Executive Proposed Basin Plan

Hylebos Creek and Lower Puget Sound

King County
Surface Water
Management

Everyone lives downstream

King County · City of Des Moines · City of Federal Way · City of Kent · City of Milton · City of Tacoma

King County
Department of Public Works

Yesler Building
400 Yesler Way, Room 700
Seattle, WA 98104-2637
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July 28, 1991

TO: Recipients of the Executive Proposed Hylebos Creek and Lower Puget Sound Basin Plan

The Executive Proposed Hylebos Creek and Lower Puget Sound Basin Plan covers 35 square miles and almost 50 miles of streams in southwest King County. The Plan proposes watershed management recommendations to protect aquatic resources and mitigate the increasing hazards and reduce property damage resulting from the rapid urbanization in the planning area. Land use and regulatory changes are recommended to reduce damage to aquatic resources and to property. Capital improvement projects are recommended to reduce peak flows and flooding, erosion and sedimentation, repair aquatic habitat damage, improve water quality, and mitigate human-caused damages. Program management policies are recommended to improve Plan implementation.

The major environmental impacts of this Proposed Plan are positive in that the recommendations will improve surface waters and help prevent future degradation and reduce property damage. Aquatic habitat impacts from instream projects are the greatest environmental concern. However, such projects are proposed only where impacts can be mitigated with fish passage or other design features. Construction of projects also will cause short-term traffic, dust, and noise impacts on adjacent residents.

Pursuant to RCW 43.21C.030(2)(c), a programmatic environmental checklist on the Draft Plan was prepared and circulated to agencies and the public. In accordance with WAC 197-11-340(2), a Declaration of Nonsignificance was issued for the Plan on March 27, 1991. More detailed environmental analysis of recommended actions (if needed) will be conducted before such recommendations are implemented.

These documents are available for review at:

King County Surface Water Management Division
400 Yesler Way, Suite 400
Seattle, WA 98104-2637
Telephone: 296-6519

If you have questions concerning the Plan, please call Roz Glasser, Hylebos and Lower Puget Sound Basin Plan Project Manager, at 296-6519.

Sincerely,

Paul Tanaka
Director

RECYCLED PAPER

EXECUTIVE PROPOSED
HYLEBOS CREEK AND LOWER PUGET SOUND BASIN PLAN

This document was prepared for approval and implementation by the following entities:

- King County Council
- Des Moines City Council
- Federal Way City Council
- Federal Way Water and Sewer District
- Federal Way Board of Commissioners
- Kent City Council
- Milton City Council
- Muckleshoot Indian Tribe
- Lower Puyallup Watershed Management Committee
- Puyallup Indian Tribe
- Seattle Solid Waste Utility
- Tacoma City Council
- Washington State Department of Transportation

Copies of this King County Executive Proposed Plan may be purchased for $15.00 at the locations identified below. Review copies are also available at the Des Moines, Federal Way, and Kent Libraries, and the City of Tacoma Main Library.

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JULY 1991

ACKNOWLEDGMENTS

AGENCIES AND INDIVIDUALS IMPLEMENTING AND/OR CONTRIBUTING TO THIS PLAN

IMPLEMENTING ENTITIES

The effectiveness of any surface water management plan lies in the manner of its implementation. The King County Surface Water Management Division and the following public officials, governmental entities, and individuals are proposed to adopt and implement the measures outlined in the Hylebos Creek and Lower Puget Sound Basin Plan:

King County

King County Executive: Tim Hill

King County Council: Audrey Gruger (District 1), Cynthia Sullivan (District 2), Brian Derdowski (District 3), Lois North (District 4), Ron Sims (District 5), Bruce Laing (District 6), Paul Barden (District 7), Greg Nickels (District 8), and Kent Pullen (District 9)

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ACKNOWLEDGMENTS

(continued)

City of Federal Way

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Kent City Council: Judy Woods, Christi Houser, Paul Mann, Steve Dowell, Jim White, John Johnson, and Leona Orr

Kent Departments and Individuals: Public Works Director Don Wickstrom, City Engineer and Surface Water Program Manager Gary Gill, Planning Director Jim Harris

City of Milton

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Milton City Council: Joe Beltz, Margaret Drotz, Christine Giron, Kent Hamilton, Dan Ruffo, Darlyne Sirack, and Ken Walters

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Muckleshoot Indian Tribe

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Tribal Council: Leroy Courville, Gilbert King George, Yvonne James, Pete Jerry, Elvina Moses, Stanley Moses, Marty Rodriguez, and Brenda Sheldon

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ACKNOWLEDGMENTS

(continued)

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City of Tacoma

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ACKNOWLEDGMENTS

(continued)

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Other King County Agencies: Building and Land Development Division, Office of Open Space; Planning and Community Development Division, Roads and Engineering Division, Resource Planning Section, Seattle-King County Public Health Department, and Prosecuting Attorney

With Special Thanks for Assistance to:

Interagency Technical Advisory Group, who provided advice to the basin planning staff with regard to their areas of concern and expertise. Team members whose comments were particularly helpful included: Tim Sample, Metro; Susan Admundsen, Kent Public Works Department; Russ Ladley, Puyallup Tribe of Indians; Doug Ostermann, Des Moines Planning Department; Mike Krautkramer, PE, Gary Minton, Ph.D., and Steve Weineke, PE, Federal Way Sewer and Water District; Kim Coble and Staff, Tacoma-Pierce County Health Department; Paul Bucich, City of Tacoma; Joe Robel, Washington State Department of Fisheries; David Heiser, Washington State Parks and Recreation Commission; and Robert Aye, PE, Washington State Department of Transportation

Citizen Advisory Committee (CAC), a broad representation of community interests formed in 1989, who met regularly throughout the planning process. The CAC helped educate the community about surface water issues in the basins and provided the Basin Plan staff with valuable insights into problems and appropriate solutions. Members of the Committee included Chair Jean Spohn, Vice Chair Mark Freeland, Cindy Byers, Marguerite Condon, Ted Enticknap, Perry Jones, Larry Minkler, Jeff Paradee, Benjamin Robertson, Leonard Welter, and Leon Woodworth

The General Public, who attended numerous CAC meetings and provided comments on the Conditions Report and Draft Plan that greatly aided both the Basin Plan Team and the CAC in developing the Plan recommendations

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ACRONYMS

BALD	King County Building and Land Development Division
BMP	Best Management Practice
BW	Basinwide Recommendation
CFS	cubic feet per second
CIP	Capital Improvement Project
CS	Central Lower Puget Sound Sub-basin Recommendation
DI	Drainage Investigation Unit of King County SWM Division
DOE	Washington State Department of Ecology
DOH	Washington State Department of Health
EB	East Branch Hylebos Creek Sub-basin Recommendation
FEMA	Federal Emergency Management Agency
HSPF	Hydrologic Simulation Program-Fortran
I-5	Interstate 5
LOD	Large Organic Debris
LSRA	Locally Significant Resource Area
NPDES	National Pollutant Discharge Elimination System
NS	North Lower Puget Sound Sub-basin Recommendation
OHWM	Ordinary High Water Mark
PCBs	Polychlorinated Biphenols
PM&D	Project Management and Design Unit of King County SWM Division
PSWQA	Puget Sound Water Quality Authority
RCW	Revised Code of Washington
RM	River Mile
RSRA	Regionally Significant Resource Areas
SAO	King County Sensitive Area Ordinance
SCS	U.S. Soil Conservation Service
SKCHD	Seattle-King County Health Department
SL	South Lower Puget Sound Sub-basin Recommendation
SR	State Route (highway)
SWM	King County Surface Water Management
US EPA	United States Environmental Protection Agency
WAC	Washington Administrative Code
WB	West Branch Hylebos Creek Sub-basin Recommendation
WSDOT	Washington Department of Transportation

Chapter 1

Executive Summary

CHAPTER 1: EXECUTIVE SUMMARY

INTRODUCTION

For 14,000 years following the last glaciation, the streams in the Hylebos and Lower Puget Sound basins have maintained a dynamic equilibrium. This equilibrium controlled flooding, minimized the erosive power of water, and supported diverse aquatic habitat and clean waters. Destructive storm flows rarely occurred, and the equilibrium enabled the streams to recover before the next large storm. In the last 20 years, however, rapid urbanization has occurred in the area, causing the systems to lose this ability. Destructive storm flows now occur at such a frequency that the available recovery time is insufficient. The streams however cannot be held responsible for the damage to homes and roads that has resulted. On the contrary, it is the impact of rapid human intrusion that has caused the failure of these aquatic systems and damage to the surrounding landscape.

These basins were among the first in the Puget Sound region to experience the full impacts of extensive suburban development. The poor condition of surface waters in the Hylebos Creek and Lower Puget Sound basins is a powerful reflection of the results of extensive and rapid development. In many ways, these basins can be viewed as a microcosm of what can be expected throughout the Puget Lowland without significant changes in management.

Three fundamental lessons have been learned during the study of these basins. First, current methods for mitigating impacts to hydrologic and biologic functions in surface-water systems have not worked. This situation has resulted in a dramatic net loss of stream and wetland functions and values. Second, attempts to correct problems are substantially more expensive than problem prevention. The capital projects recommended in this Plan will cost the public an estimated $11.4 million. Over 75 percent of this total will be needed to restore elements of the natural systems that are necessary to control flows and protect valuable resources, but which were removed or destroyed in the development process. Finally, even with the expense of complete implementation of this Plan, these aquatic systems cannot be fully restored. It will only return flows and stream channels to more stable conditions and prevent further damage as urbanization continues. It is apparent then, that the existing stormwater systems, construction practices, and other factors need to be changed if efforts to stabilize these surface water systems are to succeed.

Purpose of the Basin Plan

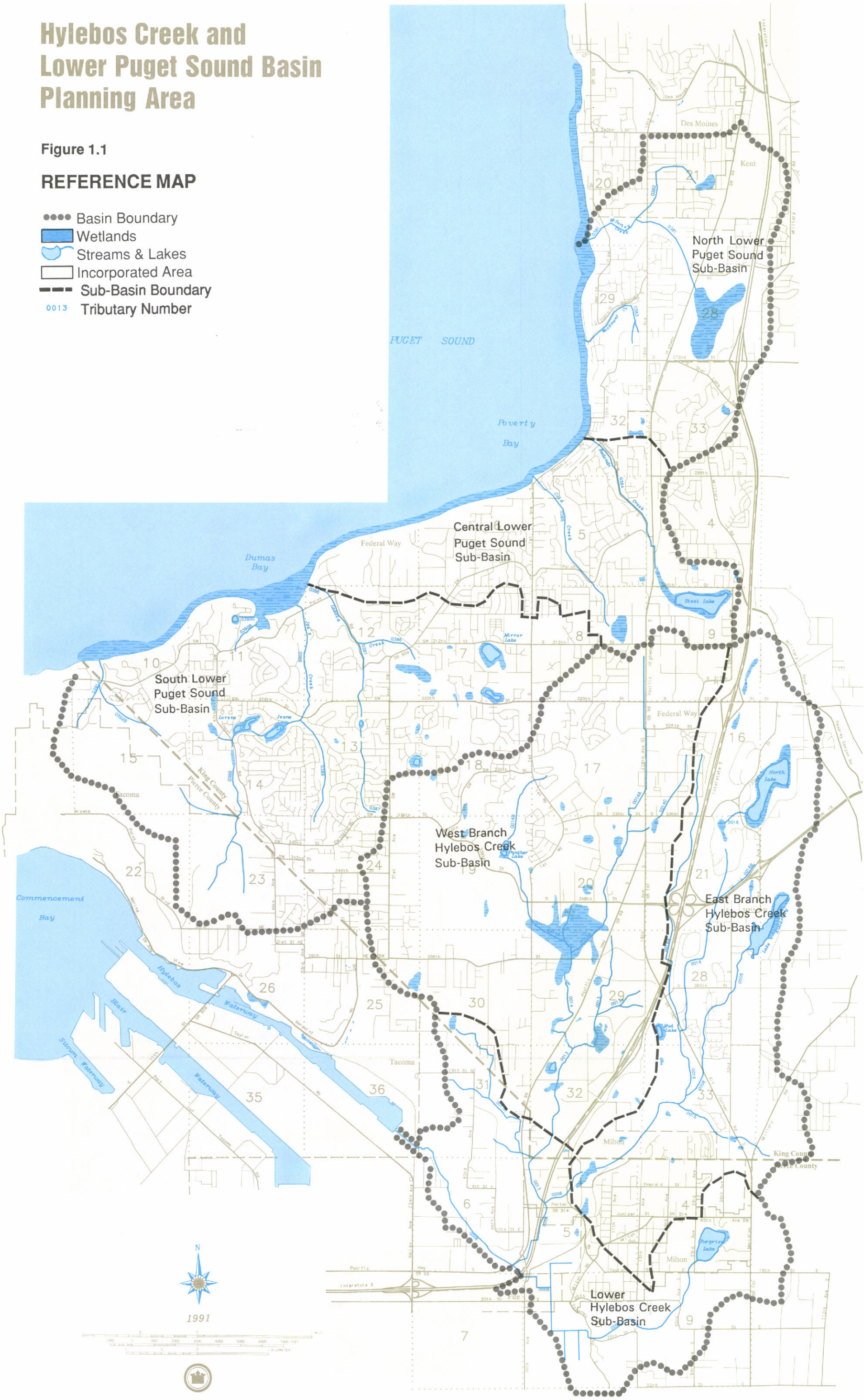
The Hylebos Creek and Lower Puget Sound basins drain over 36 square miles in southwest King County and northwest Pierce County (Figure 1.1). The Plan assesses the condition of aquatic systems in these basins today and predicts future changes based on development patterns. It recommends a variety of management tools that, when fully implemented, will result in long-term stability and protection of significant beneficial uses in the aquatic systems.

Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 1.1

REFERENCE MAP

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Sub-Basin Boundary
- 0013 Tributary Number



The two basins contain over 35 miles of streams, 11 named lakes, and numerous wetlands. Among these water features are regionally and locally significant resource areas. These resource areas include the West Hylebos Wetland, the Spring Valley Wetland, and several stream reaches in the Hylebos Creek basin. In the Lower Puget Sound basin, these resources include a reach in Joes Creek, as well as three marine estuaries,including Dumas Bay and the wetlands at the mouths of Redondo and McSorley Creeks.

The Plan is a blueprint for immediate actions needed to reduce flooding, erosion, and sedimentation; to improve water quality; and to protect these resource areas. In addition to unincorporated King County, the other entities in the basins who have been involved in planning joint action to implement the Plan include Federal Way, Des Moines, Kent, Milton, Tacoma, the Federal Way Water and Sewer District, the Washington State Department of Transportation (WSDOT), and the Puyallup and Muckleshoot Indian Tribes. Pierce County is developing a stormwater management plan for its portion of the planning area. The draft of this plan was published in March of 1991. A final plan is expected to be available the Fall of 1991.

The Need for the Basin Plan

Significant and rapid land-use changes are causing severe degradation of the surface water resources in the Hylebos Creek and Lower Puget Sound basins. A basin plan is needed to define the best management strategies to control this degradation. The most critical areas of concern are described below:

Reduce Flooding

Following extensive urbanization of the drainage basins, Hylebos Creek and the streams in the Lower Puget Sound basin are flooding more frequently and at higher levels than in the past. Inundation of homes in several areas, including Twin Lakes, S 336th, S 363rd, and S 373rd Streets, is becoming increasingly common. During these episodes, major transportation arteries, such as S 320th and S 356th Streets are flooded, causing disruption of the large traffic volumes and potentially interfering with emergency vehicle access.

Restore/Enhance Key Aquatic Systems

The stream and wetland systems remaining in the basins are either severely degraded or threatened by erosion, sedimentation, and high pollutant loads. Some of the threatened systems include the West Hylebos Wetland, East Branch Hylebos Creek ravine, lower Joes Creek, and Dumas Bay. These areas still provide habitat for a rapidly declining salmonid population, which is itself affected by these same problems. Correction of these conditions will also reduce other problems such as sedimentation and pollution in Puget Sound.

Balance Human Natural Resource Needs

The Plan focuses management efforts where flooding of structures and roads is significant, and where the resources are most valuable. However, a watershed is a complete and integrated system that includes wetlands, lakes, and streams. The stability of these systems during floods, a healthy fishery, and clean water all depend on each component functioning well. The Plan seeks to identify how improvement and protection of each disturbed surface-water component can be best achieved, and what minimum level of protection is necessary for the remaining, less disturbed components of the system.

Predict Impacts If Management Actions are Not Taken

The following conditions are predicted for the near future if no action, or incomplete action, is taken:

- Flows in some sensitive stream reaches will more than double, thereby increasing the frequency and magnitude of flooding. Typically, a flood that now occurs on average once every 100 years will occur on average once every 5 years;

- Instream erosion and fine sediment will increase and continue to degrade key habitat by clogging and cementing spawning gravels;

- The decline of fish and wildlife populations will continue to accelerate due to habitat destruction causing irretrievable losses of these valuable resources;

- Groundwater supplies will continue to be diminished due to insufficient recharge of aquifers with stormwater.

- Water quality, which already has been observed at levels that significantly exceed state water quality standards, will continue to degrade from heavy metals, oils, nutrients, and bacteria.

Basin Plan Recommendations

- The Plan recommends a comprehensive program for drainage basin management to be implemented jointly by King County; the Cities of Des Moines, Federal Way, Kent, Milton, and Tacoma; the WSDOT; and the Puyallup and Muckleshoot Indian Tribes.

- No single approach can effectively address the broad range of surface water issues in the basins. Therefore, the following multi-objective management strategy is recommended:

  1. Land Use Controls - Institute or maintain low density (1 unit per 5 acres) zoning restrictions for areas adjacent to significant fish habitat;

  2. Development Regulations - Control development impacts through the use of stream and wetland buffers, clearing limitations, and locally enhanced stormwater controls;

3. Code Enforcement and Penalties - Increase the enforcement of drainage controls and the penalties for code violations;

4. Capital Facilities - Construct 33 flow-control and habitat improvement projects including six new regional stormwater detention ponds, seven channel stabilization projects; and 20 other projects to reduce flooding and erosion, and improve water quality and habitat;

5. Education and Incentives - Initiate educational and incentive programs to encourage broad range public involvement in protecting surface water resources;

6. Monitoring - Monitor stream flow, sediment flux, water quality, and habitat conditions to evaluate the long-term success of all programs and to identify new conditions that require adjustments in management strategy; and

7. Stream Steward - Hire a Stream Steward to facilitate project implementation, to conduct education and citizen involvement programs, and to monitor basin management activities throughout the basins.

Benefits of the Basin Plan

- When implemented, the Basin Plan will significantly reduce flood-related losses and safety hazards to buildings and roads by improving flood storage and conveyance.
- The Plan will significantly reduce property damage due to erosion and sedimentation.
- Implementation of the Plan recommendations will greatly improve the protection of valuable natural resources in the basins and restore them where possible. It will minimize many aquatic habitat and water quality problems that have damaged, or threaten to damage, the viability of the basins' stream and wetland systems and affect public use and enjoyment of these systems.

Basin Plan Capital Costs

- The estimated cost in 1990 dollars for all capital projects is $11.4 million. No estimate is made for regulatory or other program elements. These costs will be determined following further review and concurrence by all cooperating jurisdictions.

Funding for the Basin Plan

- The distribution of costs for implementing the recommended capital projects will be determined following further review and consultation with the entities involved during review of this Plan.

- In order to distribute costs equitably, efforts will be made to fund projects jointly when they occur in more than one jurisdiction.
- Efforts will be made to integrate capital projects with other projects, such as the development of park and open space areas.
- All regulatory and management costs will be the responsibility of each separate jurisdiction. In some cases, these costs can be shared.
- In addition to local sources, state Centennial Clean Water grants or other grants may be available as supplemental sources of funding.

Chapter 2

Introduction

CHAPTER 2: INTRODUCTION

2.0 BACKGROUND

The Hylebos Creek and Lower Puget Sound basins are located in southwest King County (Figures 2.0.1 and 2.0.2). The Basin Plan for this area follows several years of field observation, computer simulation modeling of stormwater runoff patterns throughout the two basins, and analysis of current and future conditions by a team of engineers, biologists, geologists, planners, hydrologists', water quality specialists, and the basins' residents. These evaluations led to preparation of the Hylebos Creek and Lower Puget Sound Current and Future Conditions Report, published in August 1990 (King County, 1990a). Before this report was made final, it received broad review from the public and government entities in the planning area. The problems identified in the Conditions Report formed the technical basis for both the issues addressed in the Basin Plan and the nature of its recommended solutions.

