sources shall prevent contamination of runoff and stormwater collected on the site. These sources include, but are not limited to, bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters.

***Element 10:* Control De-Watering**

- All foundation, vault, and trench de-watering water, which has similar characteristics to stormwater runoff at the site, shall be discharged into a controlled conveyance system, prior to discharge to a sediment trap or sediment pond. Channels must be stabilized, as specified in Element #8.
- Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of the receiving waters. These clean waters should not be routed through sediment ponds with stormwater.

- Highly turbid or otherwise contaminated dewatering water, such as from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam, shall be handled separately from stormwater at the site.
- Other disposal options, depending on site constraints, may include: 1) infiltration, 2) transport off-site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters, 3) on-site treatment using chemical treatment or other suitable treatment technologies, or 4) sanitary sewer discharge with Administrator approval if there is no other option.

Element 11: **Maintain BMPs**

- All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. All maintenance and repair shall be conducted in accordance with BMPs.
- Sediment control BMPs shall be inspected weekly or after a runoff-producing storm event during the dry season and daily during the wet season.
- All temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil areas resulting from removal of BMPs or vegetation shall be permanently stabilized.

Element 12: **Manage The Project**

- **Phasing of construction**
  Development projects shall be phased where feasible in order to prevent, to the maximum extent practicable, the transport of sediment from the development site during construction. Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase. Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., preliminary plat, shoreline development, etc.) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, consideration should be given to minimizing removal of existing trees and minimizing disturbance/compaction of native soils except as needed for building purposes. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, or tree detention areas as may be required by the Administrator, shall be delineated on the site plans and marked on the development site.

- **Seasonal work limitations**
  From October 1 through April 30, clearing, grading, and other soil disturbing activities shall be permitted only if shown to the satisfaction of the Administrator that silt-laden runoff will be prevented from leaving the construction site through a combination of the following:

  1. Site conditions including existing vegetative coverage, slope, soil type and proximity to receiving waters; and

2. Limitations on activities and the extent of disturbed areas; and

3. Proposed erosion and sediment control measures.

Based on the information provided, and/or local weather conditions, the Administrator may expand or restrict the seasonal limitation on site disturbance. If, during the course of any construction activity or soil disturbance during the seasonal limitation period, silt-laden runoff leaving the construction site causes a violation of the surface water quality standard or if clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained, the Administrator shall take enforcement action, including, but not limited to a notice of violation, administrative order, penalty, or stop-work order.

The following activities are exempt from the seasonal clearing and grading limitations:

1. Routine maintenance and necessary repair of erosion and sediment control BMPs;
2. Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and
3. Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities

- **Coordination with utility purveyors and other contractors**
  The primary project proponent shall evaluate, with input from utility purveyors and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.

- **Inspection and Monitoring**
  All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. A Certified Professional in Erosion and Sediment Control shall be identified in the Construction SWPPP and shall be on-site or on-call at all times. Certification may be through the WSDOT/AGC Construction Site Erosion and Sediment Control Certification Program or any equivalent local or national certification and/or training program. Sampling and analysis of the stormwater discharges from a construction site may be necessary on a case-by-case basis to ensure compliance with standards. Monitoring and reporting requirements may be established by the City when necessary. Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, the SWPPP shall be modified, as appropriate, in a timely manner.

- **Maintenance of the Construction SWPPP**
  The Construction SWPPP shall be retained on-site or within reasonable access to the site. The Construction SWPPP shall be modified whenever there is a significant change in the design, construction, operation, or maintenance of any BMP.

7.1.3 Minimum requirement #3 – Source Control of Pollution

All known, available and reasonable source control BMPs shall be applied to all projects. Source control BMPs shall be selected, designed, and maintained according to the adopted Stormwater Manual.

7.1.4 Minimum requirement #4 – Preservation of Natural Drainage Systems and Outfalls

Natural drainage patterns shall be maintained, and discharges from the site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and downgradient properties. All outfalls require energy dissipation.

7.1.5 Minimum requirement #5 – On-Site Stormwater Management

Projects shall employ Onsite Stormwater Management BMPs to infiltrate, disperse, and retain stormwater runoff onsite to the maximum extent practicable without causing flooding or erosion impacts.

7.1.6 Minimum requirement #6 – Runoff Treatment

Thresholds. The following require construction of stormwater treatment facilities that are sized to treat runoff from the water quality design storm:

- Projects in which the total of effective, pollution-generating impervious surface (PGIS) is 5,000 square feet or more in a threshold discharge area of the project, or
- Projects in which the total of effective, pollution-generating pervious surfaces (PGPS) is three-quarters (3/4) of an acre or more in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site.

Treatment Facility Sizing. Treatment facilities shall be sized to treat runoff from the water quality design storm, defined as the 24-hour rainfall amount with a 6-month return frequency. Approved single event hydrograph methods identified in Volume III of the manual shall be used to identify runoff volumes and peak flow rates for design purposes. Alternative methods can be used if they identify volumes and flow rates that are at least equivalent. That portion of any development project in which the above PGIS or PGPS thresholds are not exceeded in a threshold discharge area shall apply On-site Stormwater Management BMPs in accordance with Minimum Requirement #5.

Treatment Requirements by Threshold Discharge Area

	< ¾ acres of PGPS	≥¾ acres PGPS	< 5,000 sf PGIS	≥5,000 sf PGIS
Treatment Facilities		√		√
Onsite Stormwater BMPS	√	√	√	√

PGPS = pollution-generating pervious surfaces
PGIS = pollution-generating impervious surfaces
sf = square feet.

Required Treatment Levels

Basic Treatment. Stormwater discharges to major receiving waters (such as the Columbia River and the Pacific Ocean) and waters not otherwise designated below shall provide facilities that meet the Basic Treatment Performance Goal of 80% removal of total suspended solids for storms up through the water quality design storm event. The Basic Treatment Menu in Volume V of the adopted Stormwater Manual identifies treatment options to achieve the goal.

Enhanced Treatment. Stormwater discharges from industrial, commercial, and multi-family residential sites, and from arterials and highways to fish-bearing streams, to waters tributary to fish-bearing streams, and to small lakes shall provide facilities that meet the Enhanced Treatment Performance Goal of increased capacity for dissolved metals removal for storms up through the water quality design storm event. The Enhanced Treatment Menu in Volume V identifies treatment options to achieve the goal.

Phosphorus Treatment. Stormwater discharges to waters that drain to lakes where eutrophication concerns have been identified by the City shall provide facilities that meet the Phosphorus Treatment Performance Goal of 50% total phosphorus removal for storms up through the water quality design storm event. The Phosphorus Treatment Menu in Volume V identifies treatment options to achieve the goal.

Oil Control. Stormwater discharges from High-Use Sites (such as vehicle storage and/or maintenance facilities) shall provide facilities that meet the Oil Control Performance Goals of no visible sheen and 10 mg/l of Total Petroleum Hydrocarbons (TPH). The Oil Control Menu in Volume V identifies treatment options.

Additional Requirements. Direct discharge of untreated stormwater from pollution-generating impervious surfaces to ground water is prohibited, except for that achieved by infiltration or dispersion of runoff through use of Onsite Stormwater BMPs. All treatment facilities shall be selected, designed, and maintained according to the City's adopted Stormwater Ordinance.

7.1.7 Minimum requirement #7 – Flow Control

Applicability. Projects must provide flow control to reduce the impacts of increased stormwater runoff from new impervious surfaces and land cover conversions. The requirement below applies wherever stormwater runoff is discharged to surface waters unless the discharge qualifies for a direct discharge exemption to a major receiving water, or the discharge is to a wetland. This requirement must be met in addition to meeting Minimum Requirement #6, Runoff Treatment.

Thresholds. The following require construction of flow control facilities and/or land use management BMPs that will achieve the standard requirement for Western Washington:

- Projects in which the cumulative total of effective impervious surfaces is 10,000 square feet or more in a threshold discharge area, or
- Projects that convert ¾ acres or more of pervious surfaces to lawn or landscape, or convert 2.5 acres or more of forested area to pasture in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site.

That portion of any development project in which the above thresholds are not exceeded in a threshold discharge area shall apply Onsite Stormwater Management BMPs in accordance with Minimum Requirement #5.

Flow Control Requirements by Threshold Discharge Area

	< ¾ acres conversion to lawn/land-scape, or < 2.5 acres of forest to pasture	**≥¾ acres conversion to lawn/land-scape, or > 2.5 acres of forest to pasture**	**< 10,000 square feet of effective impervious area**	**≥10,000 square feet of effective impervious area Flow Control**
Flow Control Facilities		√		√
Onsite Stormwater Management BMPs	√	√	√	√

Western Washington Standard Requirement: Applies to the geographic areas designated as regions 3 and 4 in NOAA Atlas #2 (Miller et al, 1973).

Stormwater discharges shall match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50% of the 2-year peak flow

up to the full 50-year peak flow. In addition, the developed peak discharge rates shall not exceed the pre-developed peak discharge rates for 2-, 10-, and 50-year return periods.

Unless reasonable, historic, site-specific information is provided to the contrary, the applicant shall use the historic vegetation map in the Ecology Hydrology Model to determine the pre-developed condition.

This standard requirement is waived for sites that will reliably infiltrate all the runoff from impervious surfaces and converted pervious surfaces.

Western Washington Alternative Requirement. An alternative requirement may be established through application of watershed-scale hydrological modeling and supporting field observations. Possible reasons for an alternative flow control requirement include:

- Establishment of a stream–specific threshold of significant bedload movement other than the assumed 50% of the 2- year peak flow;
- Zoning and Land Clearing Ordinance restrictions that, in combination with an alternative flow control standard, maintain or reduce the naturally occurring erosive forces on the stream channel; or
- A duration control standard is not necessary for protection, maintenance, or restoration of designated beneficial uses or Clean Water Act compliance.

Additional Requirement. Flow Control BMPs shall be selected, designed, and maintained according to a local government manual deemed equivalent to this manual.

Direct Discharge Exemption. A threshold discharge area is exempt from Minimum Requirement #7 if it drains to one of the major receiving waters listed by Ecology (i.e. Columbia River), AND meets all of the following criteria for direct discharge (i.e., undetained discharge) to that receiving water:

1. The area must be drained by a conveyance system that is comprised entirely of manmade conveyance elements (e.g., pipes, ditches, outfall protection, etc.) and extends to the ordinary high water line of the major receiving water. If such a system does not currently exist, one may be provided subject to the following conditions:
   - The new conveyance system (entirely man-made) must not divert flow from or increase flows to an existing wetland, stream, or near-shore habitat sufficient to cause a significant adverse impact, AND
   - If the new conveyance system drains to a river designated as a major receiving water and some or all of the new portion of the system is within one-quarter mile of the 100-year floodplain for that river, the area qualifying for the exemption must be limited to existing parcels that discharge to the system within the one-quarter mile distance.

2. Any erodible elements of the manmade conveyance system for the area must be adequately stabilized to prevent erosion.

3. Surface water from the area must not be diverted from or increased to an existing wetland, stream, or near-shore habitat sufficient to cause a significant adverse impact.

7.1.8 Minimum requirement #8 – Wetlands Protection

Applicability. The requirements below apply only to situations where stormwater discharges directly or indirectly through a conveyance system into a wetland, and must be met in addition to meeting Minimum Requirement #6, Runoff Treatment.

Thresholds. The thresholds identified in Minimum Requirement #6 – Runoff Treatment, and Minimum Requirement #7 – Flow Control shall also be applied for discharges to wetlands.

Standard Requirement. Discharges to wetlands shall maintain the hydrologic conditions, hydrophytic vegetation, and substrate characteristics necessary to support existing and designated uses unless an assessment is completed consistent with the criteria listed in "Wetlands and Stormwater Management Guidelines" of the publication, "Wetlands and Urbanization, Implications for the Future", the final report of the Puget Sound Wetland and Stormwater Management Research Program, 1997. Those guidelines (see Appendix D) shall be used for discharges to natural wetlands and wetlands constructed as mitigation.

Additional Requirements. The standard requirement does not excuse any discharge from the obligation to apply whatever technology is necessary to comply with state water quality standards, Chapter 173-201A WAC, or state ground water standards, Chapter 173-200 WAC. Additional treatment requirements to meet those standards may be required by federal, state, or local governments. Stormwater treatment and flow control facilities shall not be built within a natural vegetated buffer, except for necessary conveyance systems as approved by the City. An adopted and implemented basin plan (Minimum Requirement #9), or a Total Maximum Daily Load (TMDL, also known as a Water Clean-up Plan) may be used to develop requirements for wetlands that are tailored to a specific basin.

7.1.9 Minimum requirement #9 – Basin/Watershed Planning

Projects may be subject to equivalent or more stringent minimum requirements for erosion control, source control, treatment, wetlands protection, and operation and maintenance, and alternative requirements for flow control as identified in Basin/Watershed Plans. Basin/Watershed plans shall evaluate and include, as necessary, retrofitting urban stormwater BMPs into existing development and/or redevelopment in order to achieve watershed-wide pollutant reduction and flow control goals that are consistent with requirements of the federal Clean Water Act. Standards developed from basin plans shall not modify any of the above minimum requirements until the basin plan is formally adopted and implemented by the local governments within the basin, and approved or concurred with by the Department of Ecology.

7.1.10 Minimum requirement #10 – Operation and Maintenance

An operation and maintenance manual that is consistent with City standards shall be provided for all proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified. At private facilities, a copy of the manual shall be retained onsite or within reasonable access to the site, and shall be transferred with the property to the new owner. For public facilities, a copy of the manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken and where waste was disposed of shall be kept and be available for inspection by the City.

7.2 Redevelopment

All redevelopment projects in which the new, replaced, or total of *new plus replaced* impervious surfaces is 2,000 square feet or more, or that disturb 7,000 square feet or more of land, must comply with Minimum Requirements #1 through #5 (as stated in section 7.1) for the new and replaced impervious surfaces and the land disturbed. Projects not exceeding those thresholds shall apply Minimum Requirement #2.

Redevelopment projects that:

- Add 5,000 square feet or more of *new* impervious surfaces, or
- Convert ¾ acres of pervious surfaces to lawn or landscaped areas, or
- Convert 2.5 acres of forested area to pasture,

must comply with Minimum Requirements #1 through #10 (section 7.1) for the new impervious surfaces and the converted pervious surfaces. If the runoff quantity from the new surfaces is not separated from runoff from other surfaces prior to treatment or flow control, the stormwater facilities must be sized for the entire flow. Alternatively, the City may allow the Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area within the same site. For public roads' projects, the equivalent area must drain to the same receiving water.

Application of stormwater requirements to the entire site:

The City shall adopt a threshold(s) for redevelopment projects which, if exceeded, shall cause an entire site undergoing redevelopment to comply with Minimum Requirements #1 through #10. This includes the new, replaced, and existing pervious and impervious surfaces. Ecology will use the following as the standards against which to judge alternative requirements:

- For public transportation projects, runoff from the existing, replaced, and new impervious surfaces (including pavement, shoulders, curbs, and sidewalks) shall meet all the Minimum Requirements if the new impervious surfaces total

5,000 square feet or more and total 50% or more of the existing impervious area within the project limits.

- Other types of redevelopment projects, in which the total of new plus replaced impervious surfaces is 5,000 square feet or more, and whose valuation of proposed improvements – including interior improvements – exceeds 50% of the assessed value of the existing site improvements (or, exceeds 50% of the replacement value as determined by the Marshall Valuation System, or some similar replacement value system), shall comply with all the Minimum Requirements for the entire site.

The City may exempt redevelopment projects from compliance with Minimum Requirements for treatment, flow control, and wetlands protection if the City has adopted a plan that fulfills those requirements in regional facilities that will discharge to the same receiving water, AND if the applicant has an implementation plan and a schedule for completing construction of those facilities within five years. Redevelopment projects for public roads may be exempted from Minimum Requirements for treatment, flow control, and wetlands protection for the entire site (i.e., the exemption does not extend to new surfaces that add impervious area) if the City constructs stormwater facilities for an equivalent amount of existing road surface within two years.

7.3 Exceptions

Exceptions to Minimum Requirements #1 through #10 may be granted prior to permit approval and construction. The Administrator may grant an exception following public notice in accordance with the administrative code for the State Environmental Policy Act (SEPA) provided that a written finding of fact is prepared, that addresses the following:

A. The exception provides substantially equivalent environmental protection and is in the overriding public interest; and that the objectives of safety, function, environmental protection and facility maintenance, based upon sound engineering, are fully met; AND

B. That there are special physical circumstances or conditions affecting the property such that the strict application of these provisions would deprive the applicant of all reasonable use of the parcel of land in question, and every effort to find creative ways to meet the intent of the minimum requirements has been made; AND

C. That the granting of the exception will not be detrimental to the public health and welfare, nor injurious to other properties in the vicinity and/or downstream, and to the quality of water of the state; AND

D. The exception is the least possible exception that could be granted to comply with the intent of the Minimum Requirements.

SECTION 8: ADMINISTRATION

8.1 Administrator

The Public Utilities Supervisor or a designee shall administer this Ordinance and shall be referred to as the Administrator as defined in Section 2(a). The director shall have the authority to develop and implement administrative procedures to administer and enforce this Ordinance.

8.2 Review and approval

The Administrator may approve, conditionally approve or deny an application for activities regulated by this Ordinance.

8.3 Enforcement authority

The Administrator shall enforce this Ordinance.

8.4 Inspection

All activities regulated by this Ordinance, except those exempt in Section 5.2, shall be inspected by the director. The director shall inspect projects at various stages of the work requiring approval to determine that adequate control is being exercised. Stages of work requiring inspection include, but are not limited to, preconstruction; installation of BMPs; land disturbing activities; installation of utilities, landscaping, retaining walls and completion of project. When required by the director, a special inspection and/or testing shall be performed.

SECTION 9: ENFORCEMENT

9.1 General

Enforcement action shall be in accordance with this Ordinance whenever a person has violated any provision of this Ordinance. The choice of enforcement action and the severity of any penalty shall be based on the nature of the violation, the damage or risk to the public or to public resources, and/or the degree of bad faith of the person subject to the enforcement action.

9.2 Stop work order

The director shall have the authority to serve a person a stop work order if an action is being undertaken in violation of this Ordinance.

A. Content of Order. The order shall contain:

(1) A description of the specific nature, extent, and time of violation and the damage or potential damage; and

(2) A notice that the violation or the potential violation cease and desist, and, in appropriate cases, the specific corrective action to be taken within a given time. A civil penalty under Section 9.3 below may be issued with the order.

B. Notice. A stop work order shall be imposed by a notice in writing, either by certified mail with return receipt requested, or by personal service, to the person incurring the same.

C. Effective Date. The stop work issued under this Section shall become effective immediately upon receipt by the person to whom the order is directed.

D. Compliance. Failure to comply with the terms of a stop order shall result in enforcement actions including, but not limited to, the issuance of a civil penalty.

9.3 Civil penalty

A person who fails to comply with the requirements of this Ordinance, who fails to conform to the terms of an approval or order issued, who undertakes new development without first obtaining City approval, or who fails to comply with a stop work order issued under these regulations shall be subject to a civil penalty.

A. Amount of Penalty. The penalty shall not be less than $_____ or exceed $_____ for each violation. Each day of continued violation or repeated violation shall constitute a separate violation.

B. Aiding or Abetting. Any person who, through an act of commission or omission, aids or abets in the violation shall be considered to have committed a violation for the purpose of the civil penalty.

C. Notice of Penalty. A civil penalty shall be imposed by a notice in writing, either by certified mail with return receipt requested or by personal service, to the person incurring the same for the City. The notice shall describe the violation, approximate the date(s) of violation, and shall order acts constituting the violation to cease and desist, and, in appropriate cases, require necessary corrective action within a specific

time.

D. Application for Remission or Mitigation. Any person incurring a penalty may apply in writing within ___ days of receipt of the penalty to the City for remission or mitigation of such penalty. Upon receipt of the application, the City Council may remit or mitigate the penalty only upon a demonstration of extraordinary circumstances, such as the presence of information or factors not considered in setting the original penalty. The decision may be appealed to the City Council within ___ days of the decision.

E. Appeal of Civil Penalty. Persons incurring a penalty imposed by the Administrator may appeal in writing within ___ days of the receipt of the penalty to the City Council. The City Council's decision may be appealed to the Superior Court within ___ days of the decision.

9.3.1 Penalties due

Penalties imposed under this Section shall become due and payable ___ days after receiving it unless application for remission or mitigation is made or an appeal is filed. Whenever an application for emission or mitigation is made, penalties shall become due and payable 30 days after receipt of the decision regarding the remission or mitigation. Whenever an appeal of a penalty is filed, the penalty shall become due and payable after all review proceedings and a final decision has been issued confirming all or part of the penalty. If the amount of a penalty owed the City is not paid within the time specified, the City may take actions necessary to recover such penalty.

9.3.2 Penalty recovered

Penalties recovered shall be paid to a fund dedicated to enforcement and/or enhancement of the stormwater management program.

SECTION 10: EXCEPTIONS

10.1 Findings of fact

Exceptions to Minimum Requirements #1 through #10 may be granted prior to permit approval and construction. An exception may be granted following a public hearing, provided that a written finding of fact is prepared, that addresses the following:

A. The exception provides substantially equivalent environmental protection and is in the overriding public interest; and that the objectives of safety, function, environmental

B. protection and facility maintenance, based upon sound engineering, are fully met; AND

C. That there are special physical circumstances or conditions affecting the property such that the strict application of these provisions would deprive the applicant of all reasonable use of the parcel of land in question, and every effort to find creative ways to meet the intent of the minimum requirements has been made; AND

D. That the granting of the exception will not be detrimental to the public health and welfare, nor injurious to other properties in the vicinity and/or downstream, and to the quality of water of the state; AND

E. The exception is the least possible exception that could be granted to comply with the intent of the Minimum Requirements.

10.3 Prior approval

Any exceptions shall be approved prior to permit approval and construction.

10.4 Duration of exception

Exceptions granted shall be valid for 2 years, unless granted for a shorter period.

10.5 Rights of appeal

All actions of the City Council shall be final and conclusive, unless within __ days of the date of the City Council action, the original applicant or an adverse party gives written notice of appeal to the City Council for review of the action.

SECTION 11: SEVERABILITY

If any provision of this Ordinance or its application to any person, entity, or circumstances is held invalid, the remainder of this Ordinance or the application of the provision to other persons, entities, or circumstances shall not be affected.

APPENDIX C

APPENDIX C

Sample of XP-SWMM Model Output for the West Howerton Basin P1

Example of Output File for Port of Ilwaco (West Howerton) P1 Basin

```
Input File :          L:\ILWACO\99789\SWMM\W Howerton\WHow Exist\WHow.XP
 Current Directory:    L:\
 Executable Name:      D:\Program Files\XPS\xpswmp32.exe
 Read       0 line(s) and found     0 items(s) from your cfg file.
          *================================================*
          |                      XP - SWMM                 |
          |            Storm Water Management Model        |
          |                   Version 7.10                 |
          |================================================|
          |                 Developed by                   |
          |================================================|
          |                                                |
          |           XP Software Inc. and Pty. Ltd.       |
          |                                                |
          |              Based on the U.S. EPA             |
          |   Storm Water Management Model Version 4.40    |
          |                                                |
          |             Originally Developed by            |
          |              Metcalf & Eddy, Inc.              |
          |             University of Florida              |
          |            Camp Dresser & McKee Inc.           |
          |                September 1970                  |
          |                                                |
          |             EPA-SWMM is maintained by          |
          |             Oregon State University            |
          |             Camp Dresser & McKee Inc.          |
          |================================================|
          |     XP Software      January, 2000             |
          |       Data File Version --->     8.2           |
          *================================================*


*========================================================*
|       Input and Output file names by SWMM Layer        |
*========================================================*

 Input File  to Layer #     1 JIN.US
 Output File to Layer #     1 L:\Ilwaco\99789\Swmm\whow.int
 Input File  to Layer #     2 L:\Ilwaco\99789\Swmm\whow.int
 Output File to Layer #     2 JOT.US
```

```
*============================================================*
|   Special command line arguments in XP-SWMM. This         |
|   now includes program defaults. $Keywords are the program|
|   defaults.  Other Keywords are from the SWMMCOM.CFG file. |
|   or the command line or any cfg file on the command line. |
|   Examples include these in the file xpswm.bat under the   |
|   section :solve or in the windows version XPSWMM32 in the |
|   file solve.bat                                           |
|                                                            |
|   Note: the cfg file should be in the subdirectory swmxp   |
|         or defined by the set variable in the xpswm.bat    |
|         file.  Some examples of the command lines possible |
|         are shown below:                                   |
|                                                            |
|   swmmd swmmcom.cfg                                        |
|   swmmd my.cfg                                             |
|   swmmd nokeys nconv5 perv extranwq                        |
*============================================================*
```