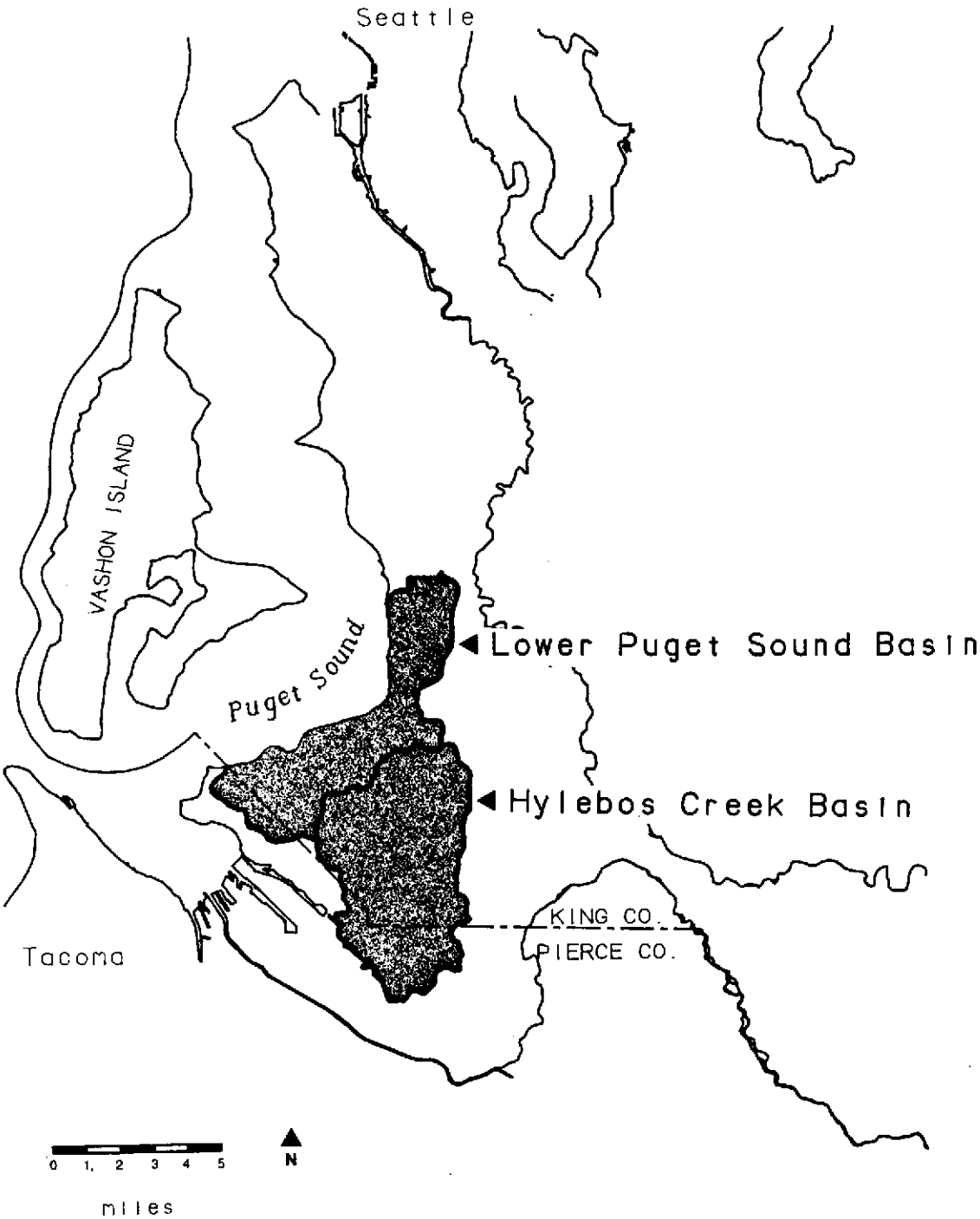
Briefly, the Conditions Report stated that the Hylebos Creek and Lower Puget Sound basins are experiencing severe effects from flooding, channel erosion and sedimentation, habitat destruction, and deteriorating water quality. In contrast, several systems within these basins were once among the most productive salmon producing streams in central Puget Sound. The conditions causing these problems include increased peak flows and flow durations due to development, increased erosion, loss of riparian (streamside) and aquatic habitat, and nonpoint source water pollution.

The objectives of the Basin Plan are to reduce current threats to public safety, to protect beneficial uses of stream resources, to minimize the likelihood of future flooding and erosion, and to improve water quality. These objectives can be achieved by a combination of capital projects and regulatory, policy, and procedural changes among the entities in the two basins. These entities include unincorporated King county, Des Moines, Federal Way, Kent, and Milton; the portion of the City of Tacoma in the basins; and the two tribes with historic interests in the basins, the Muckleshoot and Puyallup Indian Tribes. Recommendations are also made for the Washington State Department of Transportation and the Federal Way Water and Sewer District. Surface water problems in the remaining Pierce County portion of the basins will be addressed by Pierce County in the draft Pierce County Stormwater Master Plan and the Lower Puyallup Watershed Action Plan, expected to be completed in March 1991 and in 1992, respectively.

Prior to this Plan, the "Pacific Highway South Drainage Study, Federal Way, Washington," (Kramer, Chin and Mayo, 1979), "The Comprehensive Plan Augmentation for the West Campus Property Federal Way" (Wilsey and Ham, 1979), and the "South 356th Street Drainage Study" (King County 1990), guided areawide stormwater facilities development in the planning area. Proposed projects identified in tnese prior detailed drainage plans should be reviewed in the context of this Basin Plan before project implementation.

Figure 2.0.1

HYLEBOS CREEK AND LOWER PUGET SOUND BASINS
LOCATION MAP

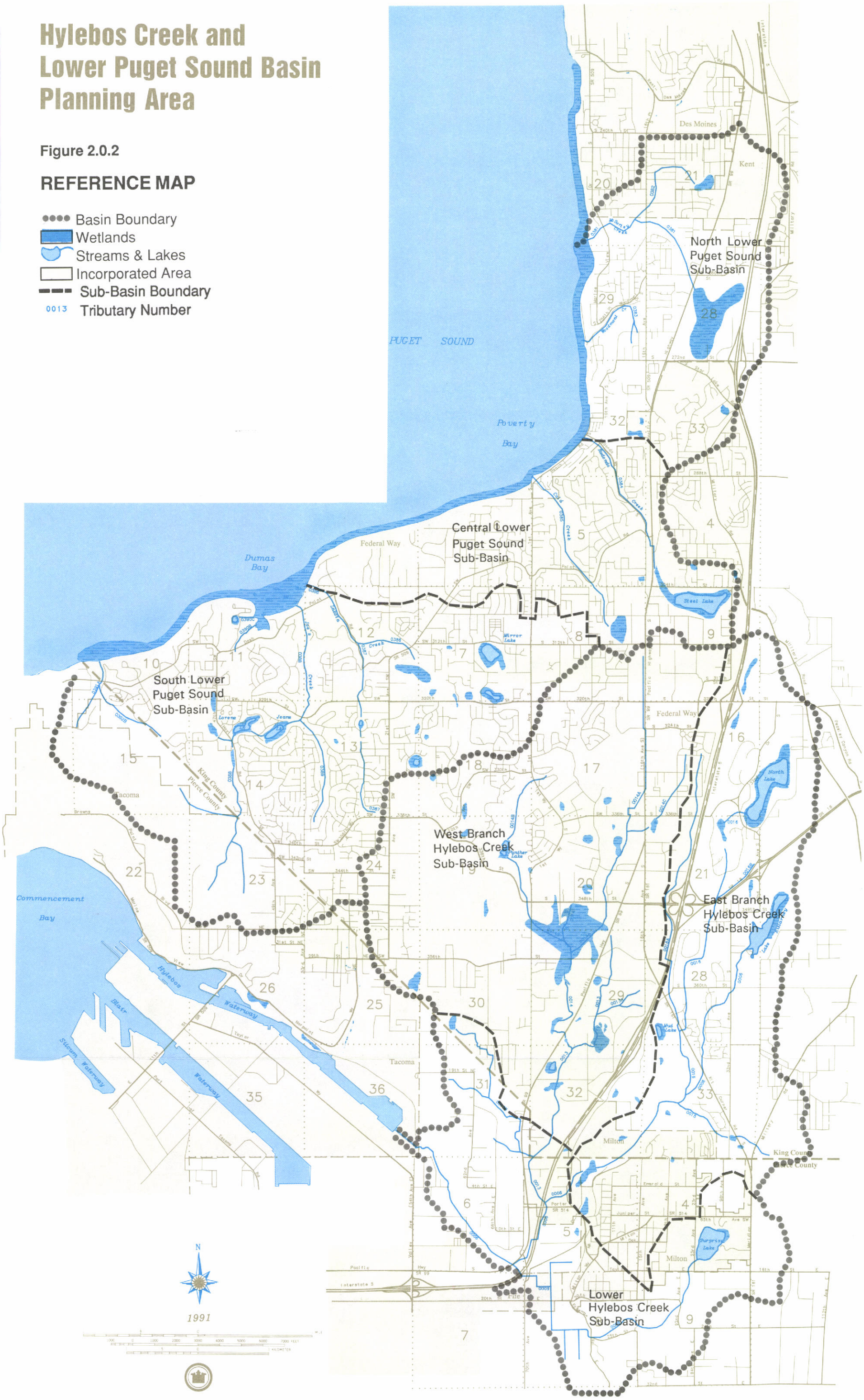


Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 2.0.2

REFERENCE MAP

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Sub-Basin Boundary
- 0013 Tributary Number



2.1 PLAN APPROACH AND CONTENT

Plan Approach

The current surface water problems in the basins and the recommended solutions in the Basin Plan reflect the nature and intensity of urban development in the planning area. Intense urbanization in Federal Way, and to a lesser extent throughout both basins, has caused severe drainage-related problems and has significantly impacted several areas of previously high-quality fish habitat.

Recommendations in the Basin Plan address surface water conditions that threaten public and private property and human health and safety, as well as the protection of the remaining natural resources in the drainage basins.

The rate of past urbanization in these basins, and its projected continued growth, suggest that both remedial and preventive measures are needed to address the full range of current and future problems. Management strategies to reduce flooding, control water pollutants, and protect remaining aquatic resources must be enacted rapidly if they are to be effective. As the frequency and magnitude of stormflows increase, property losses and disruption of transportation patterns will intensify, erosion of already unstable stream channels and streambanks will escalate, and water quality will continue to degrade. In many areas, another storm of the same magnitude as the January 1990 event and similar events since then would virtually eliminate most opportunities for resource preservation or restoration.

A principal objective of this Plan is to choose management strategies that minimize the effects of urban development by focusing efforts where flood losses can be reduced, where water quality can be most effectively managed, where the resources are most valuable, and where resource impacts are least damaging. Yet a watershed is an integrated system; stable stream channels, healthy fishery, and clean water depend on all components functioning well. This Basin Plan seeks to identify which watershed components are most critical, how protection of those components can be best achieved, and what level of protection is necessary to significantly reduce or eliminate degradation in the remainder of the system.

The Basin Plan team, with the assistance of city and agency staff, the Hylebos/Lower Puget Sound Citizen Advisory Committee, and the general public, identified the significant problem sites. Similarly, the Draft Plan with recommended solutions was broadly distributed to agencies and the public for comment. Revisions from these comments have been included in this Executive Proposed Plan. The full text of comments and responses is in Appendix A.

The recommended solutions in this Plan include zoning, operational, and regulatory solutions, as well as Capital Improvement Projects (CIPs). In combination, they provide a comprehensive, systemwide blueprint for reducing drainage-related hazards, correcting existing and anticipated impacts from urban development, and protecting fishery resource areas that are both valuable and increasingly scarce throughout the region.

These resource areas include aquatic resources of significance not only to the planning area but also to the entire Puget Sound region. It is essential that

the most significant habitats are protected both for their inherent value to the fish and wildlife and because they can form the basis for stabilization of animal populations in the future. In addition, when key habitats are considered, their value in analyzing alternative solutions can avoid significant environmental impacts due to the presence, or absence, of capital improvement projects. The significant resource areas in the Hylebos Creek and Lower Puget Sound basins are listed below. They are categorized according to whether they have local or regional value and are mapped in Figure 2.1.1. The noted criteria for determining these areas are discussed further in Section 2.4, Plan Criteria.

Regionally Significant Resource Areas:

Dash Point (40 acres) - Lower Puget Sound Wetland #7 (Criterion 2)
Important Puget Sound estuarine habitat; high public use areas.

Dumas Bay (90 acres) - Lower Puget Sound Wetland #51 (Criterion 2)
Critical estuarine habitat for Puget Sound; low level of human intrusion.

East Branch Hylebos Ravine (80 acres) - RM 6.0 to 6.75 of tributary 0006 (Criterion 2)
Riparian and instream areas reminiscent of pre-development conditions; high levels of large woody debris in stream.

West Hylebos Wetland (120 acres*) - Hylebos Wetland #18 (Criterion 2)
Large forested wetland with high diversity of vegetation and wildlife; extensive peat deposits; high public concern.

*Wetland acreages are estimates. Precise acreages, currently unavailable, can be determined when wetlands are delineated.

Locally Significant Resource Areas:

Lower Joes Creek (70 acres) - RM 0.0 to 0.8 of tributary 0388 (Criteria 1, 2, 3)
Extensive reach of stream with wide riparian corridor; moderate use by salmonids.

Redondo Beach (25 acres) - Lower Puget Sound Wetland #61 (Criterion 2)
Important Puget Sound estuarine habitat.

Salt Water State Park (40 acres) - Lower Puget Sound Wetland #21 (Criterion 2)
Important Puget Sound estuarine habitat; high public use areas.

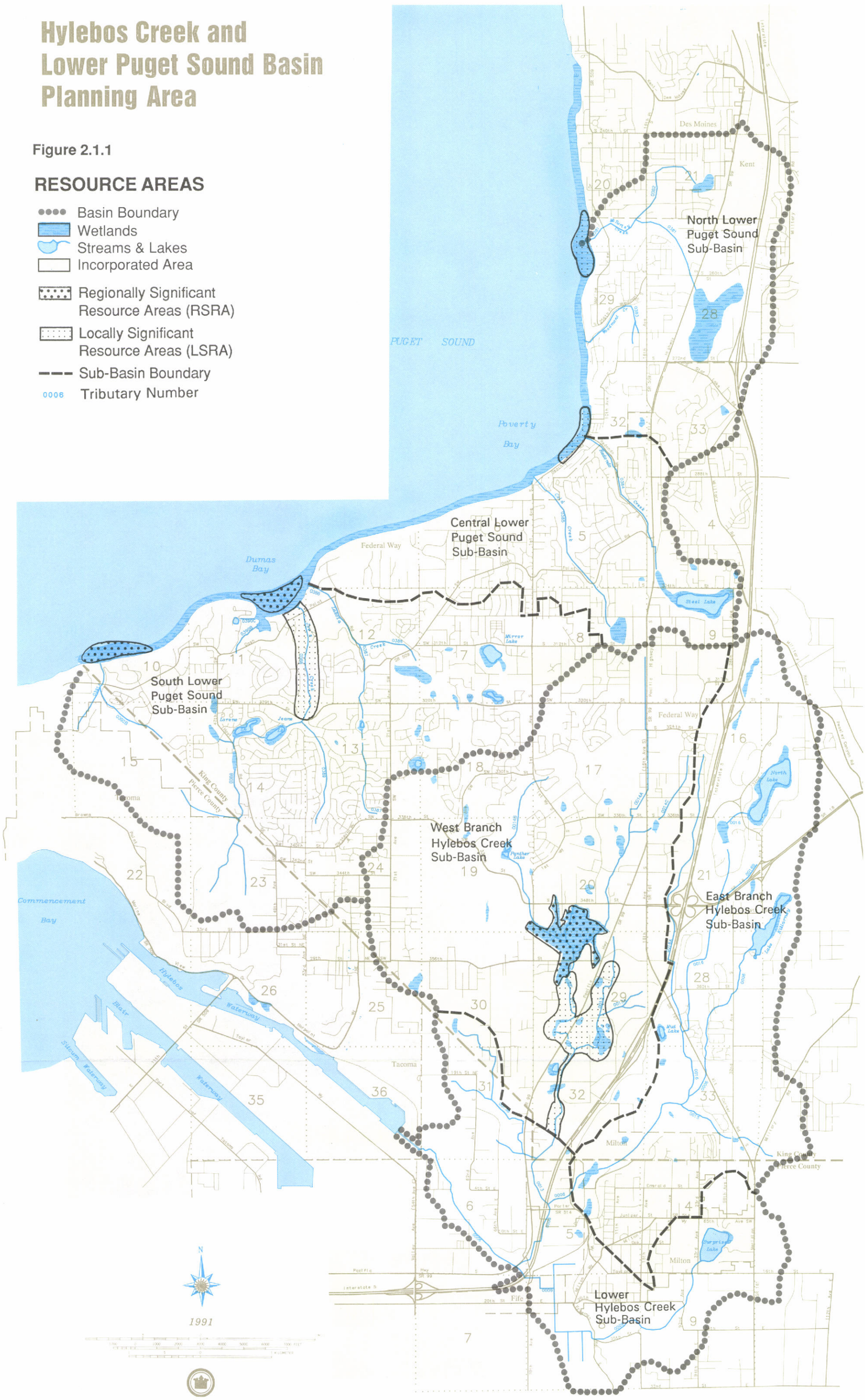
Spring Valley Wetland (Uninventoried; 95 acres) - RM 1.55 to 2.45 of tributary 0013 (Criteria 1, 2, 3)
Large forested wetland/spring/stream system; stream has high level of stability and moderate use by salmonids with potential for higher usage.

Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 2.1.1

RESOURCE AREAS

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Regionally Significant Resource Areas (RSRA)
- Locally Significant Resource Areas (LSRA)
- Sub-Basin Boundary
- 0006 Tributary Number



West Branch Hylebos Creek (70 acres) - RM 0.0 to 0.9 of tributary 0014 (Criteria 1, 2, 3)
Intact riparian corridor; high potential to stabilize channel and improve salmonid use.

West Branch Hylebos Creek (30 acres) - RM 0.6 to 1.55 of tributary 0013 (Criteria 1, 2, 3)
Intact riparian corridor; high potential to improve salmonid use through upstream drainage controls and local efforts; includes riparian corridor for connection with upstream RSRA and LSRA.

Organization of the Plan

This document analyzes both present and future conditions in the basins, assesses drainage-related problems, and recommends solutions as follows:

Chapter 1: Executive Summary

Chapter 2: Introduction - This chapter summarizes conditions in the basins, summarizes the Plan recommendations, describes criteria used in developing the Plan, discusses plan-related interjurisdictional coordination issues, and includes recommendations from the Hylebos/Lower Puget Sound Citizen Advisory Committee (CAC).

Chapter 3: Basinwide Recommendations - This chapter identifies regulatory, policy, and program recommendations such as onsite detention standards, sensitive area protection, water quality controls, and public education programs. The recommendations can help control future flooding and address the basinwide degradation of stream and wetland systems from impacts to water quality, aquatic habitat, and stream channel stability.

Chapter 4: Sub-basin Recommendations - This chapter details the nature and location of recommended Capital Improvement Projects (CIPs); policy and regulatory changes; and studies judged necessary to correct significant problems such as flooding at Panther Lake, Twin Lakes, and S 373rd Street.

Chapter 5: Basinwide Overview - This chapter summarizes the land use, geology, hydrology and hydraulics, habitat, and water quality in the basins. This analysis provides the basis for both problem recognition and the recommendations of this Basin Plan. More detailed information on basin conditions and identified problems may be found in the Hylebos Creek and Lower Puget Sound Current and Future Conditions Report (King County, 1990a).

Appendix A: Public Comments and Responses - This appendix includes the comment letters on the Draft Plan and responses to each comment.

Appendix B: Stream and Wetland Definitions - This appendix defines "stream" and "wetland" and their various classes as applied to this Plan.

Appendix C: Modeled HSPF Flow Frequencies and Durations by Subcatchment -This appendix outlines the subcatchment network by sub-basin.

Appendix D: Modeled HSPF Flow Frequencies Under Various Land Use Scenarios - This appendix displays the numeric output of the HSPF model for a range of peak annual flow frequencies by subcatchment by five land use scenarios. These scenarios include: forested, predeveloped conditions; 1987 land use; future land use without detention; future land use with Plan recommendations for all CIPs and onsite detention; future land use with the Plan recommendations for regional CIPs; and onsite detention-sized with 7-day storms on till in pre-forest conditions.

2.2 SUMMARY OF BASIN CONDITIONS

The two basins in the planning area, Hylebos Creek and Lower Puget Sound, are divided into six sub-basins: West Branch, East Branch, and Lower Hylebos Creek; and North, Central, and South Lower Puget Sound (Figure 2.0.2).

Hylebos Creek Basin

The Hylebos Creek basin consists of three sub-basins, the West Branch, the East Branch, and Lower Hylebos Creek. This basin drains 18 square miles of the planning area through more than 25 miles of streams. The Hylebos Creek basin is generally a low gradient system. It flows south from the headwater areas in Federal Way and North Lake, which flank both sides of I-5, through a full range of land uses.

Land use in this basin is dominated by commercial areas, and single- and multi-family residences. The upper part of the basin in Federal Way is heavily urbanized. Moderate- to low-density single-family land use is extensive in the East Branch sub-basin and lower reaches of the West Branch sub-basin. Agricultural activity is more localized in the East Branch and in the floodplain of lower West Branch. Farther downstream in Pierce County, the main stem of Hylebos Creek, formed by the East and West Branches, flows through mixed agricultural and heavy commercial land uses in the valley prior to entering the industrialized Hylebos Waterway and Commencement Bay.

The headwaters of West Branch Hylebos Creek sub-basin contain the most intensively developed areas in the planning area and form Federal Way's commercial center. Surface-water features in this area have undergone the greatest modification of any in the two basins. These modifications include the filling of major wetlands and piping of streams. This part of the system generates pollutants and high flows which severely degrade water quality. Similarly, high peak storm flows and poor water quality come from the West Campus commercial and residential development in the upper western part of the sub-basin. Combined flows from West Campus and the Federal Way commercial center have flooded several residences and major arterials, while causing severe disruption of traffic movement. Storm flows have also deteriorated water quality in and downstream of the West Hylebos Wetland and destabilized some of the highest quality fish habitat remaining in the planning area.

East Branch Hylebos Creek is more rural in character. However, storm flows generated in its upper reaches are also flooding residences and other structures in the middle reaches along SR 161 and in Milton. The lower portion of the sub-basin, in Milton, contains a large ravine. The channel in this reach is stabilized by substantial large organic debris (LOD) with very good fish habitat and a superior riparian corridor. However, this reach is also highly susceptible to the erosive forces from peak storm flows originating upstream.

Lower Hylebos Creek flows through a broad floodplain area along I-5 in Pierce County. Flooding in this sub-basin has intensified due to urbanization in the upper basin. Stormwater inundated a portion of I-5 during the January 1990 storm, seriously disrupting traffic flows for several days. Floodplain

filling and artificially created channel constrictions have further decreased the ability of this floodplain to accommodate peak flows. Habitat areas have also been reduced and degraded by stream filling, channelization, and sediment deposition. This reach is now primarily only a fish migration route. Interestingly, one segment contains freshwater mussels, which are generally considered indicative of high water quality. Downstream along Hylebos Waterway, however, the water quality declines significantly due to pollutant discharges from industrial activity.

Lower Hylebos Creek sub-basin is included in this discussion for purposes of describing the overall basin. However, recommendations for this sub-basin are not part of this Plan. The Pierce County Stormwater Master Plan will address surface water problems in this area. The Draft Plan was published in March 1991, and their Final Plan is expected to be available in the Fall of 1991.

Lower Puget Sound Basin

The Lower Puget Sound basin includes three sub-basins: the North, Central, and South. These sub-basins are similar. They drain almost fully developed residential areas on a plateau and slope adjacent to Puget Sound. The North Lower Puget Sound sub-basin is the least developed. This is reflected particularly in McSorley Creek, which still supports several good salmon spawning areas. However, storm flows have eroded an upper channel reach and washed significant nutrient loads into its upper reaches and the floodplain in Saltwater State Park. Due to an almost total absence of LOD, Woodmont Creek functions primarily as a stormwater conveyance channel. Severe bank erosion and local bank failures are observed in several other areas adjacent to locations of lateral filling.

In the Central Lower Puget Sound sub-basin, Redondo Creek and Cold Creek are impacted by high storm flows and affected by poor water quality resulting from significant concentrations of heavy metals, bacterial, nutrients, and solids from residential and commercial sources. Due to a combination of steep gradients and susceptibility to erosion, Redondo Creek is one of the most severely incised channels in the planning area. Fish habitat occurs only in a small reach. On Cold creek, flooding of a retirement center at the outlet of Easter Lake has nearly occurred. The creek itself has been substantially altered through piping and channelization. Where these alterations are combined with high peak flows, the channel has been stripped of habitat complexity. Almost a complete loss of fish habitat has resulted.

In the South Lower Puget Sound sub-basin, Lakota Creek, Joes Creek, and several smaller drainages are also easily eroded and prone to streambank incision, local bank failures, and heavy sediment deposition. This sub-basin has the most degraded water quality of all sub-basins sampled. Water quality samples from Joes and Lakota Creeks showed high concentrations of metals, bacteria, nutrients, and solids. In Lakota Creek, erosion problems are further exacerbated by roads and pipelines placed next to the channel, which constrain flows and increase velocities near streambanks. Lakota Creek does, however, continue to support some salmonid spawning activity due largely to enhancement efforts by the Federal Way Sewer and Water District.

Both tributaries of upper Joes Creek are subject to high peak storm flows. On the west branch, these flows flooded residences in the Twin Lakes development twice in 1990. Despite significant channel and bank erosion in the reaches of Joes Creek immediately downstream of Twin Lakes, good stream habitat remains in several areas. The lowermost portion of the creek contains the largest and best quality reach of spawning and rearing habitat in the basin. Nonetheless, this reach is threatened by sediment deposition, channel aggradation, and trash. Three other small streams west of Joes Creek have generally good riparian corridors and stable channels; however, they lack sufficient LOD to support fish spawning or rearing.

These three western tributaries, together with Joes Creek and Lakota Creek, flow into Dumas Bay. This bay, and excellent marine estuarine environment and wildlife sanctuary, is threatened by the large volumes of pollutant-laden sediment entering from these tributaries.

Throughout the planning area, future storm flows are expected to continue to increase in proportion to continued development. The greatest flow increases in the Hylebos Creek basin, are expected in the undeveloped portions of the East Branch and lower West Branch. If these areas are built out, flows are predicted to double in these streams. In the Lower Puget Sound basin, which is already substantially built out, similar flow increases are anticipated only in a few areas that are not currently developed, particularly upper Joes Creek in Pierce and King Counties.

2.3 SUMMARY OF THE RECOMMENDED PLAN

The objectives of the Hylebos Creek and Lower Puget Sound Basin Plan are: 1) to solve existing stormwater problems; 2) to prevent future problems from occurring; 3) to protect and improve aquatic habitat, whenever feasible; and 4) to encourage groundwater recharge. The Plan recommends a comprehensive surface water management program that relies on a combination of regulations, land-use density controls, code enforcement, incentives, education, and capital improvement projects (CIPs) to protect surface water resources. This program will significantly reduce problems due to flooding, erosion, sedimentation, degradation of aquatic habitat, and water quality.

Thirty-two significant problem sites are identified. Thirty-three CIPs and twenty-four program and regulatory recommendations are made to solve these problem conditions. The cost for all recommended projects is estimated at over $11.4 million. Specific sub-basin recommendations along with forty-three basinwide recommendations address conditions which supplement the effectiveness of the capital projects.

Briefly, the Plan recommends:

- Regulatory limits on clearing, filling, and grading to reduce sedimentation in streams and wetlands and increase groundwater recharge;
- Standards for stormwater detention ponds that are generally stricter than the current standards to prevent excessive storm flows from future development;
- Rural land-use densities along the portions of Joes and Hylebos Creeks with significant resource value to reduce damage to aquatic habitat and biotic functions;
- A water quality improvement program to reduce pollution from residential, commercial, and industrial activity; commercial development; roads; and stormwater facilities;
- Public education programs, such as streamside Best Management Practices (BMPs) brochures and incentive programs, such as sensitive area current-use taxation, to encourage public involvement in resource protection;
- Stream stabilization projects along reaches of Lakota, Joes, and Hylebos Creeks, including projects for streambank revegetation, fencing of a livestock-damaged reach, and improvement of instream habitat complexity; and
- Flow, erosion, and water quality improvement projects including:
  - five new regional detention facilities to reduce peak flows to stream stabilizing levels in Hylebos Creek and Joes Creek;
  - retrofit of three existing detention facilities to prevent local flooding and improve water quality in Hylebos Creek, McSorley Creek, and upper Lakota Creek; and

- a pipeline to carry flood flows from Twin Lakes to Joes Creek.

- Water quality investigations to identify major sources of pollutants in Redondo Creek and West Branch Hylebos Creek;

- Culvert upgrades on Hylebos, McSorley, and Cold Creeks to improve conveyance and prevent local flooding of roads and homes;

- Improved enforcement of, and higher monetary penalties for, violations of County and City codes;

- A Stream Steward to coordinate Plan implementation; and

- A monitoring and update program to track the success of the Basin Plan.

Summary Figures and Tables of Problems and Solutions

The following figures and tables summarize the nature and location of area-specific problems in the two basins and their recommended solutions.

Figure 2.3.1 - Problem Locations

This figure shows the location of the 32 significant problem sites in the basins.

Figure 2.3.2 - Project Locations

This figure shows the location of the 33 CIPs and studies recommended in the basins.

Tables 2.3.1a and b - Summary of Significant Problems

These tables summarize the conditions at each significant problem site identified in Figure 2.3.1. Significant problems are grouped into three categories of importance; however, these problems are not ranked within each category.

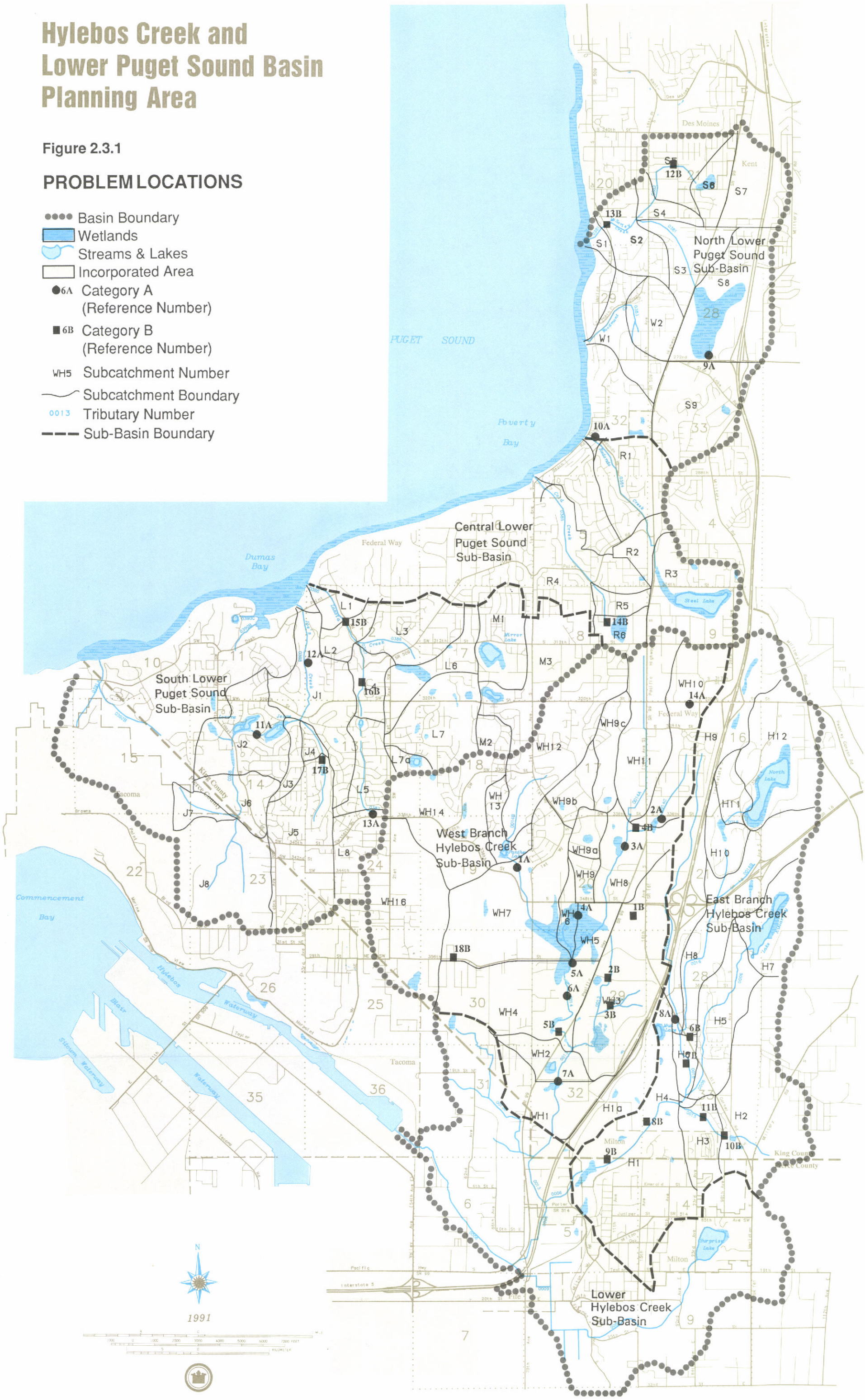
In general, problems considered to be an immediate threat to public health and safety or significant resources were ranked most important and placed in Category A. Conditions posing a potential threat to public health and safety or to high-quality aquatic habitat were ranked next highest and placed in Category B. The remaining problems identified in the basins are included in Category C. Category C problems are not addressed in this Plan because they do not meet Category A or B criteria. The list of Category C problems, and further information regarding all problems, may be found in King County, 1990a and King County, 1990e. These documents will be provided to all entities involved. For more detailed information on the criteria used to determine significant problems, refer to Section 2.4.

Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 2.3.1

PROBLEM LOCATIONS

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- 6A Category A (Reference Number)
- 6B Category B (Reference Number)
- WH5 Subcatchment Number
- Subcatchment Boundary
- 0013 Tributary Number
- Sub-Basin Boundary



Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 2.3.2

PROJECT LOCATIONS

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- 2431 Project Location & Number
- WH7 Subcatchment Numbers
- Subcatchment Boundary
- Sub-Basin Boundary
- 0388 Tributary Number

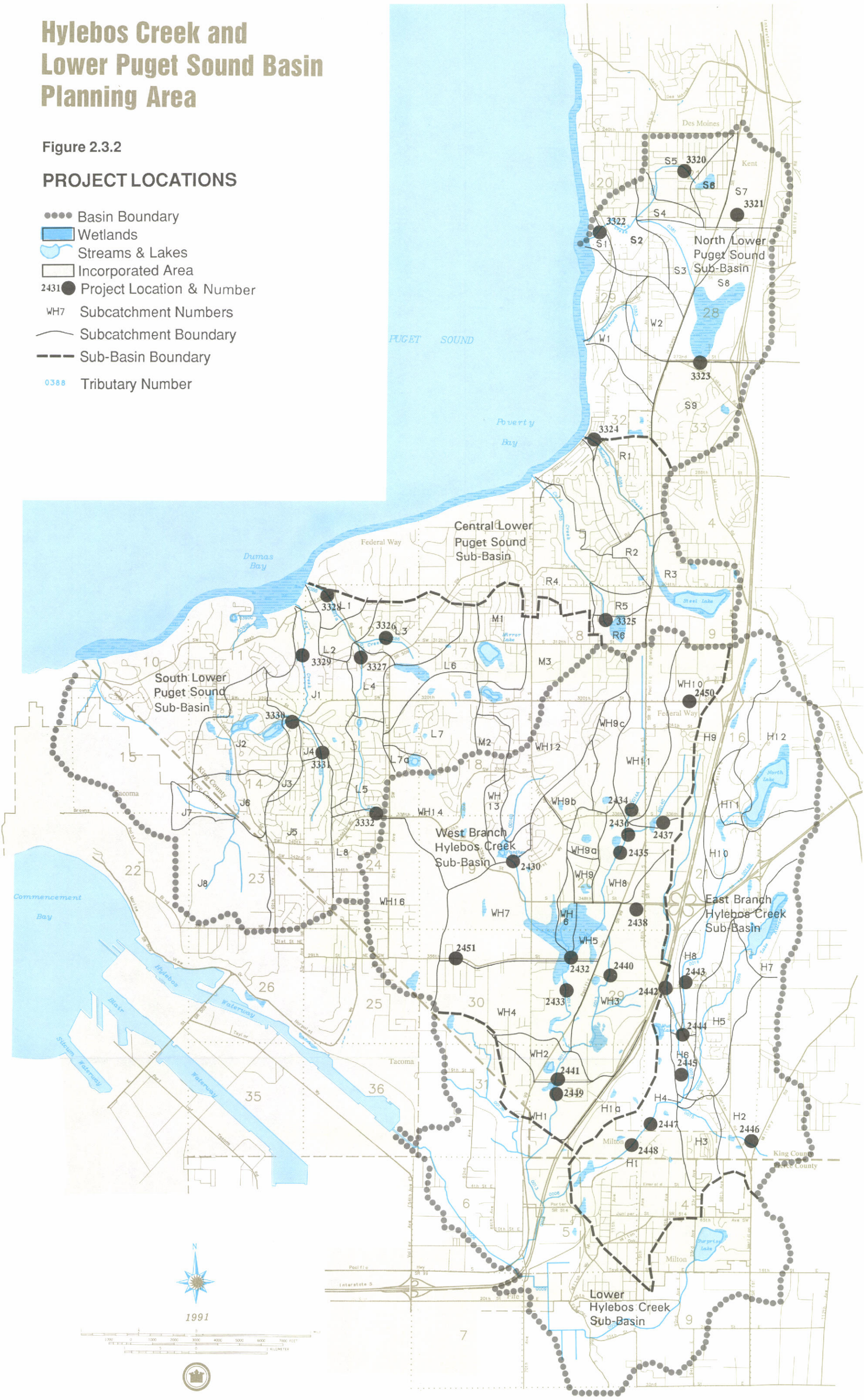


TABLE 2.3.1a
HYLEBOS CREEK AND LOWER PUGET SOUND BASINS
SIGNIFICANT PROBLEMS - Category A

REFERENCE NUMBER	LOCATION NAME	SUBCATCHMENT	TRIBUTARY	RIVER MILE	PROBLEM DESCRIPTION
1A.	PANTHER LAKE & TRIB 0014B	WH12, WH13, WH14, WH15	0014B	0.00 - 0.97	DOWNSTREAM FLOODING OF ROAD CROSSINGS; DOWNSTREAM CHANNEL EROSION; IMPACT TO WEST HYLEBOS WETLAND; LOSS OF PANTHER LAKE WETLAND FUTURE IMPACTS FROM HIGH FLOWS; DEGRADED WATER QUALITY
2A.	S 336TH ST & TRIB 0014C FLOODING	WH10	0014C	0.34	HOUSES AND ROADS FLOODED
3A.	TRIB 0014A EROSION/SEDIMENTATION	WH8, WH11	0014A	0.40 - 1.25	CHANNEL EROSION; SEDIMENTATION IMPACTING WEST HYLEBOS WETLAND & BROOK LAKE
4A.	WEST HYLEBOS WETLAND	WH5, WH6, WH7	0014 0014A 0014B	NA	THREAT TO REGIONALLY SIGNIFICANT RESOURCE AREA; DEGRADED WATER QUALITY BELOW BROOK LAKE FROM UNKNOWN UPSTREAM SOURCES
5A.	S 356TH ST & TRIB 0014 FLOODING	WH5, WH6, WH7	0014	1.09	ROAD OVERTOPPING
6A.	TRIB 0014 RAVINE	WH4	0014	0.50 - 0.80	CHANNEL EROSION & HABITAT LOSS; FUTURE IMPACTS TO HABITAT FROM HIGH FLOWS
7A.	S 373RD ST & TRIB 0013	WH2	0013	1.00 - 1.55	HOUSE AND ROAD FLOODED; LOSS OF SPAWNING AREA & CHANNEL CAPACITY; SEDIMENTATION; DEGRADED HABITAT; DEGRADED WATER QUALITY
8A.	S 363RD PLACE/SR 161 & TRIB 0016A FLOODING	H9	0016A	0.10 - 0.25	HOUSE AND STREETS FLOODED

TABLE 2.3.1a (continued)
HYLEBOS CREEK AND LOWER PUGET SOUND BASINS
SIGNIFICANT PROBLEMS - Category A

REFERENCE NUMBER	LOCATION NAME	SUBCATCHMENT	TRIBUTARY	RIVER MILE	PROBLEM DESCRIPTION
9A.	STAR LAKE RD/S 272ND ST FLOODING	S9	0381 Headwater	NA	UNDERSIZED CULVERTS AND INADEQUATE ONSITE DETENTION; ROAD FLOODING
10A.	REDONDO CREEK DEGRADED WATER QUALITY	R1, R2	0384	0.00 - 1.00	SIGNIFICANTLY DEGRADED WATER QUALITY NEAR SR 509 DOWN TO PUGET SOUND
11A.	TWIN LAKES FLOODING	J2	Jeane Lk. Lorene Lk.	NA	FLOODING OF LAKESIDE HOMES; SEDIMENTATION OF LAKES; PROPERTY DAMAGE AT LAKE OUTLET FUTURE IMPACTS FROM HIGH FLOWS
12A.	LOWER JOES CREEK HABITAT	J1	0388	0.00 - 0.90	THREAT TO HIGH VALUE STREAM AND ESTUARINE HABITAT (DUMAS BAY); DEGRADED WATER QUALITY
13A.	TRIB 0387 HEADWATER FLOODING	L8	0387	1.60	INFILTRATION POND MALFUNCTIONING; FLOODING OF COMMERCIAL AND MULTIFAMILY BUILDINGS
14A.	S 320TH STREET FLOODING	WH10	0014C Headwater	NA	FLOODING OF MAJOR ARTERIAL