$powerstation	0.0000	1	2
$perv	0.0000	0	4
$oldegg	0.0000	0	7
$as	0.0000	0	11
$noflat	0.0000	0	21
$oldomega	0.0000	0	24
$oldvol	0.0000	1	28
$implicit	0.0000	1	29
$oldhot	0.0000	1	31
$oldscs	0.0000	0	33
$flood	0.0000	1	40
$nokeys	0.0000	0	42
$pzero	0.0000	0	55
$oldvol2	0.0000	2	59
$storage_97	0.0000	1	62
$oldhot1	0.0000	1	63
$pumpwt	0.0000	1	70
$ecloss	0.0000	1	77
$exout	0.0000	0	97
$nogrelev	0.0000	1	161
$ncmid	0.0000	0	164
$new_nl_97	0.0000	2	290

```
$best97              0.0000          1       294
$newbound            0.0000          1       295

*============================================================*
| Parameter Values on the Tapes Common Block.These are the   |
| values read from the data file and dynamically allocated   |
| by the model for this simulation.                          |
*============================================================*

 Number of Subcatchments in the Runoff Block (NW)....      2
 Number of Channel/Pipes in the Runoff Block (NG)....      0
 Runoff Water quality constituents (NRQ).............      0
 Runoff Land Uses per Subcatchment (NLU).............      0
 Number of Elements in the Transport Block (NET).....      0
 Number of Storage Junctions in Transport (NTSE).....      0
 Number of Input Hydrographs in Transport (NTH)......      0
 Number of Elements in the Extran Block (NEE)........      3
 Number of Groundwater Subcatchments in Runoff (NGW).      0
 Number of Interface locations for all Blocks (NIE)..      3
 Number of Pumps in Extran (NEP).....................      0
 Number of Orifices in Extran (NEO)..................      0
 Number of Tide Gates/Free Outfalls in Extran (NTG)..      1
 Number of Extran Weirs (NEW)........................      0
 Number of scs hydrograph points.....................   1584
 Number of Extran printout locations (NPO)...........      0
 Number of Tide elements in Extran (NTE).............      1
 Number of Natural channels (NNC)....................      0
 Number of Storage junctions in Extran (NVSE)........      0
 Number of Time history data points in Extran(NTVAL).      4
 Number of Variable storage elements in Extran (NVST)      0
 Number of Input Hydrographs in Extran (NEH).........      0
 Number of Particle sizes in Transport Block (NPS)...      0
 Number of User defined conduits (NHW)...............     32
 Number of Connecting conduits in Extran (NECC)......     20
 Number of Upstream elements in Transport (NTCC).....     10
 Number of Storage/treatment plants (NSTU)...........      0
 Number of Values for R1 lines in Transport (NR1)....      0
 Number of Nodes to be allowed for (NNOD)............      3
 Number of Plugs in a Storage Treatment Unit.........      1

############################################################
```

```
#    Entry made to the Runoff Layer(Block) of SWMM    #
#    Last Updated January, 2000 by XP Software        #
#    and is CURRENTLY under development.              #

*=========================================================*
|          RUNOFF TABLES IN THE OUTPUT FILE.              |
|  These are the more important tables in the output file.|
|  You can use your editor to find the table numbers,     |
|  for example: search for Table R3 to check continuity.  |
|  This output file can be imported into a Word Processor |
|  and printed on US letter or A4 paper using portrait    |
|  mode, courier font, a size of 8 pt. and margins of 0.75|
|                                                         |
| Table R1  - Physical Hydrology Data                     |
| Table R2  - Infiltration data                           |
| Table R3  - Raingage and Infiltration Database Names    |
| Table R4  - Groundwater Data                            |
| Table R5  - Continuity Check for Surface Water          |
| Table R6  - Continuity Check for Channels/Pipes         |
| Table R7  - Continuity Check for Subsurface Water       |
| Table R8  - Infiltration/Inflow Continuity Check        |
| Table R9  - Summary Statistics for Subcatchments        |
| Table R10 - Sensitivity anlysis for Subcatchments       |
*=========================================================*


##########################################
#             RUNOFF JOB CONTROL         #
##########################################

 Snowmelt parameter - ISNOW.....................          0
 Number of rain gages - NRGAG...................          1
 Quality is not simulated - KWALTY..............          0
 Read evaporation data on line(s) F1 (F2) - IVAP..        1
 Hour of day at start of storm - NHR............          0
 Minute of hour at start of storm - NMN.........          0
 Time TZERO at start of storm (hours)...........      0.000
 Use U.S. Customary units for most I/O - METRIC...        0
 Runoff input print control...                            0
 Runoff graph plot control....                            1
 Runoff output print control..                            0
```

```
Limit number of groundwater convergence messages to      10000
Month, day, year of start of storm is:                1/ 1/2000
Wet time step length (seconds).......                    60.0
Dry time step length (seconds).......                 86400.0
Wet/Dry time step length (seconds)...                    60.0
Simulation length is......                               24.0 Hours

If Horton infiltration model is being used
A mixture of infiltration options may be used in
XP-SWMM as a watershed specific option.
Rate for regeneration of infiltration = REGEN * DECAY
Decay is read in for each subcatchment
REGEN = ..............................................  0.01000


Raingage #.............................          1
KTYPE  - Rainfall input type.............          0
NHISTO - Total number of rainfall values..       144
KINC   - Rainfall values(pairs) per line..        10
KPRINT - Print rainfall(0-Yes,1-No).......          0
KTIME  - Precipitation time units
0 --> Minutes  1 --> Hours................          0
KPREP  - Precipitation unit type
0 --> Intensity  1 --> Volume.............          1
KTHIS - Variable rainfall intervals
0 --> No, > 1 --> Yes.....................          0
THISTO - Rainfall time interval...........      10.00
TZRAIN - Starting time(KTIME units).......       0.00
```

Rainfall printout for gage number.... 1

Time(mn)	Rain(in)	Time(mn)	Rain(in)	Time(mn)	Rain(in)	Time(mn)	Rain(in)
0.00	0.0180	10.00	0.0180	20.00	0.0180	30.00	0.0180
40.00	0.0180	50.00	0.0180	60.00	0.0180	70.00	0.0180
80.00	0.0180	90.00	0.0180	100.00	0.0225	110.00	0.0225
120.00	0.0225	130.00	0.0225	140.00	0.0225	150.00	0.0225
160.00	0.0270	170.00	0.0270	180.00	0.0270	190.00	0.0270
200.00	0.0270	210.00	0.0270	220.00	0.0315	230.00	0.0315
240.00	0.0315	250.00	0.0315	260.00	0.0315	270.00	0.0315
280.00	0.0369	290.00	0.0369	300.00	0.0369	310.00	0.0369
320.00	0.0369	330.00	0.0369	340.00	0.0428	350.00	0.0427
360.00	0.0427	370.00	0.0428	380.00	0.0428	390.00	0.0427

400.00	0.0603	410.00	0.0603	420.00	0.0603	430.00	0.0810
440.00	0.0810	450.00	0.1530	460.00	0.2430	470.00	0.1215
480.00	0.0810	490.00	0.0603	500.00	0.0603	510.00	0.0603
520.00	0.0396	530.00	0.0396	540.00	0.0396	550.00	0.0396
560.00	0.0396	570.00	0.0396	580.00	0.0396	590.00	0.0396
600.00	0.0396	610.00	0.0396	620.00	0.0396	630.00	0.0396
640.00	0.0324	650.00	0.0324	660.00	0.0324	670.00	0.0324
680.00	0.0324	690.00	0.0324	700.00	0.0324	710.00	0.0324
720.00	0.0324	730.00	0.0324	740.00	0.0324	750.00	0.0324
760.00	0.0257	770.00	0.0257	780.00	0.0256	790.00	0.0257
800.00	0.0256	810.00	0.0257	820.00	0.0257	830.00	0.0256
840.00	0.0257	850.00	0.0256	860.00	0.0257	870.00	0.0257
880.00	0.0225	890.00	0.0225	900.00	0.0225	910.00	0.0225
920.00	0.0225	930.00	0.0225	940.00	0.0225	950.00	0.0225
960.00	0.0225	970.00	0.0225	980.00	0.0225	990.00	0.0225
1000.00	0.0180	1010.00	0.0180	1020.00	0.0180	1030.00	0.0180
1040.00	0.0180	1050.00	0.0180	1060.00	0.0180	1070.00	0.0180
1080.00	0.0180	1090.00	0.0180	1100.00	0.0180	1110.00	0.0180
1120.00	0.0180	1130.00	0.0180	1140.00	0.0180	1150.00	0.0180
1160.00	0.0180	1170.00	0.0180	1180.00	0.0180	1190.00	0.0180
1200.00	0.0180	1210.00	0.0180	1220.00	0.0180	1230.00	0.0180
1240.00	0.0180	1250.00	0.0180	1260.00	0.0180	1270.00	0.0180
1280.00	0.0180	1290.00	0.0180	1300.00	0.0180	1310.00	0.0180
1320.00	0.0180	1330.00	0.0180	1340.00	0.0180	1350.00	0.0180
1360.00	0.0180	1370.00	0.0180	1380.00	0.0180	1390.00	0.0180
1400.00	0.0180	1410.00	0.0180	1420.00	0.0180	1430.00	0.0180

```
########################################
# Rainfall input summary from Runoff #
########################################

 Total rainfall for gage #     1 is    4.5000 inches

   ##############################
   #        Data Group F1       #
   # Evaporation Rate (in/day) #
   ##############################
```

JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV	DEC.
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

```
************************************************
*          No Channel or Pipe Network          *
*  This is a good idea, the hydraulic routing  *
*  in your network should be done in either    *
*  the Transport Layer or Extran Layer of SWMM. *
************************************************
```

```
#####################################################
#  Table R1.  S U B C A T C H M E N T  D A T A    #
#             Physical Hydrology Data               #
#####################################################
```

Subcatchment Number	Name	Channel or inlet	Width ft	Area ac	Per-cent Imperv	Slope ft/ft	"n" mprv	"n" Perv	Deprs -sion Storge Imprv	Deprs -sion Strge Perv	Prcnt Zero Deten -tion
1	P1a#1	P1a	1.0000	4.7000	100.00	1.000	0.020	0.020	0.000	0.000	0.00
2	P1b#1	P1b	1.0000	2.5000	100.00	1.000	0.020	0.020	0.000	0.000	0.00

```
#############################################################################################
#          Table R2.  SUBCATCHMENT  DATA                                                    #
#                     Infiltration Data                                                     #
#                                                                                           #
# Infiltration Type        Infl #1      Infl #2            Infl #3             Infl #4     #
# SCS                  ->  Comp CN    Time Conc        Shape Factor    Depth or Fraction    #
# SBUH                 ->  Comp CN    Time Conc               N/A                 N/A       #
# Green Ampt           ->   Suction   Hydr Cond          Initial MD                N/A     #
# Horton               ->  Max Rate    Min Rate  Decay Rate (1/sec)                N/A     #
# Proportional         ->  Constant         N/A                 N/A                 N/A     #
# Initial/Cont Loss    ->   Initial  Continuing                 N/A                 N/A     #
# Initial/Proportional->    Initial    Constant                 N/A                 N/A     #
# Laurenson Paramters ->    B Value Pervious "n"    Impervious Cont            Exponent    #
#############################################################################################
```

Subcatchment Number	Name	Infl # 1	Infl # 2	Infl # 3	Infl # 4

1 P1a#1	98.0	0.833E-01	484.	0.00
2 P1b#1	98.0	0.833E-01	484.	0.00

```
############################################################
#     Table R3.  SUBCATCHMENT  DATA                        #
#                Rainfall and Infiltration Database Names  #
############################################################
```

Subcatchment Number	Name	Gage No	Infltrn Type	Routing Type	Rainfall Database Name	Infiltration Database Name
1	P1a#1	1	SCS Method	SCS curvilinear	SCS Type 1A	
2	P1b#1	1	SCS Method	SCS curvilinear	SCS Type 1A	

```
Total Number of Subcatchments...          2
Total Tributary Area (acres)....       7.20
Impervious Area (acres).........       7.20
Pervious Area (acres)...........       0.00
Total Width (feet)..............       2.00
Percent Imperviousness..........     100.00
```

```
#####################################################
#         S U B C A T C H M E N T  D A T A          #
#   Default, Ratio values for subcatchment data     #
#   Used with the calibrate node in the runoff.     #
# 1 - width     2 - area       3 - impervious %     #
# 4 - slope     5 - imp "n"    6 - perv "n"         #
# 7 - imp ds    8 - perv ds    9 - 1st infil        #
#10 - 2nd infil               11 - 3rd infil        #
#####################################################
```

Column	1	2	3	4	5	6
Default	0.000	0.000	0.000	0.000	0.000	0.000
Ratio	1.000	1.000	1.000	1.000	1.000	1.000
Column	7	8	9	10	11	
Default	0.000	0.000	0.000	0.000	0.000	
Ratio	1.000	1.000	1.000	1.000	1.000	

****

```
*     Arrangement of Subcatchments and Channel/Pipes     *
*********************************************************


    Inlet
P1a             No Tributary Channel/Pipes
                Tributary Subareas........ P1a#1
P1b             No Tributary Channel/Pipes
                Tributary Subareas........ P1b#1


************************************************************
* Hydrographs will be stored for the following   2 INLETS *
************************************************************
P1a       P1b


************************************************
*  Quality Simulation not included in this run *
************************************************



************************************************
*  Precipitation Interface File Summary        *
*  Number of precipitation station....      1  *
************************************************

Location Station Number
-------- --------------
       1.             1


************************************************
*      End of time step DO-loop in Runoff      *
************************************************

Final Date (Mo/Day/Year)    =            1/ 2/2000
Total number of time steps  =                 1441
Final Julian Date           =              2000002
Final time of day           =                   0. seconds.
```

```
Final time of day          =                0.00   hours.
Final running time         =               24.0000   hours.
Final running time         =                1.0000    days.

**************************************************
*     Extrapolation Summary for Watersheds       *
* Explains the number of time steps and iterations *
* used in the solution of the subcatchments.     *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of OVERLND Calls      *
**************************************************

 Subcatch   # Steps   # Calls  Subcatch   # Steps   # Calls
 --------   -------   -------  --------   -------   -------
P1a#1               0         0 P1b#1               0         0


############################################################
# Rainfall input summary from Runoff Continuity Check      #
############################################################

Total rainfall read for gage #     1 is       4.4820 in
Total rainfall read    for gage #     1 is      1430.00 minutes

************************************************************
* Table R5. CONTINUITY CHECK FOR SURFACE WATER             *
*       Any continuity error can be fixed by lowering the  *
*       wet and transition time step. The transition time  *
*       should not be much greater than the wet time step. *
************************************************************
                                                    Inches over
                                          cubic feet  Total Basin
Total Precipitation (Rain plus Snow)    1.176120E+05     4.500
Total Infiltration                      5.102473E+03     0.195
Total Evaporation                       0.000000E+00     0.000
Surface Runoff from Watersheds          1.127601E+05     4.314
Total Water remaining in Surface Storage 0.000000E+00    0.000
Infiltration over the Pervious Area...  5.102473E+03     0.000
                  --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
```

Water remaining in Snow Cover.....	1.178625E+05	4.510
Total Precipitation + Initial Storage.	1.176120E+05	4.500

The error in continuity is calculated as

```
*************************************
* Precipitation + Initial Snow Cover  *
*      - Infiltration -               *
*Evaporation - Snow removal -         *
*Surface Runoff from Watersheds -     *
*Water in Surface Storage -           *
*Water remaining in Snow Cover        *
*-------------------------------------*
* Precipitation + Initial Snow Cover  *
*************************************
```

Percent Continuity Error..... -0.213

Table R6. Continuity Check for Channel/Pipes
You should have zero continuity error if you are not using runoff hydraulics

	cubic feet	Inches over Total Basin
Initial Channel/Pipe Storage.....	0.000000E+00	0.000
Final Channel/Pipe Storage.....	0.000000E+00	0.000
Surface Runoff from Watersheds.....	1.127601E+05	4.314
Groundwater Subsurface Inflow.....	0.000000E+00	0.000
Evaporation Loss from Channels.....	0.000000E+00	0.000
Channel/Pipe/Inlet Outflow.....	1.127601E+05	4.314
Initial Storage + Inflow.....	1.127601E+05	4.314
Final Storage + Outflow.....	1.127601E+05	4.314

```
*****************************************
* Final Storage + Outflow + Evaporation  - *
* Watershed Runoff - Groundwater Inflow  - *
*     Initial Channel/Pipe Storage         *
*     ---------------------------------    *
*  Final Storage + Outflow  + Evaporation  *
*****************************************
```