TABLE 2.3.1b
HYLEBOS CREEK AND LOWER PUGET SOUND BASINS
SIGNIFICANT PROBLEMS - Category B

REFERENCE NUMBER	LOCATION NAME	SUBCATCHMENT	TRIBUTARY	RIVER MILE	PROBLEM DESCRIPTION
1B.	INDUSTRIAL AND COMMERCIAL RUNOFF INTO TRIB 0013	WH3	0013 Headwater	NA	POOR QUALITY RUNOFF ENTERING TRIB 0013 NEAR SR 99 AND S 348TH STREET
2B.	S 359TH STREET & TRIB 0013 FLOODING	WH3	0013	2.43	ROAD WASHED OUT
3B.	SPRING VALLEY WETLAND & TRIB 0013 POTENTIAL DEGRADATION	WH3	0013	1.55 - 2.60	UNINVENTORIED/UNPROTECTED WETLAND; FUTURE IMPACTS TO HABITAT FROM HIGH FLOWS; DEGRADED WATER QUALITY
4B.	TRIB 0014C KNICKPOINT	WH10	0014C	0.10	CHANNEL EROSION/KNICKPOINT
5B.	MONTESSORI & TRIB 0014 FLOODING	WH4	0014	0.40 - 1.70	THREAT TO PRIVATE SCHOOL FROM FLOOD FLOWS
6B.	SR 161 FLOODING ALONG TRIBS 0016/0016A/0006	H5, H8, H9	0016 0016A 0016	NA	POTENTIAL FUTURE FLOODING OF SR 161 AND STREAMSIDE HOMES UPSTREAM OF SR 161
7B.	TRIB 0016 EROSION	H6	0016	0.00 - 0.62	CHANNEL EROSION
8B.	TRIB 0006 EROSION	H1, H4, H5	0006	5.39 - 6.77	CHANNEL EROSION
9B.	TRIB 0006 WATER QUALITY	H1	0006	5.39 - 6.77	THREAT TO HIGH QUALITY STREAM & WETLAND HABITAT; POLLUTANTS FROM BIRD FARM & REGENCY WOODS PONDS
10B.	28TH AVENUE S & TRIB 0015 FLOODING	H2	0015	0.60	POTENTIAL FUTURE FLOODING
11B.	TRIB 0015 EROSION	H2, H3	0015	0.00 - 0.56	CHANNEL EROSION

TABLE 2.3.1b (continued)
HYLEBOS CREEK AND LOWER PUGET SOUND BASINS
SIGNIFICANT PROBLEMS - Category B

REFERENCE NUMBER	LOCATION NAME	SUBCATCHMENT	TRIBUTARY	RIVER MILE	PROBLEM DESCRIPTION
12B.	MCSORLEY CK TRIB 0382 EROSION	S5	0382	0.67	CHANNEL BANK EROSION ADJACENT TO HOUSE FOUNDATION
13B.	LOWER MCSORLEY CREEK	S1, S2	0381	0.00 - 0.50	SEDIMENTATION; FLOODING; IMPACT TO HABITAT DEGRADED WATER QUALITY
14B.	EASTER LAKE FLOODING	R6	0385	NA	FLOODING OF RETIREMENT HOME
15B.	LAKOTA CREEK EROSION/SEDIMENTATION	L1, L2, L3 L6, L7	0386	0.00 - 1.17	CHANNEL EROSION AND SEDIMENTATION IMPACTING SEWAGE TREATMENT PLANT (STP); STREAM AND ESTUARINE HABITAT (DUMAS BAY); DEGRADED WATER QUALITY
16B.	TRIB 0387 EROSION	L4	0387	0.00 - 0.45	CHANNEL EROSION ALONG SR 509 AND HIGH SCHOOL PARKING LOT IMPACTING STP; STREAM AND ESTUARINE HABITAT (DUMAS BAY); DEGRADED WATER QUALITY
17B.	OLYMPIC VIEW PARK RAVINE	J4, J5	0384	0.18 - 0.90	CHANNEL DOWNCUTTING; POTENTIAL FLOODING OF HOMES
18B.	SW 356TH STREET OFF-CHANNEL FLOODING	WH4,WH7	NA	NA	POTENTIAL FUTURE FLOODING OF HOMES; LACK OF DRAINAGE FROM CLOSED DEPRESSIONS.

Table 2.3.2 - Recommended Capital Improvement Projects and Studies

This table summarizes the capital projects and studies recommended in the Plan with locations shown in Figure 2.3.2. The list does not rank these solutions for implementation. This order will be determined following the development of criteria for ranking solutions after consultation with the affected entities in the basins. This ranking will be included in the final Basin Plan document following approval by these entities.

Estimates identified in this figure are direct costs in 1990 dollars. These costs may vary in the future, however, due to changes in mitigation standards or factors related to the general economy. These estimates do not include indirect costs, such as overhead which can increase costs by more than 30 percent.

TABLE 2.3.2
HYLEBOS CREEK AND LOWER PUGET SOUND BASINS
RECOMMENDED CAPITAL IMPROVEMENT PROJECTS AND STUDIES
(NOTE: These solutions are NOT ranked in implementation priority.)

ITEM NUMBER	PROJECT NUMBER	PROJECT NAME	PROJECT DESCRIPTION	ESTIMATED COST (1990)	LOCATION	PROBLEMS ADDRESSED
1.	2430	PANTHER LAKE ENHANCED DETENTION	PLACE BERM AND CONSTRUCT OVERFLOW SPILLWAY	$2,007,000	FW	1A, 4A, 5A, 6A, 7A, 5B
2.	2451	SW 356TH STREET DRAINAGE STUDY	CONDUCT HYDROLOGIC MODELING OF CLOSED DEPRESSIONS AND COMPLETE PRELIMINARY DESIGN OF STORMWATER DRAINAGE SYSTEM.	$78,000	FW	18B
3.	2432	S 356TH STREET CONVEYANCE UPGRADE	UPGRADE CULVERT SIZES WITH ROAD WIDENING PROJECT	$0 SEE NOTE(1)	FW	5A
4.	2433	WEST HYLEBOS RAVINE CHANNEL STABILIZATION AND HABITAT IMPROVEMENT	REPOSITION AND ADD LARGE ORGANIC DEBRIS TO THE CHANNEL TO REDUCE SEDIMENT TRANSPORT AND IMPROVE HABITAT	$348,000	FW	6A, 7A, 5B
5.	2450	S 320TH STREET STORMWATER SYSTEM DESIGN STUDY	PERFORM ENGINEERING SURVEY OF EXISTING SYSTEM AND DESIGN CONVEYANCE UPGRADE	$54,000	FW	14A
6.	2434	S 336TH STREET IMPROPER STORM SEWER HOOK-UP STUDY	LOCATE THE SOURCES AND ELIMINATE IMPROPER DISCHARGES TO TRIB 0014A	$20,000	FW	4A
7.	2435	S 336TH STREET "SOUTH" REGIONAL POND	CONSTRUCT CONTROL STRUCTURE TO REDUCE PEAK FLOWS TO STABILIZING LEVELS	$436,000	FW	3A, 4A, 5A, 6A, 7A, 5B

TABLE 2.3.2 - Continued
(NOTE: These solutions are NOT ranked in implementation priority.)

ITEM NUMBER	PROJECT NUMBER	PROJECT NAME	PROJECT DESCRIPTION	ESTIMATED COST (1990)	LOCATION	PROBLEMS ADDRESSED
8.	2436	S 336TH STREET WETLAND RESTORATION	PLANT WETLAND VEGETATION: CONTINGENT ON CULVERT REPLACEMENT	$25,000 SEE NOTE (2)	FW	3A, 4A, 5A, 6A, 7A, 5B
9.	2437	KITTS CORNER REGIONAL POND	CONSTRUCT CONTROL STRUCTURE TO REDUCE PEAK FLOWS TO STABILIZING LEVELS; UPGRADE CULVERTS AT S 336TH AND SR 99; PROVIDE BIOFILTRATION	$640,000	FW	2A, 4A, 5A, 6A, 7A, 4B, 5B
10.	2438	TRIBUTARY 0013 HEADWATERS WATER QUALITY MONITORING	MONITOR THE EFFECTIVENESS OF WATER QUALITY BMP IMPLEMENTATION AT S 348TH & 356TH ST BY SR 99 & SR 161	$15,000	FW	1B
11.	2440	S 359TH STREET CULVERT REPLACEMENT	UPGRADE CULVERT; ALLOW FOR FISH PASSAGE; PROVIDE OVERFLOW STRUCTURE; RESTORE DISTURBED CHANNEL BANKS	$82,000 SEE NOTE (3)	FW	2B
12.	2441	S 373RD STREET CHANNEL MAINTENANCE AND FENCING	CONTINUE CURRENT DREDGING TO MAINTAIN CHANNEL CONVEYANCE; FENCE LIVESTOCK; PROVIDE WATERING ACCESS; REVEGETATE STREAM CORRIDOR	$113,000 SEE NOTE (4)	FW	7A
13.	2449	TRIBUTARY 0013 FLOODPLAIN STUDY	CONDUCT HYDRAULIC MODELING TO DESIGNATE FLOODPLAIN BOUNDARIES	$10,000	FW	7A
14.	2442	S 360TH STREET REGIONAL POND	EXCAVATE OFF-STREAM POND AND CONSTRUCT CONTROL STRUCTURE TO REDUCE PEAK FLOWS TO STABILIZING LEVELS; PROVIDE BIOFILTRATION	$1,635,000	KC	8A, 6B, 7B, 8B, 9B

TABLE 2.3.2 - Continued
(NOTE: These solutions are NOT ranked in implementation priority.)

ITEM NUMBER	PROJECT NUMBER	PROJECT NAME	PROJECT DESCRIPTION	ESTIMATED COST (1990)	LOCATION	PROBLEMS ADDRESSED
15.	2443	S 360TH STREET EMBANKMENT PROTECTION	CONSTRUCT OVERFLOW CULVERT	$205,000	KC	8A, 6B, 7B, 8B, 9B
16.	2444	SR 161 CONVEYANCE UPGRADES	UPGRADE CULVERTS ON TRIBS 0006, 0016 and 0016A	$280,000	KC	8A, 6B
17.	2445	TRIBUTARY 0016 CHANNEL STABILIZATION	STABILIZE KNICKPOINTS	$16,000	KC	7B
18.	2446	SR 161 REGIONAL POND	CONSTRUCT CONTROL STRUCTURE TO REDUCE PEAK FLOWS TO STABILIZING LEVELS IN TRIB 0015; UPGRADE CULVERT; STABILIZE KNICKPOINT	$450,000	KC	8B, 9B, 10B, 11B
19.	2447	EAST BRANCH HYLEBOS WATER QUALITY IMPROVEMENTS	CONSTRUCT BIOFILTRATION SWALE; RETROFIT REGENCY WOODS PONDS; REPLACE EXISTING CONCRETE WALL FOR POND WITH A BERM; REVEGETATE STREAM CORRIDORS	$568,000	KC/MILTON	9B
20.	2448	EAST BRANCH HYLEBOS CHANNEL STABILIZATION AND HABITAT IMPROVEMENT	REPOSITION AND ADD LARGE ORGANIC DEBRIS TO REDUCE SEDIMENT TRANSPORT AND IMPROVE HABITAT	$318,000	KC/MILTON	8B
21.	3320	20TH AVENUE S CONVEYANCE UPGRADE	REPLACE TRASH RACK; STABILIZE BANKS WITH BIOENGINEERING METHODS	$38,000	DES MOINES	12B
22.	3321	MIDWAY DETENTION POND RETROFIT STUDY	CONDUCT DETAILED HYDROLOGIC ANALYSIS	$40,000	KENT	13B

TABLE 2.3.2 - Continued
(NOTE: These solutions are NOT ranked in implementation priority.)

ITEM NUMBER	PROJECT NUMBER	PROJECT NAME	PROJECT DESCRIPTION	ESTIMATED COST (1990)	LOCATION	PROBLEMS ADDRESSED
23.	3322	LOWER MCSORLEY CREEK SEDIMENT CONTROL	CONSTRUCT ROCK BERM ALONG THE CHANNEL; IMPROVE CULVERT INLETS & OUTLETS; REPLACE BOX CULVERT	$46,000	STATE	13B
24.	3323	S 272ND STREET CONVEYANCE UPGRADE	UPGRADE CULVERT SYSTEM AND CATCH BASINS	$448,000	KC/FW	9A
25.	3324	REDONDO CREEK WATER QUALITY STUDY	IDENTIFY SOURCES OF HIGH POLLUTANT CONCENTRATIONS	$22,000	FW	10A
26.	3325	EASTER LAKE OUTLET IMPROVEMENTS	ENLARGE OUTLET CHANNEL; PLACE BERM; RETROFIT OUTLET PIPE SYSTEM	$79,000	FW	14B
27.	3326	EAST BRANCH LAKOTA CREEK CHANNEL STABILIZATION AND CONVEYANCE IMPROVEMENT	RELOCATE SEWER LINE; WIDEN AND STABILIZE CHANNEL; REMOVE CHANNEL-CROSSING BERM; REMOVE INSTREAM TRASH; RETROFIT AND TIGHTLINE OUTLET OF ONSITE PONDS	$690,000	FW	15B
28.	3327	WEST BRANCH LAKOTA CREEK CHANNEL STABILIZATION AND CONVEYANCE IMPROVEMENT	RELOCATE SEWER LINE; WIDEN AND STABILIZE CHANNEL; MODIFY HIGH SCHOOL PARKING LOT FOR TRAIL AND BIOFILTRATION; CONTROL SR 509 ROAD RUNOFF	$713,000	FW	16B
29.	3328	MAIN STEM LAKOTA CREEK CHANNEL STABILIZATION	PLACE ROCK ARMOR TO PROTECT VERTICAL ROAD EMBANKMENT; REVEGETATE AND ADD LARGE ORGANIC DEBRIS	$167,000	FW	15B

TABLE 2.3.2 - Continued
(NOTE: These solutions are NOT ranked in implementation priority.)

ITEM NUMBER	PROJECT NUMBER	PROJECT NAME	PROJECT DESCRIPTION	ESTIMATED COST (1990)	LOCATION	PROBLEMS ADDRESSED
30.	3329	LOWER JOES CREEK CHANNEL STABILIZATION AND HABITAT IMPROVEMENT	PLACE LARGE ORGANIC DEBRIS	$491,000	FW	12A
31.	3330	TWIN LAKES OVERFLOW PIPELINE	CONSTRUCT PIPELINE AND DETENTION POND FOR FLOOD FLOWS	$842,000	FW	11A
32.	3331	OLYMPIC VIEW PARK CHANNEL IMPROVEMENTS	PLACE BERM AROUND CULVERT INLET; CONSTRUCT OVERFLOW SWALE AND ROAD CURB CUTS; STABILIZE KNICKPOINTS; REMOVE TRASH	$135,000	FW	17B
33.	3332	UPPER LAKOTA CREEK POND RETROFIT	MODIFY FLOW RELEASE; DREDGE POND; BERM FLOODPRONE AREAS; UPGRADE TRASH RACK AND PROVIDE OVERFLOW SPILLWAY	$354,000	FW	13A
TOTAL ESTIMATED COST				$11,365,000		

NOTES:

(1) S 356th Street Conveyance Upgrade is included in a King County Roads Division Project with an estimated $2.5 million cost. It is assumed that no cost toward the basin plan CIP funds for this conveyance update project will be incurred.

(2) Costs shown reflect wetland revegetation only.

(3) Project substantially completed by King County in 1990.

(4) An additional cost of $10,000 will be incurred with each subsequent dredging associated with Project 2441.

2.4 PLAN CRITERIA

Preparation of the recommendations in this basin plan involved selecting those problems that are the most significant from the numerous degraded conditions identified in the Hylebos Creek and Lower Puget Sound Current and Future Conditions Report (King County, 1990a). Specific criteria were developed to determine the most severe flooding, erosion and sedimentation, habitat, and water quality problems. Regionally and locally significant resource areas needing protection were also identified. This section discusses the criteria used to identify the significant resource areas and problems in this Plan and the criteria used to develop solutions.

Criteria for Identification of Significant Resource Areas

Resource areas are subcatchments, wetlands, or stream reaches that are important to the viability of fish and wildlife populations as biological, social, and/or economic resources. In the Hylebos Creek and Lower Puget Sound basins many resource areas have been severely degraded already; others are threatened by future land-use changes. For purposes of determining which resource areas are most important and therefore most in need of protection, the key resource areas in the basin have been divided into two types: Regionally Significant Resource Areas (RSRAs) and Locally Significant Resource Areas (LSRAs), as discussed below. Locations of RSRAs and LSRAs are shown in Figure 2.1.1. A description of these areas is in Section 2.3.

Regionally Significant Resource Areas. RSRAs contribute to the resource base of the entire southern Puget Sound region by virtue of exceptional species and habitat diversity and abundance when compared to resources in basins of similar size and structure elsewhere in the region. These areas may also support rare, endangered, or sensitive species.

Criteria for RSRAs:

1. Watershed structure and function, as measured by stream/wetland loss and alteration, functional characteristics, riparian corridor integrity, and natural flow regimes, are not appreciably altered from pre-development conditions; or

2. Freshwater and marine aquatic habitat diversity and abundance, as measured by various elements such as wetland class and function, pool:riffle ratio of streams, gradient, substrate condition, large woody debris and channel stability, are evenly dispersed throughout the basins, and are of consistently high quality when compared to other basins in the region. This diversity serves various species and life stages; or

3. Salmonid diversity and abundance, as measured by species composition, life stage, or populations, are at or near historic levels, or carrying capacity, and provide a demonstrated contribution to the regional fishery resource.

Locally Significant Resource Areas. LSRAs contribute to the aquatic resources, particularly for resident salmonids, within the basin. They provide wetland and stream habitat that is important for wildlife and salmonid diversity and abundance within the basin.

Criteria for LSRAs:

1. Watershed structure and function have been altered by clearing, stream and wetland loss, but wetland and riparian corridors remain generally intact, and flow conditions and habitat stability are adequate for spawning or rearing; or

2. Aquatic habitat diversity and abundance are considered good but may be unstable. Habitat damage and disturbance are generally confined to few sites. These areas may be successfully enhanced by various methods. These areas may also serve as migration routes to RSRAs. These areas may also contribute to the diversity of species in various lifestages; or

3. Salmonid diversity and abundance is lower than in RSRAs but, these areas still support one or more species or life stages.

Much of the planning area is outside both LSRAs and the higher value RSRAs. These areas generally show significant habitat alteration and degradation although there may exist localized areas of valuable habitat for salmonids and other species. The contribution of these areas to the regional and local resource base is limited.

Criteria for Significant Problems

Chapter 4, the Sub-basin Recommendations, discusses the regulations, programs, capital improvements, and studies recommended to solve the significant surface water problems in the basins and to protect significant resource areas. These priority problems, listed in Tables 2.3.1a and b, are divided into three groups: Category A, the most significant problems; Category B, less severe but still key problems; and Category C problems. Category C problems are the least significant problems and do not meet the criteria for significance. The criteria for Category A and B problems are as follows:

Category A problems are those that pose a significant immediate threat or near-term risk:

- Of flooding occupied structures;

- To the use of major arterials and state highways; or

- To the beneficial uses of the RSRAs of West Hylebos Wetland, East Branch Hylebos Creek, or Dumas Bay.

Category B problems are judged to have lower priority because they pose:

- A lesser, or long-term risk only to the most important elements of the built or natural environments listed above under Category A; or

- An immediate or near-term risk to less important elements of the built or natural environments, such as secondary roads or LSRAs of the Spring Valley Wetland and stream, lower Joes Creek, West Branch Hylebos Creek, Redondo Beach, and Saltwater State Park.

Criteria for Flow Reduction Solutions

Solutions to existing high-flow problems in the Hylebos Creek and Lower Puget Sound basins may be grouped into two broad categories: those that solve flooding problems and those that solve channel-erosion problems. Projects that address flooding were designed to reduce flows downstream to provide 100-year event flood protection for habitable structures and 25-year event protection for roads. Flooding of undeveloped lands, playfields, coastal areas, or private driveways was considered outside the scope of the solutions of this Plan.

If the project addresses instream erosion by detention, the goal is to release flows at a rate that would not cause excessive erosion. Based on empirical data in these basins and elsewhere in the region (King County, 1990a and 1990f), meeting this flow-reduction criterion requires post-development 2-year flows to be no greater than forested (i.e. pre-development) 10-year flows, post-development 10-year flows no greater than about pre-development 100-year flows, and 100-year flows no greater than about the pre-developed 500-year flow. These flow reductions will not only achieve stream stabilization but also will meet or exceed the standards for 100-year event protection of residential structures and 25-year event protection for arterials. This reflects the fact that streams may be able to experience some increase in flow rate and still maintain fair, albeit imperfect, conditions for aquatic habitat.

Solutions to flow increases caused by future development are addressed by two flow control standards. In areas where future flows are expected to have significant adverse impacts on stream stability and habitat, flows peaks to the 100-year level and flow durations to the 50-year level under future land use should not exceed existing conditions. In other areas, flow peaks under future land use should be controlled to the pre-developed 2- and 10-year levels respectively.

Criteria for Determining Priority Capital Improvement Projects

The following criteria are intended to help entities in the basins evaluate the importance of each problem or resource affected by a recommended project in their jurisdiction. No weight is assigned to each criterion; however, it is suggested that entities consider all these factors to determine an appropriate order for implementing any single project or group of projects.

1. <u>Reduction in Safety Hazards and Property Damage</u>

   a. Will the project reduce current flooding/damage or the near-term risk of flooding/damage of major roads or occupied structures?

   b. Will the project reduce future flooding or the long-term risk of flooding of major roads or occupied structures?