Percent Continuity Error..... 0.000

```
        ###################################################
        # Table R9. Summary Statistics for Subcatchments #
        ###################################################

Note: Total Runoff Depth includes pervious & impervious area
      Pervious and Impervious Runoff Depth is only the runoff from those two areas.

Subcatchment..... P1a#1          P1b#1
Area (acres).....        4.70000        2.50000
Percent Impervious.....      100.00000      100.00000
Total Rainfall (in)....        4.50000        4.50000
Max Intensity (in/hr)..        1.45800        1.45800
Pervious Area
Total Runoff Depth (in)        0.00000        0.00000
Total Losses (in)......        0.00000        0.00000
Remaining Depth (in)...        0.00000        0.00000
Peak Runoff Rate (cfs).        0.00000        0.00000
Total Impervious Area
Total Runoff Depth (in)        4.31436        4.31436
Peak Runoff Rate (cfs).        6.80313        3.61868
Impervious Area with depression storage
Total Runoff Depth (in)        0.00000        0.00000
Peak Runoff Rate (cfs).        0.00000        0.00000
Impervious Area without depression storage
Total Runoff Depth (in)        0.00000        0.00000
Peak Runoff Rate (cfs).        0.00000        0.00000
Total Area
Total Runoff Depth (in)        4.31436        4.31436
Peak Runoff Rate (cfs).        6.80313        3.61868
Unit Runoff (in/hr)....        1.44747        1.44747

===> Runoff simulation ended normally.

###########################################################
#    Entry made to the EXTRAN Layer(Block) of SWMM        #
#    Last Updated December,1999 by XP Software            #



*=========================================================*
```

```
|          EXTRAN TABLES IN THE OUTPUT FILE                  |
|  These are the more important tables in the output file.   |
|  You can use your editor to find the table numbers,        |
|  for example: search for Table E20 to check continuity.    |
|  This output file can be imported into a Word Processor    |
|  and printed on US letter or A4 paper using portrait       |
|  mode, courier font, a size of 8 pt. and margins of 0.75   |
|                                                            |
| Table E1  - Basic Conduit Data                             |
| Table E2  - Conduit Factor Data                            |
| Table E3  - Junction Data                                  |
| Table E4  - Conduit Connectivity Data                      |
| Table E5  - Junction Time Step Limitation Summary          |
| Table E5a - Conduit Explicit Condition Summary             |
| Table E6  - Final Model Condition                          |
| Table E7  - Extran Iteration Summary                       |
| Table E8  - Junction Time Step Limitation Summary          |
| Table E9  - Junction  Summary  Statistics                  |
| Table E10 - Conduit   Summary  Statistics                  |
| Table E11 - Area assumptions used in the analysis          |
| Table E12 - Mean conduit information                       |
| Table E13 - Channel losses(H) and culvert info             |
| Table E14 - Natural Channel Overbank Flow Information      |
| Table E15 - Spreadsheet Info List                          |
| Table E16 - New Conduit Output Section                     |
| Table E17 - Pump Operation                                 |
| Table E18 - Junction Continuity Error                      |
| Table E19 - Junction Inflow Sources                        |
| Table E20 - Junction Flooding and Volume List              |
| Table E21 - Extran continuity balance at simulation end    |
| Table E22 - Model Judgement Section                        |
*============================================================*

Time Control from Extran Job Control
Year.........    2000 Month.......       1
Day..........       1 Hour........       0
Minute.......       0 Second......       0


Control information for simulation
----------------------------------
```

```
Integration cycles.................      5760
Length of integration step is......     15.00 seconds
Simulation length..................     24.00 hours
Do not create equiv. pipes(NEQUAL).         0
Use U.S. customary units for I/O...         0
Printing starts in cycle...........         1
Intermediate printout intervals of.       500 cycles
Intermediate printout intervals of.    125.00 minutes
Summary printout intervals of......       500 cycles
Summary printout time interval of..    125.00 minutes
Hot start file parameter (REDO)....         0
Initial time.......................      0.00 hours

Iteration variables: SURTOL........    0.0001
                     SURJUN........    0.0060 mm or inch
                     QREF..........    1.0000
    Minimum depth (m or ft)........    0.0000
    Underrelaxation parameter......    0.8500
    Time weighting parameter.......    0.6500
    Courant Time Step Factor.......    1.0000
    Default Expansion/Contraction K    0.0000
    Default Entrance/Exit K........    0.0000
Default surface area of junctions..     12.57 square feet.
NJSW input hydrograph junctions....     0
     or user defined hydrographs...
```

==========
| Table E1 - Conduit Data |
==========

Inp Num	Conduit Name	Length (ft)	Conduit Class	Area (ft^2)	Manning Coef.	Max Width (ft)	Depth (ft)	Trapezoid Side Slopes
1	4	140.00	Circular	0.35	0.01400	0.67	0.67	
2	5	300.00	Circular	0.35	0.01400	0.67	0.67	

Total length of all conduits .... 440.0000 feet

==========
| If there are messages about (sqrt(g*d)*dt/dx), or|
| the sqrt(wave celerity)*time step/conduit length |
| in the output file all it means is that the |

| program will lower the internal time step to
| satisfy this condition (explicit condition).
| You control the actual internal time step by
| using the minimum courant time step factor in the
| Extran job control. The message put in words
| states that the smallest conduit with the fastest
| velocity will control the time step selection.
| You have further control by using the modify
| conduit option in the Extran Job Control.

Conduit Volume

Full pipe or full open conduit volume
Input full depth volume..... 1.5513E+02 cubic feet

Table E3a - Junction Data

Inp Num	Junction Name	Ground Elevation	Crown Elevation	Invert Elevation	Qinst cfs	Initial Depth-ft
1	P1a	13.5000	10.8700	10.2000	0.0000	0.0010
2	P1b	12.5200	10.1700	9.5000	0.0000	0.0000
3	Outlet	11.0000	5.6700	5.0000	0.0000	0.0000

Table E3b - Junction Data

Inp Num	Junction Name	X Coord.	Y Coord.	Type of Manhole	Type of Inlet	Maximum Capacity
1	P1a	108.	448.	No Ponding	Normal Inlet	
2	P1b	108.	427.	No Ponding	Normal Inlet	
3	Outlet	109.	405.	No Ponding	Normal Inlet	

```
*================================================*
|          Table E4 - Conduit Connectivity       |
*================================================*

 Input  Conduit    Upstream   Downstream     Upstream  Downstream
 Number Name       Node       Node          Elevation   Elevation
======  ========   =========  ==========    =========   =========
     1  4          P1a        P1b             10.200       9.500 No Design
     2  5          P1b        Outlet           9.500       5.000 No Design


*================================================*
|          FREE OUTFALL DATA (DATA GROUP I1)     |
|         BOUNDARY CONDITION ON DATA GROUP J1    |
*================================================*

Outfall at Junction....Outlet     has boundary condition number...         1


*================================================*
|        INTERNAL CONNECTIVITY INFORMATION       |
*================================================*

    CONDUIT      JUNCTION     JUNCTION
    -------      --------     --------
    FREE # 1     Outlet       BOUNDARY

*================================================*
|        Boundary Condition Information          |
|                 Data Groups J1-J4              |
*================================================*



**********************************************
*   TIDAL INFORMATION FROM THE J3 DATA GROUP  *
*   FOR BOUNDARY CONDITION NUMBER     1       *
**********************************************

KO.............................    1 NUMBER OF POINTS(NI).........    4
```

MAXIMUM NUMBER OF ITERATIONS.. 50 TIDE CHECK SWITCH(NCHTID)..... 1

NO.	TIME IN HOURS	OBSERVED STAGE(FT)	COMPUTED STAGE(FT)	DIFFERENCE
1.	28.0000	7.2300	7.9598	0.7298
2.	36.0000	1.2300	2.5151	1.2851
3.	44.0000	7.2300	5.7368	-1.4932
4.	52.0000	1.2300	2.0440	0.8140
5.	30.0000	6.3510	5.1816	-1.1694
6.	32.0000	4.2300	3.2922	-0.9378
7.	34.0000	2.1090	2.4307	0.3217
8.	38.0000	2.1090	3.2753	1.1663
9.	40.0000	4.2300	4.3253	0.0953
10.	42.0000	6.3510	5.2576	-1.0934
11.	46.0000	6.3510	5.5745	-0.7765
12.	48.0000	4.2300	4.7667	0.5367
13.	50.0000	2.1090	3.4880	1.3790
14.	59.0000	2.1090	0.3271	-1.7819
15.	66.0000	4.2300	5.3868	1.1568
16.	73.0000	6.3510	5.9323	-0.4187

ABSOLUTE RESIDUAL..... 15.1558

****
* TIDAL STAGE COEFFICIENTS *
****

A1	A2	A3	A4	A5	A6	A7	W	PHASE LAG
6.24	5.37	0.19	-3.90	0.39	-3.82	-2.30	0.08	-28.00

****
* THE WAVEFORM FUNCTION HAS THE FOLLOWING FORM.*
****

```
H(J) = A1 + A2*SIN(WT) + A3*SIN(2WT) + A4*SIN(3WT)
         + A5*COS(WT) + A6*COS(2WT) + A7*COS(3WT)
```