2. <u>Benefit to Significant Aquatic Resources</u>

   a. Will the project reduce a threat or near-term risk to Regionally Significant Resource Areas (RSRAs)?

   b. Will the project reduce a threat or near-term risk to Locally Significant Resource Areas (LSRAs)?

3. <u>Basinwide Effects</u>

   a. Does the project significantly benefit the system as a whole?

   b. Does the project significantly reduce upstream or downstream problems?

   c. Is an upstream project needed before a downstream project can be effective or vice versa?

4. <u>Timeliness</u>

   a. Can the project solve a problem quickly?

   b. Could implementation of the solution coincide with other events, programs, or plans?

   c. Can the project improve the effectiveness of another project?

   d. Will immediate implementation of the project avoid irretrievable loss of beneficial uses?

   e. Are there significant obstacles to implementation such as funding or local legislative policy that would significantly delay project implementation?

   f. Are there conflicting requirements for approval in other programs, agencies, or governments that may significantly delay project implementation?

2.5 COORDINATION WITH PENDING PLANS AND CODES

Proposed plan and code revisions related to surface water management in Des Moines, Federal Way, Pierce County, Tacoma, and King County are listed below. The processes involving these revisions are being coordinated with the Basin Plan recommendations to achieve consistency as much as possible among the entities in the basins. For example, the Basin Plan performance standard recommendations to protect sensitive areas could be implemented through the pending Des Moines and Federal Way code updates.

The Basin Plan recommendations could also initiate regulatory changes. For example, recommendations for enhanced onsite stormwater detention could be implemented through an update to development codes in Milton, Tacoma, and Kent, which do not have pending revisions in this part of their code.

Pending Regulatory Actions	Anticipated Submittal Date to Legislative Body
City of Des Moines Comprehensive Plan and Zoning Code Update	1992
City of Des Moines Critical Area Development Regulations	September 1991
City of Des Moines Surface Water Management Standards and CIPs	Upon adoption of the Surface Water Management Program expected in 1992
City of Federal Way Comprehensive Plan and Zoning Code Update	1993
City of Federal Way Comprehensive Park and Open Space Plan	September 1991
City of Federal Way Critical Area Development Regulations	September 1991
City of Kent Critical Area Development Regulations	September 1991
King County Critical Area Development Regulations	September 1991
King County Federal Way Area Community Plan Update	July 1991
King County Shoreline Master Program Update	June 1992
King County Zoning Code Revision	April 1991

Pending Regulatory Actions	Anticipated Submittal Date to Legislative Body
South King County Groundwater Management Plan	June 1992
Pierce County Critical Area Development Regulations	September 1991
Pierce County Lower Puyallup Watershed Action Plan	1992
Proposed Pierce County Stormwater Master Plan	Fall 1991
City of Tacoma Critical Ecosystems Ordinance	July 1991
City of Tacoma Wetlands Preservation Policy	Currently pending

2.6 CITIZEN ADVISORY COMMITTEE RECOMMENDATIONS

The general CAC recommendations for the Plan are presented below. Specific recommendations are presented in Attachment A.

Introduction

The members of the Hylebos Creek and Lower Puget Sound Basin Plan Citizens Advisory Committee were appointed by King County in 1989 to serve as the local eyes and ears for the County planning team. They bring to the group a variety of backgrounds and perspectives, but are linked by their ties to the area through many years of residence. CAC members represent a wide range of professions including engineering, teaching, development, general contracting, business and aerospace. One of its members had extensive personal experience as a contractor working to develop storm drainage facilities in the basins. Another member has considerable experience in water quality testing and monitoring.

Some who live or work near creeks remember an abundance of salmon, cooler water temperatures and extensive natural vegetation. The committee has spent the last two years gaining an understanding of the scientific description of the area learning about stream hydrology, underground water sources, pollutants, fish habitat requirements and geological characteristics.

As such the CAC has witnessed the development of the Plan, contributing suggestions and recommendations as they felt appropriate. As part of its participation in the Plan development, the CAC established its own set of Basin Plan objectives. Here is a broad outline of these objectives:

- Stabilize current stream, wetland and lake water quality and quantity;
- Establish public education and public involvement programs;
- Encourage interagency coordination;
- Strengthen planning, code administration and enforcement;
- Improve facility maintenance;
- Establish preservation incentives; and
- Encourage groundwater recharge.

Comments

The Hylebos Creek and Lower Puget Sound Basin Plan is a thorough and well-executed document, the implementation of which will be in the best interest of the basins and their inhabitants. CAC members are encouraged by the recommendations for buffering around sensitive wetlands and streams, for handling non-point pollution, for water quality monitoring, for encouraging public involvement, for the Stream Steward program, and for further detailed inventory of the area.

The CAC would like to amend or underscore some of the proposed policies.

Onsite Detention Standards: BW-2, BW-3

The CAC strongly recommends adoption of these basinwide policies. Without these policies in practice, the future success of creek and wetland stabilization and/or restoration is remote.

It also supports groundwater recharge as proposed by BW-21 and WHL-5. The rezone of Spring Valley, as described by BW-1 and WHL-9 is also critical to the success of the Plan.

Soil and Vegetation Retention: BW-8, BW-9

The policy that significant trees be retained is excellent (BW-8.4 and BW-8.5). In fact, if the basins are viewed in the larger context as an integrated system, the connection of the surface water problems to loss of trees cannot be overlooked.

CAC members would include a policy that requires clustering development of buildings and impervious cover, with a retention of as much as 35 percent of undisturbed vegetation on a site. This would reduce onsite and downstream flooding, as roots provide a path to groundwater and vegetation collects and holds water. Homeowners should be advised to plant trees on their property.

The CAC is concerned with enforcement of policies defining clearing and grading. Due to the past experiences with the Costco site, Harbor Ridge development, Regency Woods, the committee stresses the importance of adding a month to the window prohibiting clearing and grading. This additional month would give the land more time to revegetate. The CAC also recommends a cumulative impact assessment in terms of an environmental review for all development requiring clearing and grading.

Impact Mitigation: BW-11, BW-12, BW-13

CAC members are concerned about "mitigated" opportunities for "moving" wetlands or streams. They do not believe that any project warrants this opportunity and that mitigation is a crutch at best. In the time it takes an area to revegetate, the soil washes away, the endemic species leave or die and the local climate changes irreversibly. In fact, the Plan itself states on page 3-24 that "At one time, it was generally believed that mitigation measures could be implemented to compensate for these losses. However, such attempts have been costly, while their success rates are quite low." The CAC recommends a freeze on future disturbance of wetland and stream areas as well as all areas of natural vegetation.

Code Compliance: BW-33 to BW-36

The CAC applauds the code compliance recommendations. Penalties currently in use have not been sufficient to discourage violations. BW-35 describes an expansion of penalties which would make fines significant enough to discourage violations.

Recommendations

Designating certain sensitive areas as RSRAs and LSRAs is commendable. However, this should not mean that surrounding areas are any less important. The ultimate protection of significant resource areas will depend on the management of the land around them. Just as our national parks and forests are
being impacted by the air and water coming from surrounding areas are small in comparison to the entire Plan area, which makes them especially vulnerable to impacts from the surrounding area.

It is the opinion of the committee that the entire length of the Hylebos stream channel through Spring Valley qualifies as an LSRA. Also, the streams and watercourses which drain into and through Dash Point Park should be protected as an LSRA. In the past year, Dash Point Park has experienced severe flooding and silting due to inadequately controlled upland development.

The CAC sees the need for a centralized, responsible agency to coordinate the work of local, city, county, and state agencies, particularly with the purposed of eliminating redundant or conflicting policies and providing a crisis line, an "environmental 911," for citizens reporting problems. The Stream Steward program, as described by BW-38, could fill this need.

CAC members find themselves essentially in agreement with the Plan as drafted, although they find themselves impatient at the length of time estimated by the government entities to build capital improvement structures and halt the accelerating destruction of our streams and wetlands. In the face of such urgent needs, the CAC suggests implementing interim measures to protect the basins while detailed plans for capital improvement projects are being considered. Please see Attachment A for a specific description of these interim measures.

Conclusions

As this area of King County has experienced such a rapid rate of development, many of the natural systems for handling surface water have been irretrievably lost. For this reason, it is imperative that this Plan be implemented on a very short time schedule in order to deal with the current situations and avoid further degradation. If the communities of South King County are to remain economically viable, as well as aesthetically pleasant, more attention needs to be given to the environmental systems which make up these communities.

Continued over-development of these basins will spell disaster for the general population of these areas, as is well documented in the Current and Future Conditions Report, published as part of this Plan. The basin plan team of the Surface Water Management Division of King County has described the conditions of the areas now, and what they will look like in the future if the current management practices are continued. The CAC realizes that current methods of dealing with runoff have been detrimental to the system as a whole. A whole system approach is clearly required for correcting existing, and preventing future problems. The extensive research which has been carried out in these basins proves that they have unique attributes which do not fit into the text-book methods of dealing with surface water.

In looking to the future as the Plan is used and interpreted, the CAC suggests following general objectives as guidance for policymakers:

- To preserve or enhance environment and habitat;
- To consider community or basin priorities as preferable to landowner priorities;
- To provide long-term rather than short-term fixes;
- To channel water into the aquifer rather than into Puget Sound;
- To make provisions for water filtration before the water is directed underground or into the Sound;
- To promote natural or nonstructural solutions to surface water conveyance;
- To provide tax incentives to persons who own wetlands, have significant retention/detention facilities, or are active participants in community stewardship programs;
- To provide rebuilding or relocation assistance for individuals who have experienced loss of property due to flooding caused by poor upstream management practices;
- To expect developers and agencies to participate in reconstruction and rehabilitation of damaged habitat;
- To enhance the legal recourse available to property owners impacted by upstream mismanagement; and
- To provide adequate enforcement of surface water management regulations.

ATTACHMENT A

Additional Recommendations made by the Hylebos Creek and Lower Puget Sound Basin Plan Citizens Advisory Committee

Due to the urgent need to manage surface water problems in the Hylebos Creek and Lower Puget Sound Basins, the CAC proposes two types of measures to facilitate implementation of the Basin Plan. These measures include: 1.) adoption of interim regulations and programs, and 2.) considerations for interim and long-term capital improvement projects.

1. INTERIM DEVELOPMENT REGULATIONS AND PROGRAMS

The Executive Proposed Hylebos Creek and Lower Puget Sound Basin Plan identifies 43 Basinwide recommendations to strengthen current regulatory, administrative, and programmatic elements of surface water management in the basins. The CAC suggests that all entities in the basins adopt the recommendations identified below as interim measures in compliance with the development regulation requirements for critical area protection in the Growth Management Act. According to the Act, local governments are required to complete development regulations for critical areas in their jurisdictions by September 1, 1991. These recommendations are essential for protecting critical areas by reducing future stormwater flows, flooding, instream erosion, loss of aquatic habitat, and degradation of water quality. Furthermore, failure to implement these provisions now will only result in higher costs to the public for corrective actions in the future. The recommendations of concern are:

- BW-1: Low Density Zoning Controls for Protection of Stream Corridors and Ravines
- BW-2: Basinwide Onsite Detention Standard
- BW-3: Stream Protection Onsite Detention Standard
- BW-4: Stream Buffers
- BW-5: Wetland Buffers
- BW-7: Limitations on Stream Crossings and Stream Modifications or Relocations
- BW-8: Clearing, Grading, and Filling Limitations
- BW-9: Seasonal Clearing and Grading Limits
- BW-10: Hillslope Development and Drainage Restrictions
- BW-13: Resource Replacement and Enhancement Standards
- BW-17: BMP Programs for Control of Nonpoint Source Pollutants
- BW-21 Stormwater Infiltration Limitations (See also WHL-5 Enhanced Stormwater Infiltration, West Branch Hylebos Creek Recommendations.)
- BW-33 Enforcement/Inspection Staff
- BW-34 Citations
- BW-35 Penalties

2. CAPITAL IMPROVEMENT PROJECTS

The recommended capital improvement projects list is divided into sections describing "interim" and "long-term capital" recommendations. The interim recommendations are ones that CAC members believe can be implemented immediately with little or no cost. They include small scale modifications to existing facilities, or legal designation of certain areas of the basin as future sites for stormwater facilities. The long-term capital recommendations consist of major projects we feel are required in addition to those identified in the Plan, to adequately manage the area's surface water problems.

A. INTERIM CAPITAL IMPROVEMENT PROJECTS

1. If progress in implementing the recommended Panther Lake improvements (Project 2430) is significantly delayed, consideration should be given to the following interim measures:

   a. **Tributary 0014B, RM .35 -.50** (West of 1st Ave S, South of 348th Street)

      Establish a series of ponds within the perennial stream. The objectives of this project are to dissipate energy from high flows from Panther Lake and to improve water quality of flows into Hylebos 18 Wetland. Ponds should be metered to permit a regulated flow, to the extent possible.

   b. **Tributary 0014B, RM 1.2 to approximately 1.6** (Northeast inlet to Panther Lake)

      Augment the capability of existing mini-detention areas for improving water quality by additional berming and metered flow devices. Stabilize banks with selective plantings. This project might be coordinated with City Pride Park efforts.

B. LONG-TERM CAPITAL IMPROVEMENT PROJECTS

1. **Tributary 0013, RM 2.30** (North of 359th Street)

   In lieu of applying the BW-3 Stream Protection Onsite Detention Standard to individual development sites, consider designating an area in the ravine of the stream channel north from 359th Street as a future regional detention facility. The area to the north of this site is slated for heavy development. This fork of the Hylebos is impacted by development as far north as 340th Street and will be further impacted by installation of more impervious surface. Additional lanes are to be added to 348th, SR-16, 356th, and I-5. The forested area just south of Costco will be leveled and covered with commercial buildings and parking areas; the truck stop will be converted to a commercial area; and an area between 356th and 359th Streets is to become the new location for the Federal Way School District bus barn and maintenance yard.

   This area is also currently the headwaters of the most productive and significant resource area in the Plan Area. The CAC recommends the

construction of a large detention facility in the existing swale to handle the future runoff from the commercial areas upstream between 340th and 356th Streets, with metered outflow to prevent further degradation of spawning grounds south of 359th Street.

2. Tributary 0013, approximately RM 1.7 (8th Avenue at approximately 368th S)

   Additional analysis of gaging data should be performed to determine if this 8th Avenue site has the potential of being flooded. If so, the existing culvert should be replaced with a larger bottomless arch to increase flow. This point backed up during both 1990 floods and came within three inches of washing out. Back flooding impacts spawning areas and three wildlife conservation ponds. The water quality in Hylebos Wetland 29 is being adversely affected. Many waterfowl nests were destroyed during the April 1991 rains. This area will also receive the additional runoff from two new lanes being added to Interstate-5. New drainage systems installed from the Costco site south to 356th Street run from 36-inch diameter to 48-inch diameter, increasing flow velocity to the Spring Valley Open Space area, where it picks up the normal stream flow as well as highway runoff.

3. Tributary 0013, RM 1.7 off channel

   Coordinate with Washington State Department of Transportation to either divert flows of oil-saturated waters from the detention pond (Hylebos Creek Wetland 28) or run this discharge through an oil separator. Funding for this may be available via new Washington State Department of Ecology State Highway cleanup policy.

4. Upper Joe's Creek 0388 (Olympic View Park)

   To supplement Project 3331, Olympic View Park channel improvements, the community surrounding the park should be involved in litter clean-ups and a streamside revegetation project.

Chapter 3

Basinwide Recommendations

CHAPTER 3: BASINWIDE RECOMMENDATIONS

3.0 INTRODUCTION

Many of the existing and anticipated surface water problems in the Hylebos Creek and Lower Puget Sound basins can be addressed by strengthening several key areas of local government administration. The most important areas are development codes, enforcement, maintenance practices, public education, public involvement, and interjurisdictional coordination. This chapter includes 43 recommendations in these and related areas. The recommendations will provide the direction necessary for all cooperating jurisdictions to reduce future storm flows, improve water quality, and begin improving aquatic habitat in the basins. These recommendations focus on the prevention of future problems and the correction of existing problems at their sources. The recommendations are grounded in the belief that it has been the sum of individual actions over time that has lead to the degradation of these systems. However, with the underlying management structure in this Plan to guide future actions, individuals can also correct these past practices and trends can be reversed. When combined with the facilities, regulations, and programs recommended at the sub-basin level in Chapter 4, the basinwide recommendations provide a comprehensive strategy for improving conditions in the Hylebos Creek and Lower Puget Sound basins.

Source control recommendations affect the broad range of human activities that contribute to increased storm flows and elevated pollutant concentrations. These activities include construction practices; the daily actions of individuals in residential, commercial, and industrial areas; and routine maintenance along highways and streets, and in the stormwater facilities. When implemented, recommendations in this chapter will be immediately visible to the public. For example, new development practices that reduce erosion and sedimentation will be used at construction sites and greater attention will be paid to avoiding stream corridor impacts and keeping potential pollutants from entering surface or groundwater. Plate 3.0.1 illustrates how recommendations such as streamside buffers, buffer signs, and silt fences should be used during site construction. Plate 3.0.2 depicts how recommendations to revegetate stream corridors can reestablish stream buffers and riparian areas. Broad-based educational programs will also give the public a greater appreciation for the importance of protecting surface water systems.

This chapter also recommends lower-density zoning in stream reaches that have high resource value, tax incentives to encourage preservation and protection of sensitive areas, and a program of coordinated interjurisdictional monitoring and evaluation to assess the progress made in implementing the Basin Plan. The goal of the monitoring program is to determine whether the recommendations, once implemented, are effective in providing the needed level of control for stormwater runoff, nonpoint source pollutants, and instream habitat.

Each basinwide recommendation can affect only one aspect of the multifaceted problems in the two basins. In combination, however, they are intended to work in concert to reverse current trends and to increase the accountability of individuals and entities in the basins in their relationship with surface and groundwater resources.

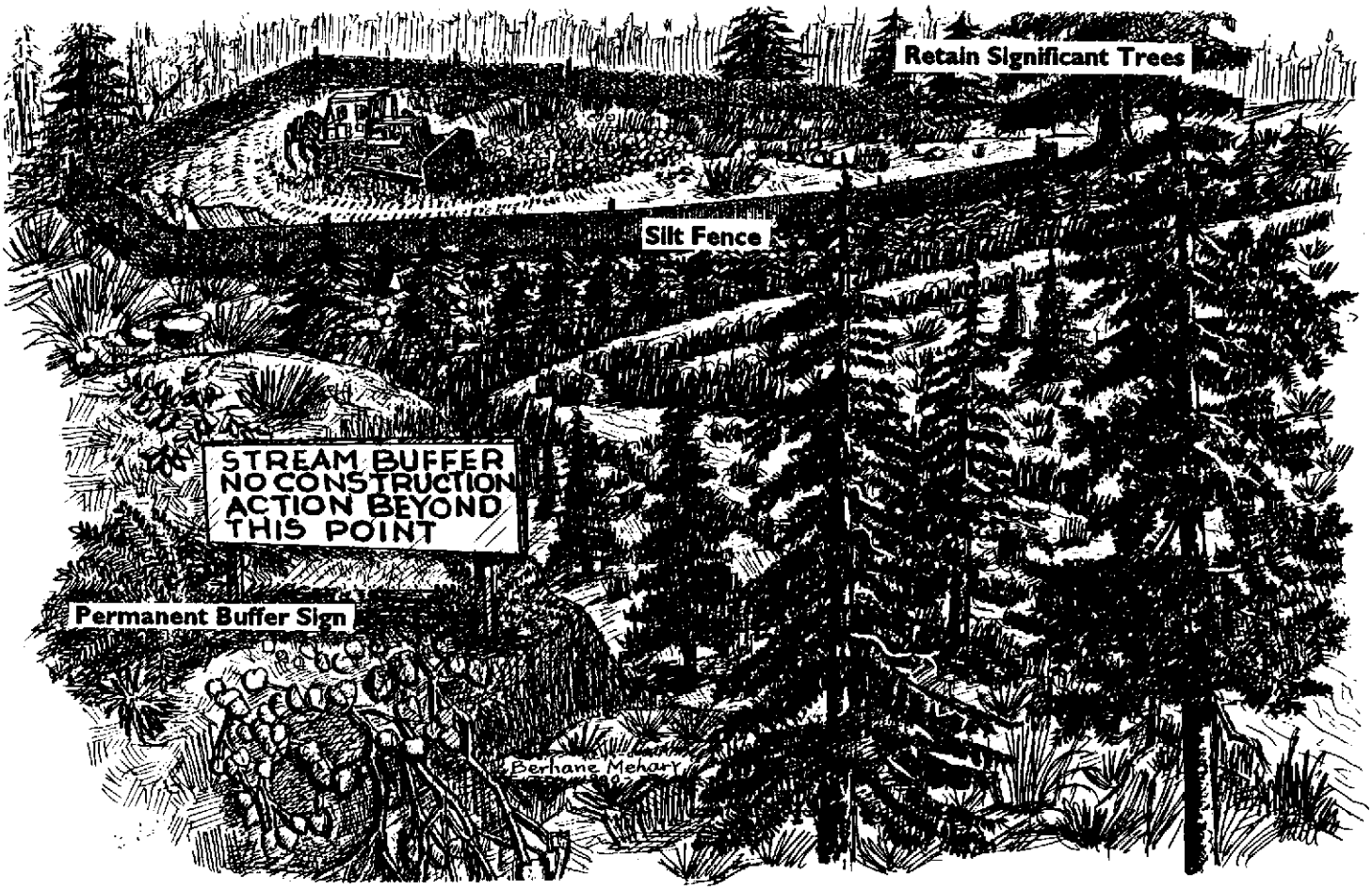


Plate 3.0.1 Stream and Wetland Protection Elements for Site Development

Plate 3.0.2 Stream Corridor Conifer Revegetation

3.1 ZONING CONTROLS FOR STREAM CORRIDORS

Introduction

Several significant stream corridors in the Hylebos Creek and Lower Puget Sound systems have been designated for urban development under the 1986 King County Federal Way Community Plan and Area Zoning and the comprehensive plans and zoning codes for the Cities of Federal Way and Milton (see Figure 5.1.2). These areas include some of the most important and threatened wetland and stream habitats in the two basins. The intent of BW-1 is to restrict development in ravine areas adjacent to stream corridors in order to preserve the stability of valuable stream channel reaches.