****

##
Header information from interface file:
##

Title from first computational layer:

```
 Title from immediately preceding computational layer


 Name of preceding layer:.............Runoff Layer
 Initial Julian date (IDATEZ)..................... 2000001
 Initial time of day in seconds (TZERO)...........     0.0
 No. Transfered input locations...................       2
 No. Transfered pollutants........................       0
 Size of total catchment area (acres).............    7.20

 ################################################
 # Element numbers of interface inlet locations: #
 ################################################

 P1a
 P1b

 Conversion factor to cfs for flow units
 on interface file.  Multiply by:     1.00000

######## Important Information ########
Start date/time of interface file was.. 2000001    0.0000 hours
Start date/time of the simulation was.. 2000001    0.0000 hours
                            Same date/time found in interface file and model

 *==================================================*
 |             XP Note Field Summary                |
 *==================================================*



 *==================================*
 |   Conduit Convergence Criteria   |
 *==================================*

   Conduit        Full       Conduit
      Name        Flow         Slope
```

```
-----------  ----------  ----------
 4               0.8041      0.0050
 5               1.3927      0.0150

 *==================================*
 |    Initial Model Condition       |
 | Initial Time =      0.00 hours   |
 *==================================*

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   0.00 /    10.20 P1b       /   0.00 /     9.50 Outlet    /   0.00 /     5.00

   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       0.00 5         /       0.00 FREE # 1  /       0.00

   Conduit/   Velocity
4         /       0.00 5         /       0.00

   Conduit/ Cross Sectional Area
4         /       0.00 5         /       0.00

   Conduit/ Hydraulic Radius
4         /       0.00 5         /       0.00

   Conduit/ Upstream/ Downstream Elevation
4         /    10.20/     9.505         /     5.00/     5.00

 ===> System inflows (file) at     2.08 hours (  Junction / Inflow, cfs)

 P1a       / 4.98E-01 P1b       / 2.65E-01

 Cycle   500      Time    2 Hrs -  5.00 Min

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   0.40 /    10.60 P1b       /   0.35 /     9.85 Outlet    /   0.35 /     5.35

   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       0.50 5         /       0.76 FREE # 1  /       0.76

 ===> System inflows (file) at     4.17 hours (  Junction / Inflow, cfs)

 P1a       / 8.35E-01 P1b       / 4.44E-01
```

```
 Cycle  1000      Time    4 Hrs - 10.00 Min

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   0.59 /    10.79 P1b       /   0.51 /    10.01 Outlet    /   0.51 /     5.51

   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       0.83 5         /       1.28 FREE # 1  /       1.28

 ===> System inflows (file) at     6.25 hours (  Junction / Inflow, cfs)

 P1a       / 1.19E+00 P1b       / 6.31E-01

 Cycle  1500      Time    6 Hrs - 15.00 Min

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   3.30*/    13.50 P1b       /   2.69*/    12.19 Outlet    /   0.60 /     5.60

   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       1.13 5         /       1.76 FREE # 1  /       1.76

 ===> System inflows (file) at     8.33 hours (  Junction / Inflow, cfs)

 P1a       / 1.72E+00 P1b       / 9.16E-01

 Cycle  2000      Time    8 Hrs - 20.00 Min

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   3.30*/    13.50 P1b       /   3.02*/    12.52 Outlet    /   1.31 /     6.31

   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       0.97 5         /       1.66 FREE # 1  /       1.66

 ===> System inflows (file) at    10.42 hours (  Junction / Inflow, cfs)

 P1a       / 1.12E+00 P1b       / 5.98E-01

 Cycle  2500      Time   10 Hrs - 25.00 Min

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   3.30*/    13.50 P1b       /   3.02*/    12.52 Outlet    /   5.20 /    10.20
```

```
   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       0.97 5         /       1.03 FREE # 1  /       1.03

 ===> System inflows (file) at    12.50 hours (  Junction / Inflow, cfs)

 P1a       / 9.21E-01 P1b       / 4.90E-01

 Cycle  3000      Time   12 Hrs - 30.00 Min

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   3.20*/    13.40 P1b       /   3.02*/    12.52 Outlet    /   9.08 /    14.08

   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       0.92 5         /       0.84 FREE # 1  /       0.84

 ===> System inflows (file) at    14.58 hours (  Junction / Inflow, cfs)

 P1a       / 7.30E-01 P1b       / 3.88E-01

 Cycle  3500      Time   14 Hrs - 35.00 Min

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   2.87*/    13.07 P1b       /   3.02*/    12.52 Outlet    /  12.31 /    17.31

   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       0.73 5         /       0.84 FREE # 1  /       0.84

 ===> System inflows (file) at    16.67 hours (  Junction / Inflow, cfs)

 P1a       / 6.40E-01 P1b       / 3.41E-01

 Cycle  4000      Time   16 Hrs - 40.00 Min

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   2.75*/    12.95 P1b       /   3.02*/    12.52 Outlet    /  14.34 /    19.34

   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       0.64 5         /       0.84 FREE # 1  /       0.84

 ===> System inflows (file) at    18.75 hours (  Junction / Inflow, cfs)

 P1a       / 5.12E-01 P1b       / 2.73E-01
```

```
 Cycle  4500      Time   18 Hrs - 45.00 Min

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   2.41*/    12.61 P1b       /   2.83*/    12.33 Outlet    /  14.82 /    19.82

   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       0.51 5         /       0.79 FREE # 1  /       0.79

 ===> System inflows (file) at    20.83 hours (  Junction / Inflow, cfs)


 P1a       / 5.13E-01 P1b       / 2.73E-01

 Cycle  5000      Time   20 Hrs - 50.00 Min

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   2.41*/    12.61 P1b       /   2.83*/    12.33 Outlet    /  13.71 /    18.71

   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       0.51 5         /       0.79 FREE # 1  /       0.79

 ===> System inflows (file) at    22.92 hours (  Junction / Inflow, cfs)

 P1a       / 5.13E-01 P1b       / 2.73E-01

 Cycle  5500      Time   22 Hrs - 55.00 Min

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   2.41*/    12.61 P1b       /   2.83*/    12.33 Outlet    /  11.27 /    16.27

   Conduit/       FLOW   ===> "*" Conduit uses the normal flow option.
4         /       0.51 5         /       0.79 FREE # 1  /       0.79


 *================================================*
 | Table E5 - Junction Time Limitation Summary    |
 |              (0.10 or 0.25)* Depth * Area      |
 | Time step = ----------------------------       |
 |                  Sum of Flow                   |
 *================================================*
 |  The time this junction was the limiting junction |
```

```
|               is listed in the third column.     |
 *================================================*

Junction     Time(.10)  Time(.25)  Time(sec)
--------     ---------  ---------  ---------
 P1a             0.72       1.81   34755.0
 P1b             0.83       2.08   51645.0
 Outlet        150.00     150.00       0.0
The junction requiring the smallest time step was...P1b


 *============================================================*
 |       Table E5a - Conduit Explicit Condition Summary       |
 |       Courant   =          Conduit Length                  |
 |       Time step = ------------------------------           |
 |                       Velocity + sqrt(g*depth)             |
 |                                                            |
 |                  Conduit Implicit Condition Summary        |
 |       Courant   =          Conduit Length                  |
 |       Time step = ------------------------------           |
 |                               Velocity                     |
 *============================================================*
 |  The 3rd column is the Explicit time step times the        |
 |      minimum courant time step factor                      |
 |                                                            |
 |  Minimum Conduit Time Step in seconds in the 4th column    |
 |  in the list. Maximum possible is 10 * maximum time step   |
 |                                                            |
 |  The 5th column is the maximum change at any time step     |
 |  during the simulation. The 6th column is the wobble       |
 |  value which is an indicator of the flow stability.        |
 |                                                            |
 |  You should use this section to find those conduits that   |
 |  are slowing your model down.  Use modify conduits to      |
 |  alter the length of the slow conduits to make your        |
 |  simulation faster, or change the conduit name to          |
 |  "CHME?????" where ????? are any characters, this will     |
 |  lengthen the conduit based on the model time step,        |
 |  not the value listed in modify conduits.                  |
 *============================================================*

   Conduit  Time(exp)  Expl*Cmin  Time(imp)  Time(min)  Max Qchange   Wobble  Type of Soln
```

```
--------  ---------  ---------  ---------  ---------  -----------  -------  ------------
 4             10.38      10.38      43.99    1440.0        -0.015    2.353   Normal Soln
 5             18.52      18.52      58.13       0.0        -0.020    2.161   Normal Soln
The conduit with the smallest time step limitation was..4
The conduit with the largest wobble was.................4
The conduit with the largest flow change in any
consecutive time step...............................5

 *================================================*
 |  Table E6. Final Model Condition               |
 |            This table is used for steady state |
 |            flow comparison and is the information|
 |            saved to the hot-restart file.      |
 |            Final Time =    24.004 hours       |
 *================================================*

 Junction / Depth  / Elevation    ===>  "*" Junction is Surcharged.
P1a       /   2.41*/    12.61/P1b       /   2.84*/    12.34/Outlet    /   9.62 /    14.62/

   Conduit/       Flow   ===> "*" Conduit uses the normal flow option.
4         /       0.51 /5         /       0.79 /FREE # 1  /       0.79 /

   Conduit/   Velocity
4         /       1.43 /5         /       2.13 /

   Conduit/      Width
4         /       0.00 /5         /       0.00 /

  Junction/        EGL
P1a       /       2.41 /P1b       /       2.87 /Outlet    /       9.62 /

  Junction/  Freeboard
P1a       /       0.89 /P1b       /       0.18 /Outlet    /      -3.62 /

  Junction/ Max Volume
P1a       /      41.47 /P1b       /      37.95 /Outlet    /     186.60 /

  Junction/Total Fldng
P1a       /       0.00 /P1b       /       0.00 /Outlet    /       0.00 /

   Conduit/ Cross Sectional Area
4         /       0.36 /5         /       0.37 /
```

```
   Conduit/  Final Volume
4         /      50.26 /5         /     110.77 /

   Conduit/ Hydraulic Radius
4         /       0.17 /5         /       0.17 /

   Conduit/ Upstream/ Downstream Elevation
4         /    12.61/    12.345         /    12.34/    14.62
```

Table E7 - Extran Iteration Summary	
Total number of time steps simulated.....	5760
Total number of passes in the simulation.....	9377
Total number of time steps during simulation....	5764
Ratio of actual # of time steps / NTCYC.....	1.001
Average number of iterations per time step.....	1.627
Average time step size(seconds).....	14.990
Smallest time step size(seconds).....	3.750
Largest time step size(seconds).....	15.000
Average minimum Conduit Courant time step (sec).	12.533
Average minimum implicit time step (sec).....	9.619
Average minimum junction time step (sec).....	9.619
Average Courant Factor Tf.....	9.619
Number of times omega reduced.....	10

Table E8 - Junction Time Step Limitation Summary

Not Convr	= Number of times this junction did not converge during the simulation.
Avg Convr	= Average junction iterations.
Conv err	= Mean convergence error.
Omega Cng	= Change of omega during iterations
Max Itern	= Maximum number of iterations

Junction	Not Convr	Avg Convr	Total Itt	Omega Cng	Max Itern	Ittrn >10	Ittrn >25	Ittrn >40

P1a	0	1.50	8672	6	7	0	0	0
P1b	0	1.87	10753	4	7	0	0	0
Outlet	0	1.82	10464	0	6	0	0	0

Total number of iterations for all junctions.. 29889
Minimum number of possible iterations..... 17292
Efficiency of the simulation..... 1.73
Excellent Efficiency

Extran Efficiency is an indicator of the efficiency of the simulation. Ideal efficiency is one iteration per time step. Altering the underrelaxation parameter, lowering the time step, increasing the flow and head tolerance are good ways of improving the efficiency, another is lowering the internal time step. The lower the efficiency generally the faster your model will run. If your efficiency is less than 1.5 then you may try increasing your time step so that your overall simulation is faster. Ideal efficiency would be around 2.0
Good Efficiency < 1.5 mean iterations
Excellent Efficiency < 2.5 and > 1.5 mean iterations
Good Efficiency < 4.0 and > 2.5 mean iterations
Fair Efficiency < 7.5 and > 4.0 mean iterations
Poor Efficiency > 7.5 mean iterations

Table E9 - JUNCTION SUMMARY STATISTICS

The Maximum area is only the area of the node, it does not include the area of the surrounding conduits

Junction Name	Ground Elevation feet	Uppermost PipeCrown Elevation feet	Maximum Junction Elevation feet	Time of Occurence Hr.	Min.	Feet of Surcharge at Max Elevation	Freeboard of node feet	Maximum Junction Area ft^2
P1a	13.50	10.87	13.50	5	50	2.63	0.00	1.257E+01
P1b	12.52	10.17	12.52	6	46	2.35	0.00	1.257E+01
Outlet	11.00	5.67	19.85	18	19	14.18	0.00	1.257E+01

Table E10 - CONDUIT SUMMARY STATISTICS

Note: The peak flow may be less than the design flow and the conduit may still surcharge because of the downstream boundary conditions.

Conduit Name	Design Flow (cfs)	Design Velocity (ft/s)	Conduit Vertical Depth (in)	Maximum Computed Flow (cfs)	Time of Occurence Hr.	Time of Occurence Min.	Maximum Computed Velocity (ft/s)	Time of Occurence Hr.	Time of Occurence Min.	Ratio of Max. to Design Flow	Maximum Depth > at Pipe Ends Upstream (ft)	Maximum Depth > at Pipe Ends Dwnstrm (ft)
4	0.80	2.28	8.04	1.15E+00	5	50	3.18	5	50	1.43	13.50	12.52
5	1.4	3.95	8.04	1.81E+00	7	55	5.16	6	47	1.30	12.52	11.00
FREE # 1	Undefnd	Undefnd	Undefnd	1.81E+00	7	55						

Table E11. Area assumptions used in the analysis
Subcritical and Critical flow assumptions from Subroutine Head. See Figure 17-1 in the manual for further information.

Conduit Name	Length of Dry Flow(min)	Length of Sub-Critical Flow(min)	Length of Upstream Critical Flow(min)	Length of Downstream Critical Flow(min)	Maximum Hydraulic Radius-m	Maximum X-Sect Area(ft^2)	Maximum Vel*D (ft^2/s)
4	0.00	1440.00	0.00	0.00	0.202	0.361	0.943E+01
5	0.75	1.00	0.00	1438.25	0.204	0.365	0.123E+02

Table E12. Mean Conduit Flow Information

Conduit Name	Mean Flow (cfs)	Total Flow (ft^3)	Mean Percent Change	Low Flow Weightng	Mean Froude Number	Mean Hydraulic Radius	Mean Cross Area	Mean Conduit Roughness
4	0.698	6.028E+04	2.188E-03	1.00	0.326	0.167	0.329	1.400E-02
5	0.988	8.536E+04	3.481E-03	0.998	0.573	0.168	0.327	1.400E-02

FREE # 1 0.988 8.535E+04

Table E13. Channel losses(H), headwater depth (HW), tailwater depth (TW), critical and normal depth (Yc and Yn). Use this section for culvert comparisons

Conduit Name	Maximum Flow	Head Loss	Friction Loss	Critical Depth	Normal Depth	HW Elevat	TW Elevat	
4	1.132	0.000	1.328	0.504	0.670	13.500	12.174	Max Flow
5	1.806	0.000	6.910	0.610	0.670	12.520	5.610	Max Flow

CULVERT ANALYSIS CLASSIFICATION, and the time the culvert was in a particular classification during the simulation. The time is in minutes. Extran used the Dynamic Wave Equation for all conduit analysis but classifies the culvert flow condition based on the HW and TW depths.

Conduit Name	Mild Slope Critical D Outlet Control	Mild Slope TW Control Outlet Control	Steep Slope TW Insignf Entrance Control	Slug Flow Outlet/ Entrance Control	Mild Slope TW > D Outlet Control	Mild Slope TW <= D Outlet Control	Outlet Control	Inlet Control	Inlet Configuration
4	45.000	682.500	0.000	0.000	2872.500	0.000	0.000	0.000	None
5	22.500	7.500	825.000	15.000	202.500	2040.000	487.500	0.000	None

Kinematic Wave Approximations
Time in Minutes for Each Condition

Conduit Name	Length of Normal Flow	Slope Criteria	Super-Critical	Roll Waves
4	0.00	0.00	3.00	0.00
5	0.00	0.00	289.00	0.00

Table E15 - SPREADSHEET INFO LIST

Conduit Flow and Junction Depth Information for use in spreadsheets. The maximum values in this table are the true maximum values because they sample every time step. The values in the review results may only be the maximum of a subset of all the time steps in the run. Note: These flows are only the flows in a single barrel.

Conduit Name	Maximum Flow	Total Flow	Maximum Velocity	##	Junction Name	Invert Elevation	Maximum Elevation
4	1.146826	60280.54	3.182838	##	P1a	10.20000	13.50000
5	1.806602	85357.31	5.161036	##	P1b	9.500000	12.52000
FREE # 1	1.807164	85348.99	0.000000	##	Outlet	5.000000	19.84997

Table E15a - SPREADSHEET REACH LIST

Peak flow and Total Flow listed by Reach or those conduits or diversions having the same upstream and downstream nodes.

Upstream Node	Downstream Node	Maximum Flow	Total Flow
P1a	P1b	1.1468	60281.
P1b	Outlet	1.8066	85357.

Table E16. New Conduit Information Section
Conduit Invert (IE) Elevation and Conduit Maximum Water Surface (WS) Elevations

Conduit Name	Upstream Node	Downstream Node	IE Up	IE Dn	WS Up	WS Dn	Conduit Type
4	P1a	P1b	10.20	9.500	13.50	12.52	Circular
5	P1b	Outlet	9.500	5.000	12.52	11.00	Circular

Table E18 - Junction Continuity Error. Division by Volume added 11/96

$$\text{Continuity Error} = \frac{\text{Net Flow} + \text{Beginning Volume} - \text{Ending Volume}}{\text{Total Flow} + (\text{Beginning Volume} + \text{Ending Volume})/2}$$

Net Flow = Node Inflow - Node Outflow
Total Flow = absolute (Inflow + Outflow
Intermediate column is a judgement on the node continuity error.

Excellent < 1 percent Great 1 to 2 percent Good 2 to 5 percent
Fair 5 to 10 percent Poor 10 to 25 percent Bad 25 to 50 percent
Terrible > 50 percent

Junction Name	<------Continuity Error -------> Volume	% of Node	% of Inflow	Remaining Volume	Beginning Volume	Net Flow Thru Node	Total Flow Thru Node	Failed to Converge
P1a	26.4457	0.0198	0.0235	30.2761	0.0111	13298.3882	133864.740	0
P1b	149.3723	0.0808	0.1325	35.6256	0.0141	14054.2578	184778.385	0
Outlet	-119.8024	-.0702	0.1063	120.9258	0.0030	1.1204	170706.301	0

The total continuity error was 56.016 cubic feet
The remaining total volume was 186.83 cubic feet
Your mean node continuity error was Excellent
Your worst node continuity error was Excellent

Table E19 - Junction Inflow Sources
Units are either ft^3 or m^3
depending on the units in your model.

Junction Name	Constant Inflow to Node	User Inflow Inflow to Node	Interface Inflow to Node	Outflow from Node	Evaporation from Node
P1a	0.0000	0.0000	73584.2003	13241.6775	0.0000
P1b	0.0000	0.0000	39140.5321	13869.2740	0.0000
Outlet	0.0000	0.0000	0.0000	85348.9397	0.0000

Table E20 - Junction Flooding and Volume Listing. The maximum volume is the total volume in the node including the volume in the flooded storage area. This is the max volume at any time. The volume in the flooded storage area is the total volume above the ground elevation, where the flooded pond storage area starts. The fourth column is instantaneous, the fifth is the sum of the flooded volume over the entire simulation. Units are either ft^3 or m^3 depending on the units.

Junction Name	Surcharged Time (min)	Flooded Time(min)	Out of System Flooded Volume	Maximum Volume	Stored in System Ponding Allowed Flood Pond Volume
P1a	1156.500	295.5000	13241.6775	41.4678	0.0000
P1b	1148.250	599.7500	13869.2740	37.9493	0.0000
Outlet	962.5000	0.0000	0.0000	186.6047	0.0000

Simulation Specific Information

Number of Input Conduits.....	2	Number of Simulated Conduits.....	3
Number of Natural Channels.....	0	Number of Junctions.....	3
Number of Storage Junctions.....	0	Number of Weirs.....	0
Number of Orifices.....	0	Number of Pumps.....	0
Number of Free Outfalls.....	1	Number of Tide Gate Outfalls.....	0

Average % Change in Junction or Conduit is defined as:
Conduit % Change ==> 100.0 (Q(n+1) - Q(n)) / Qfull
Junction % Change ==> 100.0 (Y(n+1) - Y(n)) / Yfull

The Conduit with the largest average change was..FREE # 1 with 0.004 percent
The Junction with the largest average change was.Outlet with 0.349 percent
The Conduit with the largest sinuosity was.....4 with 2.353

Table E21. Extran continuity balance at the end of the simulation
Junction Inflow, Outflow or Street Flooding
Error = Inflow + Initial Volume - Outflow - Final Volume

Inflow Junction	Inflow Volume,ft^3	Average Inflow, cfs
P1a	73584.2003	0.8517
P1b	39140.5321	0.4530

Outflow Junction	Outflow Volume,ft^3	Average Outflow, cfs
P1a	13241.6775	0.1533
P1b	13869.2740	0.1605
Outlet	85348.9397	0.9878

Initial system volume	=	2.8168E-02 Cu Ft
Total system inflow volume	=	1.1272E+05 Cu Ft
Inflow + Initial volume	=	1.1272E+05 Cu Ft
Total system outflow	=	1.1246E+05 Cu ft
Volume left in system	=	1.8683E+02 Cu ft
Evaporation	=	0.0000E+00 Cu ft
Outflow + Final Volume	=	1.1265E+05 Cu ft

Total Model Continuity Error
Error in Continuity, Percent = 0.04969
Error in Continuity, ft^3 = 56.016
+ Error means a continuity loss, - a gain

Table E22. Numerical Model judgement section

```
Your overall error was                              0.0497 percent
Worst nodal error was in node P1b          with     0.0808 percent
Of the total inflow this loss was                   0.1325 percent
Your overall continuity error was                    Excellent
                                                    Excellent Efficiency
Efficiency of the simulation                         1.73
Most Number of Non Convergences at one Node          0.
Total Number Non Convergences at all Nodes           0.
Total Number of Nodes with Non Convergences          0.

===> Extended Transport model simulation ended normally.
 ===> SWMM Simulation ended normally.
===> Your input file was named  : L:\ILWACO\99789\SWMM\W Howerton\WHow Exist\WHow.DAT
===> Your output file was named : L:\ILWACO\99789\SWMM\W Howerton\WHow Exist\WHow.out

*============================================================*
|             SWMM Simulation Date and Time Summary          |
*============================================================*
| Starting Date... January     8, 2001  Time...   14:31:46:72 |
|   Ending Date... January     8, 2001  Time...   14:32: 0:70 |
|  Elapsed Time...    0.23300 minutes or     13.98000 seconds |
*============================================================*
```

APPENDIX D

Guidelines for Monitoring Stormwater Facilities

ATTACHMENT "A"

MAINTENANCE PROGRAM
COVER SHEET FOR PIERCE COUNTY

Inspection Period: _____

Number of Sheets Attached: _____

Date Inspected: _____

Name of Inspector: _____

Inspector's Signature: _____

INSTRUCTIONS FOR USE OF MAINTENANCE CHECKLISTS

The following pages contain maintenance needs for most of the components that are part of your drainage system, as well as for some components that you may not have. Let the County know if there are any components that are missing from these pages. Ignore the requirements that do not apply to your system. You should plan to complete a checklist for all system components on the following schedule:

(1) Monthly from November through April.
(2) Once in late summer (preferable September)
(3) After any major storm (use 1-inch in 24 hours as a guideline), items marked "S" only.

Using photocopies of these pages, check off the problems you looked for each time you did an inspection. Add comments on problems found and actions taken. Keep these "checked" sheets in your files, as they will be used to write your annual report (due in May, for Pierce County Only). Some items do not need to be looked at every time an inspection is done. Use the suggested frequency at the left of each item as a guideline for your inspection.

ATTACHMENT "A"

MAINTENANCE PROGRAM

Maintenance Checklist for Closed Detention Systems (Pipes/Tanks)

Frequency	Drainage Systems Feature	✓	Problem	Conditions To Check For	Conditions That Shall Exist
M	Storage area (pipe tank)		Plugged air vents (small pipe that connects catch basin to storage pipe)	One-half of the end area of a vent is blocked at any point with debris and sediment. Plugged vent can cause storage area to collapse.	Vents free of debris and sediment.
M			Debris and sediment	Accumulated sediment depth exceeds 15% of diameter. Example: 72- inch storage tank would require cleaning when sediment reaches depth of 10 inches	All sediment and debris removed from storage area. Contact the County for guidance on sediment removal and disposal.
A			Joints between tank/pipe section	Any crack allowing material to leak into facility.	All joints between tank/pipe sections are sealed.
A			Tank/pipe bent out of shape	Any part of tank/pipe is noticeably bent out of shape.	Tank/pipe repaired or replaced to design. Contact a professional engineer for evaluation.
M,S	Manhole		Cover not in place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
A			Locking mechanism not working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2-inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
A			Cover difficult to remove	One maintenance person cannot remove lid after applying 80 pounds of lift. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
A			Ladder rungs unsafe	Maintenance person judges that ladder is unsafe due to missing rungs, misalignment, rust, or cracks. Ladder must be fixed or secured immediately.	Ladder meets design standards and allows maintenance persons safe access.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

A = Annual (March or April preferred)
M = Monthly (see schedule)
S = After major storms (use 1-inch in 24 hours as a guideline)

ATTACHMENT "A" (CONTINUED)

Maintenance Checklist for Control Structure/Flow Restrictor
(Structure that controls rate at which water exits facility)

Frequency	Drainage Systems Feature	✓	Problem	Conditions To Check For	Conditions That Should Exist
M	Structure		Trash & debris (includes sediment)	Distance between debris buildup and bottom of orifice plate is less than 1-1/2 feet.	All trash and debris removed.
A			Structural damage	Structures are not securely attached to manhole wall and outlet pipe structure should support at least 1,000 pounds of up or down pressure.	Structure securely attached to wall and outlet pipe.
A				Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
A				Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are watertight; structure repaired or replaced and works as designed.
M				Any holes--other than designed holes--in the structure.	Structure has no holes other than designed holes.
M,S	Cleanout gate		Damaged or missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
A				Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
M,S				Chain leading to gate is missing or damaged.	Chain is in place and works as designed.
A				Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
M,S			Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
M,S	Overflow pipe		Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.

If you are unsure whether a problem exists, please contact a Professional Engineer.
Comments:

Key:

A=Annual (March or April preferred)
M=Monthly (See schedule)
S=After major storms (use 1-inch in 24 hours as a guideline)

ATTACHMENT "A" (CONTINUED)

Maintenance Checklist for Catch Basins and Inlets

Frequency	Drainage System Feature	✓	Problem	Conditions To Check For	Conditions That Should Exist
M,S	General		Trash, debris, and sediment in or on basin	Trash or debris in front of the catch basin opening is blocking capacity by more than 10%	No trash or debris located immediately in front of catch basin opening. Grate is kept clean and allows water to enter.
M				Sediment or debris (in the basin) that exceeds 1/3 the depth from the bottom of basin to invert of the lowest pipe into or out of the basin.	No sediment or debris in the catch basin. Catch basin is dug out and clean.
M,S				Trash or debris in any inlet or pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
M			Structural damage to frame and/or top slab	Corner of frame extends more than 3/4 inch past curb face into the street (if applicable).	Frame is even with curb.
M				Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (intent is to make sure all material is running into the basin).	Top slab is free of holes and cracks.
M				Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab.	Frame is sitting flush on top slab.
A			Cracks in basin walls/bottom	Cracks wider than 1/2 inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards. Contact a professional engineer for evaluation.
A				Cracks wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	No cracks more than 1/4 inch wide at the joint of inlet/outlet pipe. Contact a professional engineer for evaluation.
A			Settlement/ misalignment	Basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards. Contact a professional engineer for evaluation.
M,S			Fire hazard or other pollution	Presence of chemicals such as natural gas, oil, and gasoline. Obnoxious color, odor, or sludge noted.	No color, odor, or sludge. Basin is dug out and clean.
M,S			Outlet pipe is clogged with vegetation	Vegetation or roots growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

A=Annual (March or April preferred)
M=Monthly (see schedule)
S=After major storms (use 1-inch in 24 hours as a guideline)

Maintenance Checklist for Ponds

Frequency	Drainage System Feature	✓	Problem	Conditions to Check For	Conditions That Should Exist
M,S	General		Trash & debris buildup in pond.	Dumping of yard wastes such as grass clippings and branches into basin. Unsightly accumulation of nondegradable materials such as glass, plastic, metal, foam, and coated paper.	Remove trash and debris and dispose as prescribed by the County.
M,S			Trash rack plugged or missing	Bar screen over outlet more than 25% covered by debris or missing.	Replace screen. Remove trash and debris and dispose as prescribed by the County.
M			Poisonous vegetation	Any poisonous vegetation which may constitute a hazard to the public. Examples of poisonous vegetation include: tansy ragwort, poison oak, stinging nettles, devilsclub.	Remove poisonous vegetation. Do not spray chemicals on vegetation without obtaining guidance from the Cooperative Extension Service and approval from the County.
M,S			Fire hazard or pollution	Presence of chemicals such as natural gas, oil, and gasoline, obnoxious color, odor, or sludge noted.	Find sources of pollution and eliminate them. Water is free from noticeable color, odor, or contamination.
M			Vegetation not growing or is overgrown	For grassy ponds, grass cover is sparse and weedy or is overgrown. For wetland ponds, plants are sparse or invasive species are present.	For grassy ponds, selectively thatch, aerate, and reseed ponds. Grass cutting unnecessary unless dictated by aesthetics. For wetland ponds, hand-plant nursery-grown wetland plants in bare areas. Contact the Cooperative Extension Service for direction on invasive species such as purple loosestrife and reed canary grass. Pond bottoms should have uniform dense coverage of desired plant species.
M			Rodent holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. Contact the Tacoma-Pierce County Health Department for guidance.
M			Insects	When insects such as wasps and hornets interfere with maintenance activities, or when mosquitoes become a nuisance.	Insects destroyed or removed from site. Contact Cooperative Extension Service for guidance.
A			Tree growth	Tree growth does not allow maintenance access or interferes with maintenance activity (e.g., slope mowing, silt removal, or equipment movements). If trees are not interfering with access, leave trees alone.	Trees do not hinder maintenance activities. Selectively cultivate trees such as alders for firewood.
M	Side slopes of pond		Erosion on berms or at entrance or exit	Check around inlets and outlets for signs of erosion. Check berms for signs of sliding or settling. Action is needed where eroded damage over 2 inches deep and where there is potential for continued erosion.	Find causes of erosion and eliminate them. Then slopes should be stabilized by using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
M	Storage area		Sediment build-up in pond	Accumulated sediment that exceeds 10% of the designed pond depth. Buried or partially buried outlet structure probably indicates significant sediment deposits.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
A	Pond dikes		Settlements	Any part of dike which has settled 4 inches lower than the design elevation.	Dike should be built back to the design elevation.