Recommendation:

BW-1: Low Density Zoning Controls for Protection of Stream Corridors and Ravines

All stream corridors and ravines within RSRAs and LSRAs should be zoned at rural densities of 1 unit per 5 acres or less. Criteria for determining these significant resource areas are discussed in Chapter 2.4 and shown in Figure 2.1.1. These corridors include portions of lower Joes Creek (tributary 0388, RM 0.0 to 0.8); East Branch Hylebos Creek (tributary 0006, RM 6.0 to 6.75); West Branch Hylebos Creek (tributary 0014, RM 0.0 to 0.9), and in, and adjacent to the Spring Valley Wetland on tributary 0013 (RM 0.6 to 1.5) (see also Sub-basin Recommendations WHL-10, EH-3, and SL-4).

The recommendation does not apply to parcels that are already developed to higher densities. The low-density area and ravine corridors should include all parcels that are either undeveloped, or developed to densities which do not exceed 1 unit per 5 acres. The zoning boundary should be set at the top of each ravine and extend downslope to the stream on stream corridors except in the Spring Valley Wetland area. The recommended low-density area in the vicinity of the Spring Valley Wetland is bounded by S 359th Street on the north, I-5 on the east, S 373rd (extended) on the south, and 8th Avenue S and SR 99 on the west. It should include all Class III landslide hazard areas and erosion hazard areas as defined in the King County Sensitive Area Ordinance (SAO) or their equivalent in other applicable local codes (see also BW-4.2).

Affected Entities:

The three entities in the basins affected by this recommendation, Federal Way, King County, and Milton, have a wide range of current zoning in these stream corridors including single-family, multifamily, and office park. To be consistent with the recommended density, Federal Way, King County, and Milton should rezone the affected reaches in their jurisdiction.

Discussion of Recommendation:

Regionally significant and locally significant resource areas (RSRAs and LSRAs) include stream reaches and wetlands that are important to the stability of aquatic ecosystems and the viability of fish and wildlife populations as biological, recreational, and economic resources. Urban-density development necessitates large-scale alterations of the landscape. These alterations result in more stream and wetland crossings, more construction-related erosion, loss of small streams and wetlands to culverts or fills, increased stormwater runoff rates and volumes, loss of large conifer trees that stabilize stream channels, and intrusion into stream and wetland buffers. No combination of mitigation strategies completely avoids these impacts with intensive development.

Higher urban densities can be achieved in other less sensitive parts of the basins. Overall, the lower densities are expected to have substantially fewer and smaller-scale impacts. Adoption of the recommended zoning in the LSRA and RSRA stream ravine corridors by Federal Way, King County, and Milton is an important step in preventing the adverse effects from development and associated human intrusions. Applying such measures to the ravine areas, where development impacts are greatly magnified by the steep slopes in proximity to the stream, yields the most effective protection of the stream while affecting the least amount of land area. Without adoption of this recommendation there is an increasing potential for disturbance to, or destruction of, streamside and slope vegetation and/or instream LOD which are sustaining habitat and maintaining stream stability in these reaches. The loss of these functions would further destabilize these reaches. Secondary impacts would seriously affect the viability of the remaining fishery resource in the basins and result in the deposition of substantially more eroded sediment downstream.

The recommendation applies to approximately 620 acres or about 2.5 percent of the area in the basins. Implementing this recommendation will result in lower density within these limited areas.

3.2 CONTROL OF VOLUME AND TIMING OF RUNOFF FROM DEVELOPING SITES

Introduction:

In a natural landscape, water reaches streams by complex and dispersed paths. Water may infiltrate to groundwater aquifers or may flow underground to the stream as shallow groundwater flow, or interflow. The remainder of the surface runoff is slowed by vegetation or low channel gradients. During site development, removal of natural land cover, and the paving of the land surface increases the volume and rate of runoff and decreases the time in which water reaches the stream or storm drain. The cumulative effects of widespread development are that streams reach higher peak flows more frequently than before development. These large, more frequent flows cause greater flooding, erosion, and damage to aquatic habitat. Recommendation BW-2 and BW-3 are intended to control the size and frequency of post-development flows through the use of enhanced onsite detention standards.

Recommendations:

BW-2: Basinwide Onsite Detention Standard

To control downstream or downslope impacts of new development, including public and private street and highways, onsite retention/detention (R/D) facilities in the Hylebos Creek and Lower Puget Sound basins should be designed to control the post-development 2- and 10-year flows to corresponding pre-development levels. The calculated storage volume should be increased by a safety factor or 30 percent to account for various uncertainties in the analysis and design.

The design methodologies recommended are either a modification of the 1990 King County Design Manual or the use of a calibrated continuous hydrologic model. Following further modeling of these basins, it was determined that the existing Design Manual methodolgy would not enable development in the planning area to achieve the post-development run-off objectives of reducing peak 2-and 10-year flows to pre-developed levels. Therefore, one of the recommended methodologies includes modifications to the Design Manual methods. The modifications will produce a detention pond that reduces 2- and 10-year peak flows to pre-development rates. The modifications to the current manual include a 7-day design storm with a more representative distribution instead of a 24-hour storm and a more accurate method of determining the time of concentrations. For additional details regarding these modifications, contact King County SWM Basin Planning.

BW-3: Stream Protection Onsite Detention Standard

In subcatchments where future flows are expected to have significant adverse impacts on stream stability and habitat, onsite detention ponds for new development, including public and private streets and highways, should be designed such that post-development flow peaks and durations are reduced to pre-development levels for flows greater than 50 percent of the 2-year and less than the 50-year. In addition, the 100-year post-development peak flow should be reduced to the 100-year pre-development level. The recommended method of designing these detention ponds is a calibrated continuous hydrologic model, preferably HSPF.

An alternative to using a continuous hydrologic model is SCS methods with a design release rate such that the post-developed 100-year flow is released at 70-percent of the pre-development 2-year rate. A 24-hour design storm, as described in the 1990 King County Design Manual, is recommended. Additional design methods may become available in the future. Contact King County SWM Basin Planning for additional details. See Figures 4.1.3, 4.2.3, and 4.5.3 for areas where this standard applies.

Affected Entities:

The Basinwide Onsite Detention Standard (BW-2) is a modification of the Design Manual. The design methodology of all entities currently using the Design Manual should be updated to include 7-day design storms and revised time of concentration calculations. The revised methodology produces detention ponds that are between 50 percent and 100 percent larger, depending on site density.

Milton currently utilizes a less stringent standard that requires design of onsite detention ponds to control the 10-year storm. To be consistent with the Basin Plan, it is recommended that Milton adopt the detention standard in BW-2.

The Stream Protection Onsite Detention Standard (BW-3) applies to parts of five entities in the basins: King County and Milton in subcatchment H2 on tributary 0015 on the East Branch Hylebos Creek and in Tacoma, Pierce County, and Federal Way in subcatchments J2, J6, J7, and J8 that drain into upper Joes Creek and subcatchment WH3 in tributary 0013 which flows into West Branch Hylebos Creek. Presently no affected entity has this standard in place. To be consistent with the Basin Plan it is recommended that Federal Way, King County, Milton, Pierce County, and Tacoma adopt recommendation BW-3 in the areas indicated.

Discussion of Recommendations:

Computer modeling results suggest that existing methods of detention pond design will not be adequate for the hydrologic conditions found in the planning area. Peak flow releases from detention ponds designed under current standards in the 1990 King County Design Manual were found to increase substantially over undeveloped conditions. Increasing the length of design storm to 7-day and reducing the time of concentration (BW-2) will produce detention ponds that reduce post-developed peak 2- and 10-year flows to pre-developed levels.

Specific areas have special characteristics that warrant an onsite standard different from the general basinwide standard above. These areas are generally more sensitive to increased flows from urbanization and thus require enhanced detention standards. Hydrologic modeling demonstrates that onsite detention, using the standards recommended in BW-3, would reduce peak flows and long-term flow durations to pre-developed levels. Thus potential for increased erosion from instream sources is, in theory, eliminated with this standard.

3.3 SENSITIVE AREA PROTECTION

Introduction:

The recommendations in this section (BW-4 through BW-15) are intended to reduce or minimize the major impacts associated with development in sensitive areas, particularly streams, wetlands, and steep slopes. Many of these recommendations are based on the existing sensitive area ordinances of King County, Federal Way, and Des Moines. For more specific information, the reader is referred to these codes.

The recommendations are grouped into five categories: a) stream and wetland protection; b) soil and vegetation retention; c) steep slope protection; d) impact mitigation; and e) sensitive area mapping. The issues involved with each category are described below. The basinwide recommendations follow these descriptions.

a) Stream and Wetland Protection

The Hylebos Creek and Lower Puget Sound systems include many streams and wetlands that support populations of fish and wildlife. These systems have also helped to buffer the impacts of increased storm flows through time, however, land development and other human activities have caused significant damage. Damage is especially severe in upper Joes Creek, lower Lakota Creek, lower McSorley Creek, and upper West and East Branches of Hylebos Creek. In these systems, stream channels have been altered, wetlands lost, vegetation removed, soils eroded, and stream corridors encroached upon. These modifications, have in turn resulted in degraded habitat, sediment deposition, and increased flooding. As development proceeds and more wetland and stream alterations occur, the erosive force of high flows and the frequency of flooding will increase throughout the basins. In response to these issues, two types of recommendations are made in BW-4 to BW-7. These include: 1) stream and wetland buffers, and 2) stream intrusion controls which include livestock access limitations and stream modification requirements.

b) Soil and Vegetation Retention

Vegetation intercepts and transpires falling rain and absorbs water through its roots. Trees also increase infiltration by breaking up the soil structure, particularly in till areas. Conversion of native vegetation to urban uses contributes to significant increases in runoff. Loss of native streamside vegetation, especially large conifers, adversely affects habitat, channel stability, food availability, nutrients, shade, and shelter. These elements are essential for maintaining good aquatic and terrestrial habitat.

The addition of fine-grained sediment to stream channels is a significant cause of fish habitat and water quality degradation in the basins. This fine sediment clogs stream gravels, reduces the clarity of the water, and carries a substantial proportion of the urban contaminants into downstream water bodies. Active construction and land grading are the

primary sources of observed turbidity problems in individual streams throughout this and other basins in King County.

To address these issues, two types of recommendations are made in BW-8 and BW-9. The are: 1) clearing, grading, and filling limitations to minimize the loss of native vegetation; and 2) seasonal clearing and grading limitations to reduce sedimentation during the development process.

c) Steep Slope Protection

Hylebos Creek and the Lower Puget Sound basins have numerous steep slopes. Some of these areas are threatened; others are actively moving. Recommendations BW-10 is intended to minimize drainage impacts on erodible slopes through reducing the potential for mass wasting and erosion.

d) Impact Mitigation

The significant decline in the quality and number of surface water resources providing stormwater storage, water quality, and habitat benefits greatly increases the importance of each stream segment, wetland, and lake that still remains. Development codes and environmental regulations generally require mitigation for project impacts to these resources. However, past mitigation requirements for impacts generally failed to adequately restore or compensate for losses to these resources. In many cases, the technology has not been available, while in other cases it may have been improperly applied or the project was not monitored to make corrections. Recommendations BW-11 to BW-14 are made to strengthen mitigation standards and procedures.

e) Sensitive Area Mapping

Sensitive area regulations will preclude development of stream, wetland, and steep slope areas. Sufficient information on these development constraints is not readily available for these conditions to be taken into consideration before land is purchased or developed. Recommendation BW-15 addresses this situation.

Recommendations:

a) **Stream and Wetland Protection**

BW-4: Stream Buffers

1. A minimum 100-foot buffer from the ordinary high water mark (OHWM) should be required on Class 2 streams containing salmonids, such as in Joes, Lakota, and Hylebos Creeks. For other Class 2 streams and Class 3 streams, the buffers should be 50 feet from the OHWM on each side of the stream (no Class 1 streams exist in the planning area). Buffers should be measured horizontally from the OHWM.

2. In RSRAs and LSRAs (see Figure 3.3.1 and designation criteria in Chapter 2.4), a minimum buffer of 150 feet from the OHWM on each side of all

Class 2 streams should be required. This recommendations applies to the East Branch Hylebos ravine tributary 0006 (RM 6.0 to 6.75), lower Joes Creek tributary 0388 (RM 0.0 to 0.8), West Branch Hylebos Creek tributary 0014 (RM 0.0 to 0.9), and West Branch Hylebos Creek tributary 0013 (RM 0.6 to 1.5). For Class 3 streams, the buffer should be a minimum 100 feet from the OHWM on each side of the stream. This recommendation applies to drainages tributary to the Spring Valley Wetland. Where site conditions permit, the growth of large conifers should be encouraged in stream buffers. (See also BW-16, Basin Revegetation).

Stream classes are defined in Appendix A. Exceptions to the stream buffer standards are noted in the King County Sensitive Areas Ordinance (SAO).

BW-5: Wetland Buffers

At a minimum, the buffers should be 100 feet from the edge of Class 1 wetlands except for the West Hylebos Wetland RSRA and Spring Valley LSRA; 50 feet from Class 2, and 25 feet from Class 3 wetlands. The West Hylebos and Spring Valley Wetlands are the only wetlands that would not receive additional protection from the shoreline management program, therefore these two wetlands should have a 150-foot buffer.

Wetland classifications are defined in Appendix A.

BW-6: Livestock Access Control

Access to streams and wetlands should be limited by fencing livestock from riparian buffers or other equivalent means. Provisions can be made for access to watering points.

BW-7: Limitations on Stream Crossings and Stream Modification or Relocation

1. Non-essential stream crossings should not be allowed unless an analysis determines that compared to other alternatives, the crossing has the least environmental impact to the stream system. Permitted crossings should not interfere with the free passage of fish nor restrict the predicted future 100-year flows. All crossings should have adequate clearance to pass flows and large woody debris. One of the following design alternatives defined below should be used. In decreasing order of preference, and only where site conditions eliminate the feasibility of a higher ranked alternative, site alternatives are:

   a. Roads:
      1) Bridges with abutments placed outside the OHWM of the stream channel.

      2) Bottomless pipe arches with footings placed outside the OHWM of the stream channel.

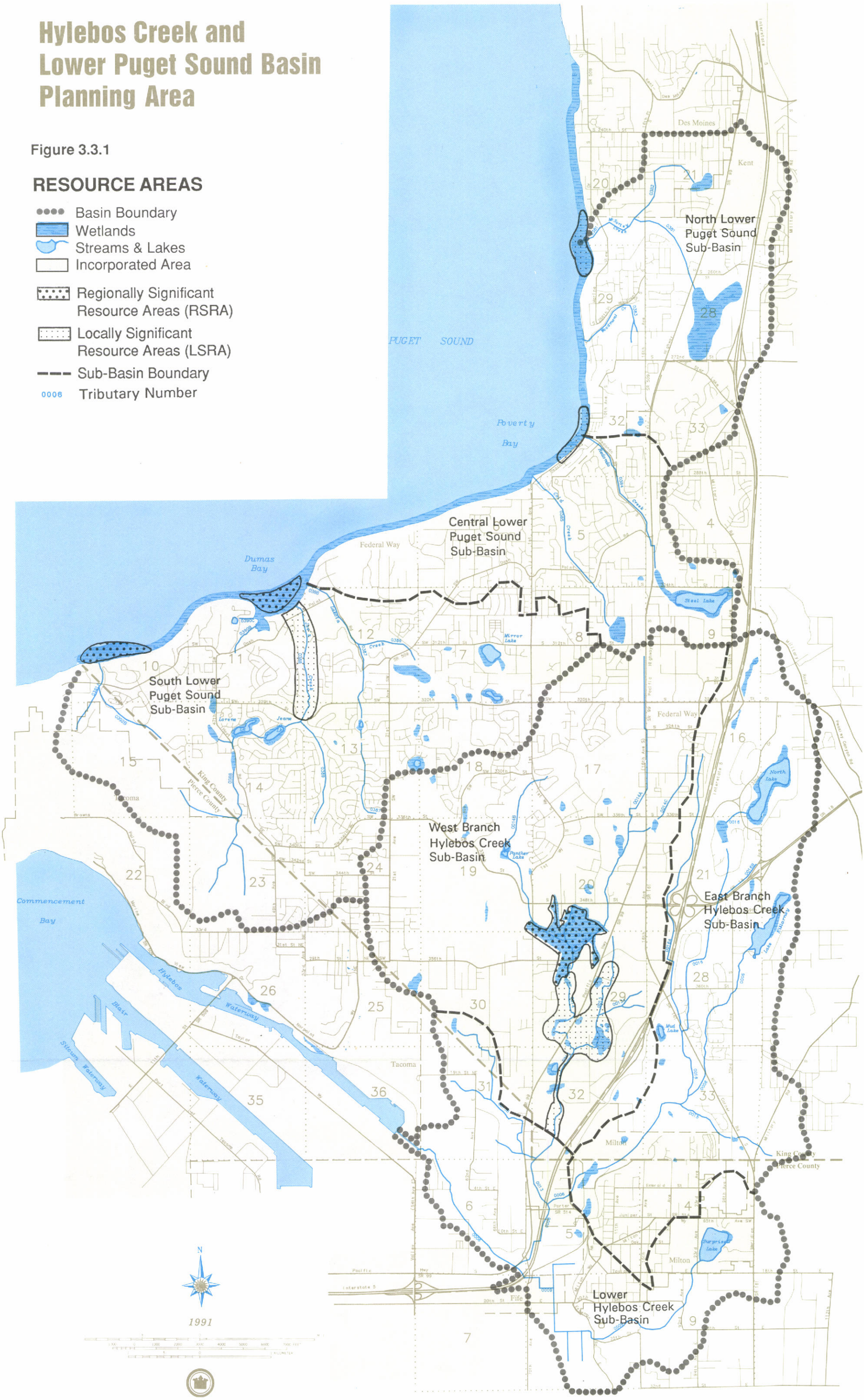
      3) Arch culverts installed in accordance with the King County Surface Water Design Manual.

Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 3.3.1

RESOURCE AREAS

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Regionally Significant Resource Areas (RSRA)
- Locally Significant Resource Areas (LSRA)
- Sub-Basin Boundary
- 0006 Tributary Number



b. Pipelines:

1) Jacked and bored under active stream channel starting outside the OHWM.

2) Suspension over the active channel.

3) Restoration of functions and values of natural stream channel features where channel disturbance is unavoidable.

2. Major modification or relocation of Class 2 stream channels should not be allowed. Modifications or relocations of Class 3 streams should not be permitted unless an analysis determined that, compared to other alternatives, such modifications or relocations have the least environmental impact to the stream system.

a. If stream modification or relocation is permitted, the mitigation plan must be implemented with a contingency plan. The mitigation plan should identify long-term (25 years) goals and objectives for restoration of the stream channel and riparian areas. A three- to five-year monitoring program should be implemented to track success of the mitigation and make necessary adjustments. Mitigation should be designed to resist the 25-year storm event. The mitigation plan and monitoring program should be secured by a cash deposit or letter of credit for 100 percent of the cost of modification or relocation and the mitigation. Development and implementation of project and mitigation designs, monitoring program, contingency plan, and long-term management plan should be certified by a state licensed engineer and a qualified biologist.

Following each storm season (after March 31) in the three- to five-year mitigation program period, a state licensed engineer and qualified biologist should assess the conditions of the mitigation relative to the management plan goals and objectives and report their findings to the appropriate jurisdiction. This report should also include recommended actions needed to correct problem conditions and an action plan to implement these modifications. Following approval by the jurisdiction and agencies involved, the action plan should be implemented prior to the next storm season (before September 15).

3. The Federal Way Sewer and Water District should evaluate their existing utility stream crossings to determine if they are adversely impacting hydrologic or biologic functions. Where these functions are impaired, crossings should be reconfigured according to the recommendations in BW-7. (See also Chapter 4, Sub-basin Recommendations.)

b) Soil and Vegetation Retention

BW-8: Clearing, Grading, and Filling Limitations

1. Filling of more than three feet in vertical depth or excavation of more than five feet in vertical depth, or any grading that involves more than

100 cubic yards of material, should require a permit. In environmentally sensitive areas such as streams, wetlands, steep slopes, or their buffers, a permit should be required for grading of any quantity or dimension.