Frequency	Drainage System Feature	✓	Problem	Conditions to Check For	Conditions That Should Exist
A	Emergency overflow/ spillway		Rock missing	Only one layer of rock exists above native soil in area 5 square feet or larger, or any exposure of native soil..	Replace rocks to design standards.
One Time	Emergency overflow/ spillway		Overflow missing	Side of pond has no area with large rocks to handle emergency overflows.	Contact the County for guidance.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

A=Annual (March or April preferred)
M=Monthly (see schedule)
S=After major storms (use 1-inch in 24 hours as a guideline)

Maintenance Checklist for Infiltration Systems

Frequency	Drainage System Feature	✓	Problem	Conditions to Check For	Conditions That Should Exist
M,S	General		Trash & debris buildup in pond	See Maintenance Checklist for Ponds.	See Maintenance Checklist for Ponds.
M			Poisonous vegetation	See Maintenance Checklist for Ponds.	See Maintenance Checklist for Ponds.
M,S			Fire hazard or pollution	See Maintenance Checklist for Ponds.	See Maintenance Checklist for Ponds.
M			Vegetation not growing or is overgrown	See Maintenance Checklist for Ponds.	See Maintenance Checklist for Ponds.
M			Rodent holes	See Maintenance Checklist for Ponds.	See Maintenance Checklist for Ponds.
M			Insects	See Maintenance Checklist for Ponds.	See Maintenance Checklist for Ponds.
A	Storage area		Sediment buildup in system	A soil texture test indicates facility is not working at its designed capabilities or was incorrectly designed.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design. A sediment trapping area is installed to reduce sediment transport into infiltration area.
A			Storage area drains slowly (more than 48 hours) or overflows	A soil texture test indicates facility is not working at its designed capabilities or was incorrectly designed.	Additional volume is added through excavation to provide needed storage. Soil is aerated and rototilled to improve drainage. Contact the County for information on its requirements regarding excavation.
M			Sediment trapping area	Any sediment and debris filling area to 10% of depth from sump bottom to bottom of outlet pipe or obstructing flow into the connector pipe.	Clean out sump to design depth.
One Time			Sediment trapping area not present	Stormwater enters infiltration area directly without treatment.	Add a trapping area by constructing a sump for settling of solids. Segregate settling area from rest of facility. Contact the County for guidance.
M	Rock filters		Sediment and debris	By visual inspection little or no water flows through filter during heavy rain storms.	Replace gravel in rock filter.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

A=Annual (March or April preferred)
M=Monthly (see schedule)
S=After major storms (use 1-inch in 24 hours as a guideline)

ATTACHMENT "A" (CONTINUED)

Maintenance Checklist for Energy Dissipators

Frequency	Drainage System Feature	✓	Problem	Conditions to Check For	Conditions That Should Exist
A	Rock pad		Missing or moved rock	Only one layer of rock exists above native soil in area 5 square feet or larger, or any exposure of native soil.	Replace rocks to design standard.
A	Rock-filled trench for discharge from pond		Missing or moved rock	Trench is not full of rock.	Add large rock (+ or - 30 lb. each) so that rock is visible above edge of trench.
M	Dispersion trench		Pipe plugged with sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed.
M			Perforations plugged	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Clean or replace perforated pipe.
M,S			Not discharging water properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench). Intent is to prevent erosion damage.	Trench must be redesigned or rebuilt to standard. Elevation of lip of trench should be the same (flat) at all points.
M,S			Water flows out top of "distributor" catch basin	Maintenance person observes water flowing out during any strom less than the design storm or it is causing or appears likely to cause damage.	Facility must be rebuilt or redesigned to standards. Pipe is probably plugged or damaged and needs replacement.
M,S			Receiving area over-saturated	Water in receiving area is causing or has potential of causing landslide.	Stabilize slope with grass or other vegetation, or rock if condition is severe. Contact a professional engineer for evaluation.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

A=Annual (March or April preferred)
M=Monthly (see schedule)
S=After major storms (use 1-inch in 24 hours as a guideline)

ATTACHMENT "A" (CONTINUED)

Maintenance Checklist for Fencing/Shrubbery Screen/Other Landscaping

Frequency	Drainage System Feature	✓	Problem	Conditions to Check For	Conditions That Should Exist
M	General		Missing or broken parts/dead shrubbery	Any defect in the fence or screen that permits easy entry to a facility.	Fence is mended or shrubs replaced to form a solid barrier to entry.
M,S			Erosion	Erosion has resulted in an opening under a fence that allows entry by people or pets.	Replace soil under fence so that no opening exceeds 4 inches in height.
M			Unruly vegetation	Shrubbery is growing out of control or is infested with weeds.	Shrubbery is trimmed and weeded to provide appealing aesthetics. Do not use chemicals to control weeds.
A	Wire Fences		Damaged parts	Posts out of plumb more than 6 inches.	Posts plumb to within 1-1/2 inches of plumb.
A				Top rails bent more than 6 inches.	Top rail free of bends greater than 1 inch.
A				Any part of fence (including posts, top rails, and fabric) more than 1 foot out of design alignment.	Fence is aligned and meets design standards.
A				Missing or loose tension wire.	Tension wire in place and holding fabric.
A				Missing or loose barbed wire that is sagging more than 2-1/2 inches between posts.	Barbed wire in place with less than 3/4-inch sag between posts.
A				Extension arm missing, broken, or bent out of shape more than 1-1/2 inches.	Extension arm in place with no bends larger than 3/4 inch.
A			Deteriorated paint or protective coating	Part or parts that have a rusting or scaling condition that has affected structural adequacy.	Structurally adequate posts or parts with a uniform protective coating.
M			Openings in fabric	Openings in fabric are such that an 8-inch diameter ball could fit through.	No openings in fabric.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

A=Annual (March or April preferred)
M=Monthly (see schedule)
S=After major storms (use 1-inch in 24 hours as a guideline)

ATTACHMENT "A" (CONTINUED)

Maintenance Checklist for Gates

Frequency	Drainage System Feature	✓	Problem	Conditions to Check For	Conditions That Should Exist
M	General		Damaged or missing components	Gate is broken, jammed, or missing.	Pond has a functioning gate to allow entry of people and maintenance equipment such as mowers and backhoe. If a lock is used, make sure the County field staff have a key.
M				Broken or missing hinges such that gate cannot be easily opened and closed by a maintenance person.	Hinges intact and lubed. Gate is working freely.
A				Gate is out of plumb more than 6 inches and more than 1 foot out of design alignment.	Gate is aligned and vertical.
A				Missing stretcher bands, and ties.	Stretcher bar, bands, and ties in place.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

A=Annual (March or April preferred)
M=Monthly (see schedule)
S=After major storms (use 1-inch in 24 hours as a guideline)

ATTACHMENT "A" (CONTINUED)

Maintenance Checklist for Conveyance Systems (Pipes, Ditches, and Swales)

Frequency	Drainage System Feature	✓	Problem	Conditions to Check For	Conditions That Should Exist
M,S	Pipes		Sediment & debris	Accumulated sediment that exceeds 20% of the diameter of the pipe.	Pipe cleaned of all sediment and debris.
M			Vegetation	Vegetation that reduces free movement of water through pipes.	All vegetation removed so water flows freely through pipes.
A			Damaged (rusted, bent, or crushed)	Protective coating is damaged; rust is causing more than 50% deterioration to any part of pipe.	Pipe repaired or replaced.
M				Any dent that significantly impedes flow (i.e., decreases the cross section area of pipe by more than 20%).	Pipe repaired or replaced.
M				Pipe has major cracks or tears allowing groundwater leakage.	Pipe repaired or replaced.
M,S	Open ditches		Trash & debris	Dumping of yard wastes such as grass clippings and branches into basin. Unsightly accumulation of nondegradable materials such as glass, plastic, metal, foam, and coated paper.	Remove trash and debris and dispose as prescribed by the County.
M			Sediment buildup	Accumulated sediment that exceeds 20% of the design depth.	Ditch cleaned of all sediment and debris so that it matches design.
A			Vegetation	Vegetation (e.g., weedy shrubs or saplings) that reduces free movements of water through ditches.	Water flows freely through ditches. Grassy vegetation sh be left alone.
M			Erosion damage to slopes	See Ponds Checklist.	See Ponds Checklist.
A			Rock lining out of place or missing (if applicable)	Maintenance person can see native soil beneath the rock lining.	Replace rocks to design standard.
Varies	Catch basins			See Catch Basins Checklist.	See Catch Basins Checklist.
M,S	Swales		Trash & debris	See above for Ditches.	See above for Ditches.
M			Sediment buildup	See above for Ditches.	Vegetation may need to be replanted after cleaning.
M			Vegetation not growing or overgrown	Grass cover is sparse and seedy or areas are overgrown with woody vegetation.	Aerate soils and reseed and mulch bare areas. Maintain grass height at a minimum of 6 inches for best stormwater treatment. Remove woody growth, recontour, and reseed as necessary.
M,S			Erosion damage to slopes	See Ponds Checklist.	See Ponds Checklist.
M			Conversion by homeowner to incompatible use	Swale has been filed in or blocked by shed, woodpile, shrubbery, etc.	If possible, speak with homeowner and request that swale area be restored. Contact the County to report problem if not rectified voluntarily.
A			Swale does not drain	Water stands in swale or flow velocity is very slow. Stagnation occurs.	A survey may be needed to check grades. Grades need to be in 1-5% range if possible. If grade is less than 1% underdrains may need to be installed.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

A=Annual (March or April preferred)
M=Monthly (see schedule)
S=After major storms (use 1-inch in 24 hours as a guideline)

ATTACHMENT "A" (CONTINUED)

Maintenance Checklist for Grounds (Landscaping)

Frequency	Drainage System Feature	✓	Problem	Conditions to Check For	Conditions That Should Exist
M	General		Weeds (nonpoisonous)	Weeds growing in more than 20% of the landscaped area (trees and shrubs only).	Weeds present in less than 5% of the landscaped area.
M			Insect hazard	Any presence of poison ivy or other poisonous vegetation or insect nests.	No poisonous vegetation or insect nests present in lanscaped area.
M,S			Trash or litter	See Ponds Checklist.	See Ponds Checklist.
M,S			Erosion of Ground Surface	Noticeable rills are seen in landscaped areas.	Causes of erosion are identified and steps taken to slow down/spread out the water. Eroded areas are filled, contoured, and seeded.
A	Trees and shrubs		Damage	Limbs or parts of trees or shrubs that are split or broken which affect more than 25% of the total foliage of the tree or shrub.	Trim trees/shrubs to restore shape. Replace trees/shrubs with severe damage.
M				Trees or shrubs that have been blown down or knocked over.	Replant tree, inspecting for injury to stem or roots. Replace if severely damaged.
A				Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Place stakes and rubber-coated ties around young trees/shrubs for support.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

A=Annual (March or April preferred)
M=Monthly (see schedule)
S=After major storms (use 1-inch in 24 hours as a guideline)

ATTACHMENT "A" (CONTINUED)

Maintenance Checklist for Access Roads/Easements

Frequency	Drainage System Feature	✓	Problem	Conditions to Check For	Conditions That Should Exist
One Time	General		No access road exists	If ponds or other drainage system features needing maintenance by motorized equipment are present, either an access road or access from public streets is required.	Determine whether an easement to drainage feature exists. If yes, obtain the County permits and construct gravel (or equal) access road. If not, report lack of easement to the Municipaolity.
M			Blocked Roadway	Debris which could damage vehicle tires (glass or metal).	Roadway free of debris which could damage tires.
A				Any obstructions which reduce clearance above road surface to less than 14 feet.	Roadway overhead clear to 14 feet high.
A				Any obstructions restricting the access to less than 15 feet width.	Obstruction removed to allow at least a 15-foot-wide access.
A,S	Road Surface		Settlement, potholes, mush spots, ruts	When any surface irregularity exceeds 6 inches in depth and 6 square feet in area. In general, any surface defect which hinders or prevents maintenance access.	Road surface uniformly smooth with no evidence of settlement, potholes, mush spots, or ruts. Occasionally application of additional gravel or pitrun rock will be needed.
M			Vegetation in road surface	Woody growth that could block vehicular access. Excessive weed cover.	Remove woody growth at early stage to prevent vehicular blockage. Cut back weeds if they begin to encroach on road surface.
M,S	Shoulders and ditches		Erosion damage	Erosion within 1 foot of the roadway more than 8 inches wide and 6 inches deep.	Shoulder free of erosion and matching the surrounding road.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:

A=Annual (March or April preferred)
M=Monthly (see schedule)
S=After major storms (use 1-inch in 24 hours as a guideline)

APPENDIX E

Construction Cost Estimates

Ilwaco Comprehensive Stormwater Management Plan
Cost Estimate
Improvements North of Howerton

	Item	Quantity		Unit Cost	Total
1	Mobilization/Demobilization	1	LS	$4,000	$4,000
2	Traffic Control	1	LS	$500	$500
3	Clearing and Grubbing	1	LS	$1,000	$1,000
4	Locate Existing Utilities	1	LS	$500.00	$500.00
5	Storm Sewer Pipe 12-in. Diam	320	LF	$25	$8,000
6	Storm Sewer Pipe 24-in. Diam	400	LF	$45	$18,000
7	Catch Basin Type 2, 48 inch diameter	2	EA	$1,500	$3,000
8	Special Excavation of Unsuitable Materials	15	CY	$35	$525
9	Trench Excavation Safety Systems	1	LS	$2,000.00	$2,000.00
10	Foundation Gravel	98	TN	$30	$2,940
11	Bankrun Gravel for Trench Backfill	36	CY	$20	$720
12	Crushed Surfacing Base Course	144	TN	$20.00	$2,880.00
13	Crushed Surfacing Top Course	49	TN	$20.00	$980.00
14	Erosion Control	1	LS	$1,000	$1,000
15	Dewatering	1	LS	$10,000	$10,000

Subtotal		$56,045
Contingency	0.20	$11,209
Subtotal		$67,254
Sales Tax	0.08	$5,515
Overhead	0.25	$16,814
Total		$89,582
Total Construction Cost (Rounded)		**$90,000**

Ilwaco Comprehensive Stormwater Management Plan
Cost Estimate
Improvements South of Howerton

	Item	Quantity		Unit Cost	Total
1	Mobilization/Demobilization	1	LS	$3,000	$3,000
2	Traffic Control	1	LS	$1,000	$1,000
3	Clearing and Grubbing	1	LS	$1,000	$1,000
4	Locate Existing Utilities	1	LS	$1,000.00	$1,000.00
5	Storm Sewer Pipe 24-in. Diam	232	LF	$45	$10,440
6	Catch Basin Type 1	2	EA	$750	$1,500
7	Catch Basin Type 2, 48 inch diameter	1	EA	$1,500	$1,500
8	Special Excavation of Unsuitable Materials	35	CY	$35	$1,225
9	Sawcutting	392	LF	$2.00	$784.00
10	Trench Excavation Safety Systems	1	LS	$2,000.00	$2,000.00
11	Foundation Gravel	33	TN	$30	$990
12	Bankrun Gravel for Trench Backfill	25	CY	$20	$500
13	Crushed Surfacing Base Course	40	TN	$20.00	$800.00
14	Asphalt Conc. Pavement Cl. B	16.5	TN	$70.00	$1,155.00
15	Topsoil Type A	5	CY	$25	$125
16	Seeding Fertilizing and Mulching	27	SY	$2	$54
17	Erosion Control	1	LS	$5,000	$5,000
18	Dewatering	1	LS	$10,000	$10,000

Subtotal		$42,073
Contingency	0.20	$8,415
Subtotal		$50,488
Sales Tax	0.08	$4,140
Overhead	0.25	$12,622
Total		$67,249
Total Construction Cost (Rounded)		**$68,000**

Ilwaco Comprehensive Stormwater Management Plan
Cost Estimate
Replacement of Willow Ditch with 24-Inch Pipe

	Item	Quantity		Unit Cost	Total
1	Mobilization/Demobilization	1	LS	$2,000	$2,000
2	Traffic Control	1	LS	$500	$500
3	Clearing and Grubbing	1	LS	$1,000	$1,000
4	Storm Sewer Pipe 24-in. Diam	200	LF	$45	$9,000
5	Catch Basin Type 1	1	EA	$750	$750
6	Catch Basin Type 2, 48 inch diameter	1	EA	$1,500	$1,500
7	Manhole 48-in Diam Type 2	1	EA	$2,500	$2,500
8	Special Excavation of Unsuitable Materials	5	CY	$35	$175
9	Bankrun Gravel for Trench Backfill	30	TN	$20	$600
10	Seeding Fertilizing and Mulching	290	SY	$2	$580
11	Erosion Control	1	LS	$1,000	$1,000
12	Topsoil Type A	35	CY	$25	$875
13	Dewatering	1	LS	$5,000	$5,000

Subtotal		$25,480
Contingency	0.20	$5,096
Subtotal		$30,576
Sales Tax	0.08	$2,507
Overhead	0.25	$7,644
Total		$40,727
Total Construction Cost (Rounded)		**$41,000**

Ilwaco Comprehensive Stormwater Management Plan
Cost Estimate
City/Port Ditch Rehabilitation

Item	Quantity		Unit Cost	Total
1 Labor (3 peope/day)	4	DAY	$660	$2,640
2 Equipment Rental	4	DAY	$300	$1,200

Subtotal		$3,840
Contingency	0.20	$768
Subtotal		$4,608
Sales Tax	0.08	$378
Overhead	0.25	$1,152
Total		$6,138

Total Construction Cost (Rounded) **$7,000**

APPENDIX F

Stormwater Base Map

– INCORPORATED 1891 –

CITY OF ILWACO

120 First Ave. N. • P.O. Box 548
Ilwaco, WA 98624

e-mail: ilwacoch@willapabay.org

Phone: 360-642-3145 Fax: 360-642-3155

Planning Commission Meeting

Tuesday, September 17, 2002

6:00 p.m.

Agenda

1. **Roll Call**
2. **Approval of Minutes of August 20, 2002 Meeting—*Action Item***
3. **Waliser Conditional Use Permit—Private Shooting Range—*Action Item***
4. **Draft Comprehensive Stormwater Management Plan—Barry Baker from Gray & Osborne—*Discussion Item***
5. **Anticipated October Meeting Agenda**
6. **Adjourn**

APPENDIX G

SEPA Checklist

City of Ilwaco
State Environmental Protection Act (SEPA)
Environmental Checklist

A. BACKGROUND

1. Name of proposed project, if applicable:
   City of Ilwaco Stormwater Management Plan

2. Name of applicant:
   City of Ilwaco

3. Address, phone number and name of contact person:
   Gray & Osborne, Inc.
   701 Dexter Avenue North, Suite #200
   Seattle, Washington 98109
   Contact: Ms. Nancy Lockett, P.E., City Engineer
   (206) 284-0860

4. Date checklist prepared:
   January 2002

5. Agency requesting checklist:
   City of Ilwaco

6. Proposed timing or schedule (include phasing if applicable):
   The Stormwater Management Plan will be completed in January 2002.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.
   Individual stormwater projects are to be completed per the management plan in the future. Additional environmental documents will be completed as required.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this project.
   None

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, describe.
   None

10. List any government approvals or permits that will be needed for your proposal, if known.
    Adoption of the Stormwater Management Plan by the City of Ilwaco Council.

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project site. There are several questions later in this checklist that ask you to describe certain aspects of you proposal. You do not need to repeat those answers on this page.
The Stormwater Management Plan is to be completed for the purpose of maintaining and improving the management of the City's stormwater system.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.
N/A

B. ENVIRONMENTAL ELEMENTS

1. EARTH

a. General description of the site (circle or highlight one):

flat rolling steep slopes other

If other, describe. **N/A**

b. What is the steepest slope on the site (approximate percent slope)?
N/A

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, mulch)? If you know the classification of agricultural soils, specify them and note any prime farmland.
N/A

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.
N/A

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.
N/A

f. Could erosion occur as a result of clearing, construction or use? If so, generally describe.
N/A

g. Approximately what percentage of the site will be covered with impervious surfaces after project construction (for example, asphalt, buildings)?
N/A

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any.
N/A

2. ***AIR***

a. What types of emissions to the air would result from the proposal (i.e. dust, automobile, odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.
N/A

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.
N/A

c. Proposed measures to reduce or control emissions or other impacts to the air, if any.
N/A

3. ***WATER***

a. Surface:

1. Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, described type and provide names. If appropriate, state what stream or river it flows into.
Black Lake

2. Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.
N/A

3. Estimate the amount of fill and dredge material that would be placed in or removed from surface or wetlands and indicate the area of the site that would be affected. Indicate the sources of fill material.
N/A

4. Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.
N/A

5. Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.
N/A

6. Does the proposal involve any discharge of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.
N/A

b. Ground

1. Will ground water be withdrawn, or will water be discharged to ground water? Give general description, purpose, and approximate quantities if known.
N/A

2. Describe waste materials that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial containing the following chemicals...., agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.
N/A

c. Water Runoff (including storm water)

1. Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.
N/A

2. Could waste materials enter ground or surface waters? If so, generally describe.
N/A

d. Proposed measures to reduce or control surface, ground, and runoff water impacts, if any:
N/A

4. ***PLANTS***

a. Circle or highlight types of vegetation found on the site: **N/A**

__ Deciduous tree:
Alder Maple Aspen Other:

__ Evergreen tree:
Fir Cedar Pine Other:

__ Shrubs
__Grass
__ Pasture
__ Crop or grain
__ Wet soil plants:
Cattail Buttercup Bulrush
Skunk Cabbage Other:

__ Water plants:
Water lily Celgrass Milfoil

__ Other types of vegetation:

b. List threatened or endangered species known to be on or near the site.
N/A

c. What kind and amount of vegetation will be removed or altered?
N/A

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:
N/A

5. ***ANIMALS***

a. Circle or highlight any birds and animals which have been observed on or near the site or are known to be on or near the site: **N/A**

Birds:	Hawk Other:	Heron	Songbird	Eagle
Mammals:	Deer Other:	Bear	Elk	Beaver
Fish:	Bass Trout Other:	Salmon Shellfish		Herring

b. List any threatened or endangered species known to be on or near the site.
N/A

c. Is the site part of a migration route? If so, explain.
N/A

d. Proposed measures to preserve or enhance wildlife, if any.
N/A

6. ***ENERGY AND NATURAL RESOURCES***

a. What kind of energy (electrical, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.
N/A

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.
N/A

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:
N/A

7. **ENVIRONMENTAL HEALTH**

a. Are there any environmental hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur as a result of this proposal? If so, describe.
N/A

1. Describe special emergency services that might be required.
N/A

2. Proposed measures to reduce or control environmental health hazards, if any:
N/A

b. Noise

1. What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?
N/A

2. What types and levels of noise would be created by or associated with the project on a short-term or long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.
N/A

3. Proposed measures to reduce or control noise impacts, if any:
N/A

8. ***LAND AND SHORELINE USE***

a. What is the current use of the site and adjacent properties?
N/A

b. Has the site been used for agriculture? If so, describe.
N/A

c. Describe any structures on the site.
N/A

d. Will any structures be destroyed? If so, what?
N/A

e. What is the current zoning classification of the site?
N/A

f. If applicable, what is the current shoreline master program designation of the site?
N/A

g. What is the current comprehensive plan designation of the site?
N/A

h. Has any part of the site been classified as an "environmentally sensitive" area? If so, specify.
N/A

i. Approximately how many people would reside or work in the completed project?
N/A

j. Approximately how many people would the completed project displace?
N/A

k. Proposed measure to avoid or reduce displacement impacts, if any?
N/A

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:
N/A

9. ***HOUSING***

a. Approximately how many units would be provided, if any? Indicate whether high, middle or low income housing.
N/A

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle or low income housing.
N/A

c. Proposed measures to reduce or control housing impacts, if any:
N/A

10. ***AESTHETICS***

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?
N/A

b. What views in the immediate vicinity would be altered or obstructed?
N/A

c. Proposed measures to reduce or control aesthetic impacts, if any?
N/A

11. ***LIGHT AND GLARE***

a. What type of light and glare will the proposal produce? What time of day would it mainly occur?
N/A

b. Could light or glare from the finished project be a safety hazard or interfere with views?
N/A

c. What existing off-site sources of light or glare may effect your proposal?
N/A

d. Proposed measures to reduce or control light or glare impacts, if any:
N/A

12. ***RECREATION***

a. What designated and informal recreation opportunities are in the immediate vicinity?
N/A

b. Would the proposed project displace any existing recreational uses? If so, describe.
N/A

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:
N/A

13. ***HISTORICAL AND CULTURAL PRESERVATION***

a. Are there any places or objects listed on or proposed for, national, state or local preservation registers known to be on or next to the site? If so, generally describe.
N/A

b. Generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known to be on or next to the site.
N/A

c. Proposed measures to reduce or control impacts, if any?
N/A

14. ***TRANSPORTATION***

a. Identify public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.
N/A

b. Is the site currently served by public transit? If not, what is the approximate distance to the nearest transit stop?
N/A

c. How many parking spaces would the completed project have? How many would the project eliminate?
N/A

d. Will the proposal require any new roads or streets, or improvements to existing road or streets, not including driveways? If so, generally describe (indicate whether public or private).
N/A

e. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.
N/A

f. How many vehicular trips per day would be generated by the completed project?
N/A

g. What peak hour traffic is generated by the proposed project?
N/A

h. The directional movements the traffic shall take and the peak hour distribution.
N/A

i. The traffic influence at the two (2) closest intersections to the proposed project.
N/A

j. Proposed measures to reduce or control transportation impacts, if any.
N/A

15. PUBLIC SERVICES

a. Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.
N/A

b. Proposed measures to reduce or control direct impacts on public services, if any.
N/A

16. ***UTILITIES***

a. Circle or highlight utilities currently available at the site: **N/A**

electricity	natural gas	water
telephone	refuse service	sanitary sewer
septic system	cable television	
other:		

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.
N/A

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on then to make its decision.

Signature: Nancy Hackett

Date Submitted: 1/29/02

D. SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS
(do not use this sheet for project actions)

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment.

When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage or release of toxic or hazardous substances; or production of noise?

   The intent of the proposal is the provide a plan to reduce flooding and improve water quality within the City. In accomplishing this, some change in stormwater release rates is likely. The plan will not produce an increase in any type of pollution. It offers recommendations on reducing the amount of pollution entering local waters.

   Proposed measures to avoid or reduce such increases are:

   N/A

2. How would the proposal be likely to affect plants, animals, fish or marine life?

   The plan will not directly affect plants, animals, fish or marine life. In adopting the Department of Ecology standards, which require treatment of runoff, the plan will likely have a positive impact of plants and wildlife.

   Proposed measures to protect or conserve plants, animals, fish, or marine life are:

   N/A

3. How would the proposal be likely to deplete energy or natural resources?

   The proposal will not affect energy or natural resources.

   Proposed measures to protect or conserve energy and natural resources are:

   N/A

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection; such

as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

The proposal will not affect sensitive areas.

Proposed measures to protect such resources or to avoid or reduce impacts are:

N/A

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

The plan will recommend that land development follow Department of Ecology standards for stormwater discharge and water quality measures. This will not affect land use.

Proposed measures to avoid or reduce shoreline and land use impacts are:

N/A

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

The plan will likely increase public utility demands by recommending increased maintenance of existing stormwater facilities.

Proposed measures to reduce or respond to such demand(s) are:

N/A

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

The plan will recommend that the City adopt Washington State Dept. of Ecology standards for management of stormwater.