2. Erosion, sedimentation, and stormwater controls consistent with the 1990 King County Surface Water Design Manual or updates, as adopted by the entity, should be required to be in place and inspected for appropriate installation before clearing, grading, or filling begins. Regular inspection of these controls should be required at specific phases of site work to ensure these controls are functioning as designed.

3. Sites that have been cleared, graded, or filled in violation of current or prior standards should be fully restored before construction permits are issued. Particular attention should be paid to sites that may be filled with unauthorized solid wastes. Any large releases of sediment or spills that are documented as non-compliance of permit conditions or cause water quality or habitat degradation should be fully compensated and restored before construction permits are issued.

4. Significant trees should be identified during the platting process and retained on all sites. Significant trees are coniferous trees eight inches in diameter or greater, or any deciduous tree, other than red alder, 12 inches or more diameter, each measured 54 inches above grade.

5. Significant natural vegetation should be retained. Significant natural vegetation is a concentration of vegetation with significant biological importance such as dense, mature native vegetation that supports local wildlife.

6. Areas with retained vegetation should be clearly and permanently marked on the site prior to starting site work, identified on all plat maps and title instruments, and have legally binding restrictions placed on them.

BW-9: Seasonal Clearing and Grading Limits

Bare ground associated with clearing, grading, utility installation, building construction, and other development activity should be completely revegetated by October 1 and not disturbed until the following March 31. Earth-moving or land clearing activity should not occur during this period, except for regular maintenance for public facilities and public agency response to emergencies that threaten the public health, safety, and welfare. Landscaping of single-family residences, existing permitted commercial forestry and mining activities in areas zoned for resource use, and development sites with approved and constructed drainage facilities that infiltrate 100 percent of surface runoff should be exempt from these restrictions, although appropriate measures as identified in BW-8.2 above, should be taken to prevent off-site movement of sediment. When land clearing is permitted, disturbed soil areas that are to be left unworked for more than 12 hours should be covered with appropriate erosion control measures as required in the 1990 King County Surface Water Design Manual to prevent off-site erosion.

c) **Steep Slope Protection**

BW-10: Hillslope Development and Drainage Restrictions

1. A minimum 50-foot buffer area should be required from the top and toe of the slope of landslide hazard areas or slopes that are 40 percent or greater. A minimum 15-foot building setback should be required from the edge of the buffer. Based upon a geotechnical study by a qualified geotechnical engineer, the buffer may be reduced to a minimum of 10 feet when it can be shown that the reduction will adequately protect the proposed development and the sensitive area.

2. Where drainage from impervious surfaces flows towards such areas, after appropriate water quality treatment, it should be "tightlined" down these slopes unless directed to stable receiving areas as determined by a downstream analysis.

d) **Impact Mitigation**

BW-11: Wetland and Stream No Net Loss Policy

A basinwide policy of no overall net loss of wetland and stream functions and values, and a net gain over time, should be adopted by all jurisdictions in the basins. This policy would be consistent with directives from the federal and state governments.

BW-12: Order of Mitigation

Impacts to streams, wetlands, or lakes should be mitigated using the following descending order of preference:

1. Avoid the impact all together by not taking a certain action or parts of an action;
2. Minimize impact 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 impact;
3. Rectify the impact by repairing, rehabilitating or restoring the affected sensitive areas;
4. Reduce or eliminate the impact over time by prevention and maintenance operations during the life of the actions;
5. Compensate for the impact by replacing, enhancing, or providing substitute sensitive areas and environments;
6. Monitor the impact and take appropriate corrective measures.

BW-13: Resource Replacement and Enhancement Standards

1. If a wetland must be altered or enhanced, the formulae for best wetland mitigation should be as follows with equal or greater biologic values:

   Class 1 and 2 wetlands on a 2:1 type and acreage basis
   Class 3 wetlands on a 1:1 type and acreage basis

   Projects whose primary objective is to restore the functions and values of a previously damaged wetland to approximate its pre-developed func-

tions and values should be exempt from this mitigation requirement. This exemption should only apply, however, if the restoration is not mitigation for offsite or adjacent development impacts.

2. For all stream classes, mitigation plans should be developed to replace and enhance stream elements such as pools, riffles, LOD, and spawning gravel on a relative 2:1 basis in function and area. This mitigation may be accomplished at the project site or on another stream reach through mitigation banking.

BW-14: Sensitive Area Mitigation Fund

A fund should be established solely for use in enforcing and implementing sensitive areas codes. All moneys obtained from civil penalties and sensitive area violations should be deposited in this fund.

BW-15: Sensitive Area Mapping

1. The Cities of Des Moines, Federal Way, Milton, and Tacoma should update wetland inventory maps for areas within the basins. A high priority for Federal Way should be an inventory and delineation of the Spring Valley Wetland.

2. Streams, wetlands, buffers, and other designated sensitive areas in the County and in the Cities of Des Moines, Federal Way, Milton, and Tacoma should be shown on King County Assessor's property line maps. Entities in the basins should formally request that the assessor maps show designated sensitive areas in their jurisdiction upon their adoption of the Basin Plan.

3. Updated maps should be made conveniently available to realtors, agency officials, and the public in city halls and at King County BALD.

Affected Entities:

The six entities in the basins currently have a wide range of development codes to protect sensitive areas. The following discussion compares these codes in relation to the Basin Plan sensitive area recommendations and identifies where additional provisions are needed.

<u>King County</u>

The King County stream and wetland protection general standards for streamside buffers require a minimum of 100 feet from Class 2 streams used by salmonids, 50 feet from other Class 2 streams, and 25 feet from Class 3 streams. The minimum requirement for wetland buffer areas are consistent with the Basin Plan. The code, however, does not include a special 150-foot buffer standard for stream RSRAs and LSRAs although the possibility of enhanced buffers for areas of higher resource value is acknowledged.

The King County code includes livestock access limitations to surface waters, such as stream fencing. Stream modification standards for road

crossings are consistent with the Basin Plan. However, the code does not include requirements for pipeline crossings and stream channel modifications or relocations that are as stringent as the Plan.

The King County stream and wetland protection standards are not as strict as the Basin Plan. In order to provide adequate protections, King County should adopt recommendation BW-4.2, BW-7.1b, and BW-7.2. The soil and vegetation retention provisions in King County generally require a permit when more than 100 cubic yards of material is graded or filled. In sensitive areas, a permit is required for grading any quantity or dimension of material. Erosion and sedimentation controls according to the Design Manual must be in place and inspected before site work begins and regular inspections are made during development. Sites that are cleared, graded, or filled in violation of the standards must be fully restored before construction permits are granted. Significant trees must be retained, however retention of significant vegetation is not required. Permanent signage of retained areas must be on sites, shown on plats, and recorded on title instruments. Clearing and grading is generally prohibited on erosion hazard areas, where slopes are 15 percent or greater, between November 2 and March 31.

The King County soil and vegetation retention standards are not as stringent as the Basin Plan. To be consistent with the Plan, King County should adopt recommendations BW-8.5 and BW-9.

Steep slope buffer and setback standards in King County are consistent with the Basin Plan. No changes are recommended in this part of the King County code.

The King County impact mitigation requirement is consistent with the Basin Plan. No changes are recommended in this part of the code.

The County Assessor is in the process of incorporating previously identified sensitive areas into its maps. It is recommended that King County adopt recommendation BW-15 to continue this process with the updated inventory information.

The King County code has a number of provisions that can effectively protect the sensitive areas of the unincorporated portions of the plan area. Of primary concern in the planning area is curbing the heavy sediment loading, especially in McSorley and East Branch Hylebos Creeks. Development-induced erosion is adding to the instream degradation in these systems and impacting the significant resource areas at the mouth of McSorley Creek and in the lower East Branch Hylebos ravine. Protection of significant vegetation and amending the seasonal clearing and grading limitations are of prime importance in addressing this problem. By adopting recommendation BW-9, site disturbance limits would be extended to a critical month, October. The effect would be to significantly reduce sedimentation from the accumulated soils exposed during summer construction that are washed into streams by storm events during this month, about 10 percent of the average annual total. Retention of significant vegetation in these drainages will hold the soils in place, absorb more precipitation than grass and ornamental varieties, and provide better habitat for remaining wildlife.

Des Moines:

The Des Moines stream and wetland protection requirements include a minimum buffer of 100 feet from Type 1, 2, and 3 streams and a 35-foot buffer from Type 4 and 5 streams. Minimum buffer areas from Class 1 and 2 wetlands are 100 feet and 35-foot buffers are required from Class 3 wetlands. No specific requirements are established for limiting livestock access to streams. However, there are no animal-keeping activities in the portion of Des Moines in the planning area.

Stream modification provisions require bridges on streams that support salmonids. Where culverts are used, they must be superspan or oversized. Crossings are not permitted in salmonid spawning areas unless no other feasible crossing site exists. Bridge piers or abutments must be placed outside the floodway or OHWM, as appropriate. Specific requirements for stream relocation or modifications and pipeline crossings are not included in this code.

The Des Moines regulations for stream and wetland protection are not fully consistent with the Basin Plan. To be consistent, Des Moines should adopt recommendations BW-7.1b, and BW-7.2 for the portion of the city in the planning area.

Des Moines determines allowed site disturbance limitations according to the slopes on each site. On slopes between 0 percent and 15 percent, the entire site can be disturbed. Sites with 15 percent to 40 percent slopes are allowed decreasing amounts of disturbance with increasing slope. Where slopes are 40 percent or greater, only one-third of the site can be disturbed.

Clearing is limited to the minimum necessary for construction. A permit is required for any grading, filling, or clearing. Stormwater controls are required for clearing, filling, and grading according to the Des Moines Surface Water Design Manual. However, developments are not required to have erosion and sedimentation measures inspected prior to, and during various phases of site work. The code does not include provisions for protecting significant trees or significant vegetation. However, site disturbance activity is controlled by encouraging consolidation of buildings, use of common drives and utility corridors, reducing impervious surfaces, and maximizing the use of natural contours. Grading beyond 10 feet from a building footprint is prohibited. Retained vegetation must be permanently marked on the site, shown on plat drawings, and described in the title. Seasonal clearing, grading, and filling regulations limit these activities to between April 1 and October 1 on hillsides within erosion hazard areas.

The Des Moines soil and vegetation retention code is in part consistent with the the Basin Plan. To be fully consistent, it is recommended that Des Moines adopt recommendations BW-8.2, BW-8.4, and BW-8.5 for the portion of the city in the planning area.

Steep slope protection standards in Des Moines require a 50-foot buffer of native vegetation from the top, toe, and sides of all ravine

sidewalls. However, this buffer can be reduced to ten feet with a geologic study indicating that a smaller buffer will not create hazardous conditions. Grading, clearing, and filling on gradients with 15 percent or greater slope must follow the slope disturbance limitations discussed above.

The Des Moines steep slope protection regulations are consistent with the Basin Plan. No change is recommended in this portion of the City code.

Impact mitigation regulations in Des Moines do not include a policy of no overall loss of stream or wetland functions or values. They do not specify an order of preference for mitigation of impacts to sensitive areas. However, development in sensitive areas and their buffers is generally prohibited. All other projects must show the proposal is necessary to the reasonable use of the property, construction techniques will result in the least adverse impact to sensitive areas, and they comply with the Des Moines Surface Water Design Manual.

Mitigation requirements for impacts include restoration for impacts occurring prior to development approval and compliance with a full mitigation plan. Compensation for loss of stream or wetland resources requires compliance with a mitigation plan and replacement of the resource with an equal or greater size, function, and value resource. Ratios for stream and wetland replacement or enhancement are not specified. Provision for a mitigation fund is not included in this code.

The Des Moines impact mitigation standards are in part consistent with the Basin Plan. To meet the Plan, Des Moines should adopt recommendations BW-11, BW-12, BW-13, and BW-14 for the portion of the city in the plan area.

Many of the sensitive area code provisions in Des Moines have a positive effect on protecting the portion of McSorley Creek in the city. Stream, wetland, and steep slope requirements are especially helpful. However, because of flooding and impacts from sedimentation in the lower portion of the creek, particular emphasis is needed on controlling erosion and stormwater runoff during site development, in strengthening resource loss policy, and mitigation procedures. Therefore, implementation of recommendations BW-7.1, 3W-7.2, BW-11, BW-12, and BW-13 is very desirable.

Federal Way

The Federal Way stream and wetland protection buffer standards require a 100-foot buffer measured from the top of the bank of streams or tributaries that support local or migratory fish. A 50-foot buffer is required from the top of the bank of all other streams. The buffer requirements for Class 1, 2, and 3 wetlands is 100 feet. This code does not include special buffer standards for stream and wetland RSRAs and LSRAs. No specific requirement limits livestock access to streams.

Stream modification requirements allow the use of culverts if no significant habitat area would be destroyed by their use and if it is

necessary for the reasonable use of property. Where culverts are used, they must be sized for fish passage and the 100-year storm flow. No specific requirements apply to stream pipe crossings, relocations, or modifications.

Stream and wetland protection standards in Federal Way are in part consistent with or exceed those in the Basin Plan. To be fully consistent with the Plan, Federal Way should also adopt recommendations BW-4.2, BW-5, BW-6, BW-7.1, and BW-7.2.

The Federal Way soil and vegetation retention regulations limit the amount of material that can be cleared, graded, or filled (land surface modifications) in several ways. These activities are not permitted on undeveloped sites without approval of a specific development plan. In any one year, not more than 100 cubic yards of material can be graded or filled on a developed site. For sites larger than one acre, this limit is 100 cubic yards for each acre. Significant trees and significant vegetation must be retained. In residential developments, 15 percent of the gross area must be set aside for permanent open space.

Land surface modifications require stormwater and erosion controls according to the Federal Way Surface Water Design Manual. However, such controls are not required to be inspected prior to beginning of and throughout site work. Where vegetation has been disturbed in violation of the code, it must be replaced in kind. There is no provision for permanently marking or recording the vegetation to be retained on a site and no seasonal restriction on clearing, grading and filling applies.

The Federal Way soil and vegetation retention standards are partially consistent with the Basin Plan. To fully meet the Plan, Federal Way should adopt recommendations BW-8.2, BW-8.6, and BW-9.

Steep slope protection provisions in Federal Way require a 25-foot buffer from Class III landslide hazard areas, Class III seismic areas, erosion hazard areas, and other slopes 40 percent and greater. To meet the Basin Plan, Federal Way should adopt recommendation BW-10.

The Federal Way impact mitigation regulations do not include explicit policies of no overall loss of wetland or stream functions or values, a preferred order of mitigation, resource replacement or enhancement standards, or a mitigation fund. To be consistent with the Basin Plan, Federal Way should adopt recommendations BW-11, BW-12, BW-13, and BW-14.

The current wetland inventory in Federal Way (King County, 1983) did not include a number of wetlands, the most prominent of which in Federal Way is the 95-acre Spring Valley Wetland, an LSRA, located at the headwaters of tributary 0013. Although much of this wetland will be set aside for open space, future commercial and residential development in the surrounding area threaten the great value of the biologic and hydrologic functions now performed by this wetland. Without an inventory of the extent of resources and determination of the wetland boundary, the potential exists for encroachment into this and other uninventoried wetlands in the city. Consequently, it is recommended that Federal Way adopt recommendation BW-15.

The Federal Way development code contains several important protections for surface waters through its stream and wetland buffer requirements and land surface modification limitations. The current and future surface water conditions in the two basins suggest a wide range of other code provisions are also essential to prevent further cumulative impacts to these sensitive areas. Particular needs include strong measures to limit sedimentation from site development; to maintain channel conveyance capacity; to protect remaining stream habitat, especially in significant resource areas in Joes Creek, Hylebos Creek, and the Redondo beach wetland; and to ensure mitigation policies and procedures are able to avoid further resource losses.

Adoption of the following Plan recommendations is of particular import in addressing these needs: BW-4.2, BW-7.1, BW-7.2, BW-8.2, BW-8.6, BW-9, BW-10.1, BW-11, BW-12, BW-13, BW-14, and BW-15.

Kent

According to the King County Sensitive Areas Map Folio (King County, 1987), the portion of Kent within the plan area does not contain streams, wetlands, or steep-slope sensitive areas. Therefore, no analysis or recommendations are made for the Kent development code regarding protection of or mitigation for these resources.

Kent requires a permit for filling or grading of more than 50 cubic yards of material. Grading and filling projects must comply with the erosion and sedimentation controls in the Kent Surface Water Design Manual. Erosion and sedimentation measures are required to be inspected prior to site work. Regular inspections at specific phases of site work are not required. Significant trees must be retained although significant vegetation is not required to be retained. Retained vegetation is not required to be permanently marked. Trees removed in violation of the code must be replaced. The code does not include seasonal clearing and grading limitations.

The Kent soil and vegetation retention standards are particularly important, given the presence of the city in the area tributary to McSorley Creek. McSorley Creek receives high sediment volumes during storm events. These sediments are impacting instream habitat and the LSRA estuary at the mouth of the creek. The Kent standards to address this problem are in part consist with the Basin Plan. To meet the Basin Plan, it is especially important that Kent adopt recommendations BW-8.2, BW-8.3, BW-8.5, BW-8.6, and BW-9.

Milton

The Milton development codes related to sensitive areas in the basins do not include specific standards for protecting streams, wetlands, steep slopes, RSRAs, or LSRAs. A permit is required for grading or filling that involves more than 100 cubic yards of material. Stormwater and sedimentation controls for these activities must conform to the 1979 King County Design Manual. Compared to the 1990 King County Manual, the 1979 version is much less stringent. For example, stormwater ponds are sized

only for storms up to the 10-year event. These ponds also tend to be undersized due to calculation methods. Standards regulating clearing, and impact mitigation are not in place.

The Milton development code is not consistent with the Basin Plan. It is essential that the deficiencies in this code are corrected quickly, because one of the most valuable resources in the two basins, the RSRA in the lower East Branch Hylebos Creek ravine, is strongly impacted by stormwater discharges and development-related sedimentation. It is particularly important that Milton adopt recommendations BW-4, BW-7.1, BW-7.2, BW-8.2, BW-8.3, BW-9, BW-10, BW-11, BW-12, BW-13, and BW-14 for the portion of the city in the plan area to address these problems. Adoption of the current Design Manual (King County, 1990d) would also provide an important tool in preventing downstream sedimentation and future localized flooding.

Tacoma

The Tacoma development code does not include specific standards for protecting streams, wetlands, and steep slopes in the portion of the plan area in the city. Grading and filling involving more than 50 cubic yards requires a permit. The King County Surface Water Design Manual erosion controls and drainage standards apply. However, sites are not required to be inspected prior to and during site work for installation and maintenance of these controls. Grading and filling in violation of the standards does not require site restoration. Clearing restrictions and impact mitigation standards are not in place.

The Tacoma sensitive area development standards are not consistent with the Basin Plan. It is anticipated, however, that if pending code amendments are adopted by the City, many new provisions will meet the Basin Plan. More stringent protections will still be needed especially in upper Joes Creek as it builds out, to reduce development-related sedimentation and stormflows downstream. Areas that have been particularly impacted by these conditions are the Twin Lakes, lower Joes Creek (an LSRA), Dumas Bay (an RSRA), and Dash Point State Park intertidal area (an LSRA). Since code revisions are not in place as of this writing, Tacoma presently needs to adopt recommendations BW-4.1, BW-5, BW-7.1, BW-7.2, BW-8.2, BW-8.3, BW-9, BW-10, BW-11, BW-12, BW-13, and BW-14 for the portion of the city in the basins.

Discussion of Recommendations:

Past development activity has significantly impacted much of the stream and wetland resource in the Hylebos Creek and Lower Puget Sound basins. As a consequence of limitations in local and federal laws, stream and wetland corridors have been encroached upon from filling, clearing, grading, animal keeping, and human intrusion. These activities have reduced stream and wetland stormwater capacity, degraded habitat, reduced groundwater infiltration, and deteriorated water quality. Buffers would substantially reduce direct stream degradation providing they are enforced. Existing intrusions would continue, because regaining full buffer widths is generally infeasible. Yet

even in those areas, some separation of upland activity from the stream should be required. Even limited revegetation of stream buffers under existing uses, for example, could provide significant benefit to aquatic resources. Although specific requirements should vary with the type of existing land use, regulation of activities adjacent to streams should provide, at a minimum, some water quality protection, minimization of bank erosion, and shading by means of undisturbed vegetation adjacent to the channel banks.

The buffer requirements (BW-4 and BW-5) together with their clear delineation on maps used by other agencies and the public (BW-15), would likely reduce future streamside clearing, channel manipulations, and wetland losses. With the retention of significant trees and significant vegetation, storage, shade, and supplies of leaf litter and large woody debris would be greatly enhanced. Species that use riparian habitats (including wetland fringes) would tend to persist longer at a given location. Such buffers are not, however, panaceas for habitat protection. While they may prevent direct human disturbance, they cannot prevent impacts from such indirect disturbances as stormwater runoff flowing into the stream. Furthermore, buffers would have no effect on development outside their boundaries. Such development will continue to parcel land into even smaller fractions, isolating habitat, reducing groundwater recharge, and increasing stormwater runoff.

Culverted crossings for roads often constrict storm flows because culverts are easily clogged with debris and can create nearby flooding. Also, fish are often unable to swim through these culverts. This can preclude the full use of available habitat. Also, utility crossings that use riprap to stabilize channels are prone to overbank erosion in high flow conditions and generally lack needed riparian vegetation. Stream crossings must be limited so they do not induce further streambank erosion; reduce riparian vegetation; or create restrictions on stormflows, instream debris, or fish (BW-7).

Eroded soil from site development has added greatly to the sediment already in surface waters. A recent study by the King County Soil Conservation District (Tiffany, 1990) found that 95 percent of the construction sites they monitored had either improperly installed or poorly maintained BMPs for soil erosion control during site development. Therefore, it is essential that erosion and sedimentation BMPs are properly installed before site work begins and that regular inspections are made throughout the development process to ensure these measures are functioning as designed (BW-8.2).

Significant trees and vegetation hold the soil in place, absorb substantially more precipitation than grasses and ornamental plants, and maintain the habitat that non-native plants cannot provide. Therefore it is important to protect significant vegetation from being cleared (BW-8.4 and BW-8.5).

Because fine sediment is only partly controlled by other erosion-control measures, seasonal restrictions are necessary to reduce its introduction and transport. The recommended restriction (BW-9) would reduce the erosivity of average annual rainfall, and thus of average erosion, by 81 percent (based on Portland rainfall as reported in U.S. Department of Agriculture (USDA) Handbook 537; equivalent data are not specifically available for western Washington).

Changing the period of allowable development activity changes the anticipated reduction in erosion compared to year-around activity. Based on data in the U.S. Department of Agriculture Handbook 537, sample reductions are listed below with the six-month period offering the best balance between erosion reduction and restrictions on activity:

Construction Period	Percent Reduction
4 Months (May-August)	90
5 Months (May-September)	88
6 Months (April-September)	81
7 Months (April-October)	70
8 Months (March-October)	58

The Plan recommendation to preclude clearing and grading activity from October through March is expected to reduce erosion in the basins by 70 percent. This recommendation would reduce erosion by an additional 10 percent over the current seasonal grading requirements in the King County SAO which precludes clearing and grading between November and March. By not clearing and grading for another month, October, significant impacts to surface water quality can be avoided. Controlling erosion impacts during October is deemed essential to countering the "first flush" effects of eroded soil on aquatic systems. First flush effects occur when eroded soils, which accumulate on development sites during the construction period, are collectively washed into aquatic systems by the first major storm event(s) of the storm season. The results can be devastating during this period because October coincides with spawning activity of several fish species whose stocks have been significantly depleted in these basins. Prior to, rather than during, October is also a more appropriate time to establish the vegetation needed to protect sites over the wet weather season. It is anticipated that when development-induced erosion is controlled primarily with this provision, aquatic habitat in both basins can improve dramatically.

Drainage discharges onto steep hillsides have initiated or accelerated erosion, leading to habitat damage and hazardous conditions. Stormwater detention alone does not eliminate these impacts. Requiring improved control of steep slope drainage impacts (BW-10), in addition to more area-specific recommendations, would reduce this serious problem. The sub-basin recommendations (Chapter 4) identify specific measures to stabilize major hazardous or erodible hillslopes that can impact instream conveyance or habitat.

Surface water modifications such as piping and relocating streams or filling wetlands, coupled with high peak flows in the two basins, have resulted in streams and wetlands that are unable to perform basic functions of controlling and conveying storm flows. These modifications also destroy the biological stability needed for healthy fishery and wildlife resources. As more streams and wetlands are adversely affected, greater reliance is placed on the remaining resources for these functions. At one time, it was generally believed that mitigation measures could be implemented to compensate for these losses. However, such attempts have been costly, while their success rates are quite low. This may be because the systems involved are more complex than first imagined and that the methods behind these projects are quite crude. The result has been a rapid decline in stream and wetland resources. Since

these systems are both difficult and expensive to replace, a strong policy direction is needed to avoid such losses and make net gains when possible. Where impacts are unavoidable, mitigation measures must have ample opportunity to fully compensate for lost functions and values. Consequently, replacement ratio must be at least double the size of the impacted resource to allow for uncertainty and failure (BW-13).

3.4 BASIN REVEGETATION

Introduction:

Conversion of the forests in the Hylebos Creek and Lower Puget Sound basins to impervious surfaces and other urban uses has dramatically reduced groundwater recharge, wildlife habitat, riparian habitat, and aesthetic values. Conversely, that conversion has increased surface water runoff, the incidence of hillslope failure, and the rate of stream erosion. The intent of BW-16 is to reintroduce native vegetation to the planning area to the extent possible in order to counter these impacts.

BW-16: Basin Revegetation

1. An aggressive program to plant trees and revegetate areas identified in Figure 3.4.1 should be implemented. These priority sites include high infiltration areas that are not fully developed, fragile marine shorelines (not shown on the Figure), and the key stream and wetland riparian corridors. Vegetation in these areas should be managed on a long time scale and the desired vegetation should reflect climax states in sizes and species distribution. The program should be coordinated through the Stream Steward (BW-38).

2. The planting of large numbers and diversities of native species, and protection of large conifer trees and other native vegetation should be incorporated and managed in the landscaping of public facilities such as parks, open space areas, and road corridors.

3. Establish a basin nursery where at minimal cost the public can obtain native trees, shrubs, and wetland vegetation, including locally adapted trees, to plant in priority areas during an annual arbor week event.

4. Undeveloped but legally cleared, filled, or graded sites, especially in sensitive areas should be encouraged to be restored and take advantage of tax incentives to preserve these areas (see Section 3.10).

5. Removal of fill from illegally filled wetlands, stream riparian areas, and floodplains, followed by site restoration with appropriate native plant species, should be an enforcement priority.

Discussion of Recommendations:

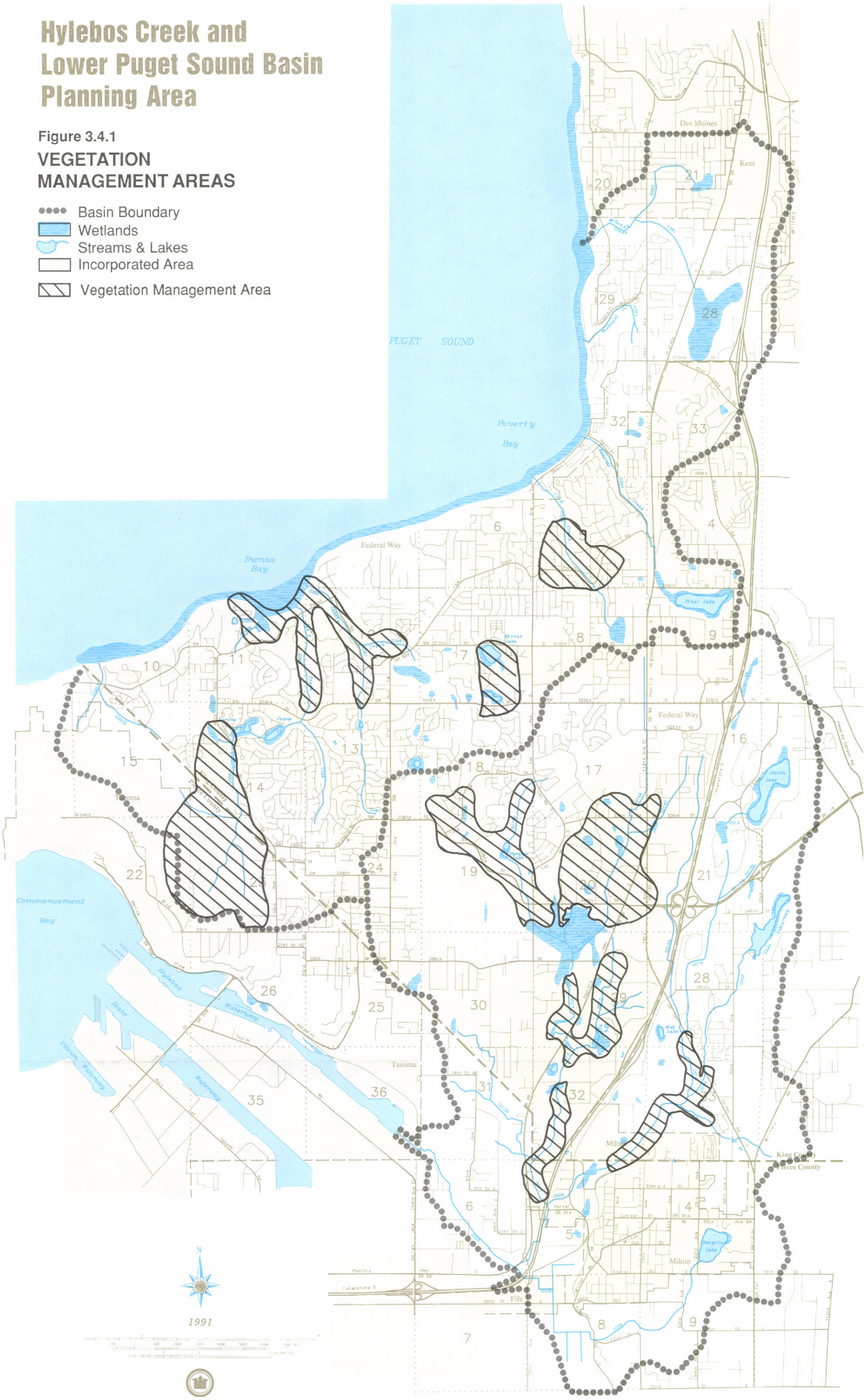
Forested stream corridors help to improve the quality of fish habitat providing shade and protected littoral areas, by contributing insect and detrital matter to the food base, and by providing additional sites for filtering pollutants entering from the watershed. Trees also help determine the structure of streambanks. They stabilize these banks and help to prevent excessive erosion. Trees that are undermined by normal stream movement in a channel can help to fortify the channel against the forces of high storm flows. Large organic debris (LOD), especially soft woods like Douglas Fir, can remain in place for many years. During this time, they keep peak flows

Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 3.4.1

VEGETATION MANAGEMENT AREAS

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Vegetation Management Area



from severely eroding the streambed and they help to restore lost habitat. Several capital projects in the Sub-basin Recommendations (Chapter 4) are designed to take advantage of the naturally stabilizing effects of LOD placement. Managing stream corridors for large conifers will maintain the constant supply of LOD needed for stream stability and habitat restoration over time.

Prior to the recent cutting and clearing, upland forests in the basins provided abundant wildlife habitat and great beauty. They also reduced surface water flows by intercepting falling rain, by absorbing water through roots and transporting it, and by creating an absorbent organic layer on the forest floor. Through these processes, surface water could readily infiltrate and recharge groundwater supplies in the outwash soils especially around Panther Lake. In till areas, where soil infiltrates slower, trees aid infiltration by breaking up the soil structure thus adding to infiltration. A long-term community effort to revegetate the basins can provide an important contribution from the general public in reducing and controlling stormwater runoff while improving basinwide aesthetics.

3.5 MANAGEMENT OF NONPOINT SOURCE WATER POLLUTION

Introduction:

Water quality sampling of storm flows taken during development of this Plan showed elevated concentrations of nonpoint source pollutants throughout the two basins (Figure 5.5.1). Pollutants identified include heavy metals, such as copper, lead, and zinc; nutrients; sediment; and fecal coliform bacteria. Probable sources for these pollutants are vehicular usage (lead and zinc); household detergents and landscaping fertilizers (nutrients); development and land-clearing activity (sediment); and pet wastes, leaking sanitary sewage facilities, or poor animal husbandry practices (fecal coliform bacteria). Stormwater runoff carries these contaminants into surface waters from parking lots, streets, and residential, commercial, industrial, and agricultural areas. Sediment loads have already impaired stream habitat in the basins' streams. High bacteria densities have resulted in the decertification of the Lower Puget Sound beaches for commercial and recreational shellfish harvesting. High pollutant levels are depleting oxygen supplies for fish and other aquatic species. Periodic exposure to high levels of heavy metals may have acute and/or chronic toxic effects on aquatic organisms.

Several new state and federal requirements have been recently enacted to control nonpoint source pollution. The Federal Clean Water Act of 1987 requires pollutant controls on stormwater discharges from municipal and industrial uses. The 1991 Puget Sound Water Quality Plan (PSQWA, 1991) requires urban jurisdictions such as Federal Way to prepare comprehensive water quality and stormwater management plans that include source identification, regular maintenance of stormwater facilities, public education, and improved enforcement programs. Nonpoint pollution sources are also regulated under a local planning and management rule (WAC 400-12). This PSQWA regulation requires entities to prepare watershed plans similar to this Plan, that address source controls for failing onsite sewage disposal systems, sediments, marinas and boats, forest practices, agricultural practices, and stormwater.

The following six components comprise a comprehensive program for the management of nonpoint source water pollution. These program elements are consistent with the intent of state and federal requirements and respond to the observed nonpoint source problems in this planning area. Basinwide recommendations follow a brief discussion of each component.

1. **Control of Nonpoint Source Pollutants** - The stormwater sampling results which show significant concentrations of heavy metals, bacteria, sediment, and nutrients throughout the planning area, indicate a wide spectrum of nonpoint sources are contributing to this problem. These pollutants are originating from residential, commercial, industrial, and agricultural activities. Both educational and regulatory measures are needed to lower these pollutant loads to acceptable levels. BW-17 identified Best Management Practices (BMPs) to control nonpoint source pollutants from these sources.

2. **Highway Runoff Program** - Runoff from highways and their corridors has been shown to be a significant source of solids, heavy metals, and other pollutants to surface waters in the Puget Sound basins. As a result DOE has directed WSDOT to develop a management program to control runoff from freeways and highways. In anticipation of this program, and in recognition of the presence of pollutants from highway runoff in streams in the two basins, BW-18 recommends a general program for the management of these pollutants.

3. **Collection and Disposal of Residuals** - Solids and liquids that accumulate in stormwater collection facilities and roadside ditches in urban areas can contain high concentrations of pollutants such as solids, heavy metals, oils and greases, and organic hydrocarbons. In some cases, concentrations can be high enough to require classification of these residuals as hazardous wastes. As a result, regular collection and appropriate disposal of these residuals can be an important element in a comprehensive program of water quality management. The two recommendations in BW-19 include appropriate programs for collection and disposal of these residuals. The recommendations are in keeping with statewide regulations that are being prepared by DOE at this time.

4. **Maintenance of Roadside Ditches** - Regular and proper maintenance of vegetation in roadside ditches can help to settle and filter out pollutants in road and highway runoff through biofiltration. BW-20 recommends such a program for the two basins.

5. **Stormwater Infiltration Limitations** - Infiltration of stormwater is an important technique for reducing surface water runoff volumes and improving water quality. It also helps to maintain critical summer low flows by recharging groundwater. However, in some areas, slow soil permeability and prevention of ground water contamination are limitations that may locally preclude onsite infiltration. Recommendation BW-21 addresses these circumstances.

6. **Lake Water Quality** - The 12 lakes in the planning area can be either sources or sinks for nonpoint pollutants in stormwater. Comprehensive approaches are needed to identify pollutant sources and to develop solutions to lake water quality problems such as low oxygen levels, nuisance weeds, algal blooms, or sedimentation. Recommendation BW-22 provides actions for lakeside residents to undertake to improve water quality.

BW-17: BMP Programs for Control of Nonpoint Source Pollutants

1. BMP programs for control of nonpoint source pollutants originating from residential land-use practices should be developed. BMPs should include methods to prevent fertilizers, other nutrients, and toxic compounds from entering surface water especially in the sub-drainages or sites in the sub-basins identified below:

   a) West Branch Hylebos Creek
      - All tributaries and areas draining to Panther Lake (including tributary 0014B and subcatchment WH15)
      - All tributary areas above S 356th Street

   b) East Branch Hylebos Creek
      - Tributary 0016 above the intersection of SR 161 and 363rd Place
      - Drainage area northeast of SR 161 (Kitts Corner Road)

   c) North Lower Puget Sound
      - Middle McSorley Creek

   d) Central Lower Puget Sound
      - Redondo Creek (tributary 0384)
      - Middle Cold Creek

2. BMP programs for the control of sediments from upland source areas should be developed. BMPs should include covering exposed soil, installation of silt fences, and planting of riparian vegetation where appropriate in the following sites and streams (see also BW-16).

   a) West Branch Hylebos Creek
      - The Evergreen Truck Wash at 348th and SR 99
      - The Costco Development
      - West Campus Development (October 1 through April 1)

   b) East Branch Hylebos Creek
      - Regency Wood Detention Ponds

   c) Central Lower Puget Sound
      - Redondo Creek

   d) South Lower Puget Sound
      - Lower Joes Creek
      - Lower Lakota Creek

3. BMP programs for the control of pollutants from the commercial and industrial areas should be developed. Commercial and industrial uses should implement BMPs specific to the nature of the activity involved. For example, gas stations should implement BMPs for fueling stations, storage of liquids, emergency spill plans, and other appropriate practices. Absorbent pillows should be placed in large detention manholes at the entrance (inflow) to wetponds and vaults. These pillows need to be inspected, maintained, and properly disposed of (e.g., at hazardous waste handling facility). The individual owners of these stormwater facilities should be responsible for these BMPs.

It is recommended that all commercial properties and high density residential areas (i.e., apartment complexes) place absorbent pillows in strategically located manholes (e.g., furthest downstream storm drain on property). In addition, any designated car washing areas located on these properties should have connecting storm drains plumbed to the sanitary sewer system. (See also sub-basin recommendation WHL-3.)

The following commercial and industrial areas should be targeted:

a) West Branch Hylebos Creek
   - The Evergreen Truck Wash and the surrounding S 348th Street Commercial Area
   - Vicinity of SeaTac Mall at S 320th Street
   - S 336th Street northwest of SR 99

b) East Branch Hylebos Creek
   - Drainage from the Enchanted Village Bird Farm

c) North Lower Puget Sound
   - Headwaters of McSorley Creek at SR 99

d) Central Lower Puget Sound
   - Redondo Creek at SR 99

e) South Lower Puget Sound
   - Lakota Creek tributary 0086 along SR 509 and at S 320th Street

f) All Basins
   - All commercial areas located in tributary headwaters.
   - The SR 99 Corridor

4. The Seattle/King County Health Department (SKCHD) should identify high-, moderate-, and low-risk areas for onsite sewage disposal system failures, beginning with high risk areas where onsite systems are more than 15 years old. Based on areas with previous failures and stormwater sampling results, high risk areas which should be investigated further include:

   a) West Branch Hylebos Creek
      - All areas west of SR 99 and south of S 348th Street

   b) East Branch Hylebos Creek
      - Lake Killarney sub-drainage

   c) North Lower Puget Sound
      - McSorley Creek
      - Areas upstream of the confluence of tributaries 0381 and 0382.

   d) Central Lower Puget Sound
      - All areas that drain to Redondo and Lakota Creeks and directly to Puget Sound

   The following enhanced inspection/reporting program is recommended in these areas:

1) Owners of onsite sewage disposal systems in low- and moderate-risk categories should be regularly notified of the need to inspect and maintain their systems.

2) Failed or failing onsite sewage disposal systems in all risk areas should be repaired or replaced pursuant to State Department of Health (DOH) requirements in 248-96 WAC and Title 13 of the King County Board of Health.

3) In high risk areas, an onsite sewage disposal system maintenance program should be implemented through an onsite sewage disposal system maintenance district or other appropriate means. Owners should be required to have their systems routinely inspected and maintained every three to five years as needed. Such a mechanism might involve the owner sending a receipt showing "proof of inspection/maintenance activities completed."

4) An educational program targeting problem areas that focuses on increased awareness, and upkeep and maintenance practices should be developed for local residents (see BW-37).

5. BMP programs for control of agricultural sources of nonpoint source pollution should be developed. Farms plans should be prepared and implemented through the King County Conservation District to identify appropriate methods to conserve soil; better manage wastes; and control the use of pesticides, herbicides, and fertilizers for the following areas:

   a) Lower West Branch Hylebos subcatchments

   b) East Branch Hylebos Sub-basin

BW-18: Highway Runoff Controls

1. The WSDOT should develop a program for the management of highway runoff from I-5 and SR 99 in the planning area. Initial focus of efforts should be in the areas where these roads cross or drain directly to water courses. DOE directives should be followed as they become available.

2. Regular communication should be established between local entities and WSDOT to discuss planning issues (e.g., road widening or improvements projects) and goals and objectives (e.g., comparing high priority areas, BMPs, or retrofits) of the Highway Runoff Program.

3. All WSDOT facilities not performing to King County and other local standards should be retrofit accordingly.

4. New facilities should be designed and constructed to meet current local codes and standards.

BW-19: Collection and Disposal of Residuals

1. Residual wastes should be removed from all private and public drainage facilities located in areas with high vehicular usage at least twice

annually and at least once prior to October 1. Wastes should be stored at interim, designated handling facilities.

2. In coordination with DOE, a program should be developed by SKCHD for collecting and disposing residuals wastes from the cleaning of stormwater detention and conveyance systems. The program should include:

   a) A full inventory of all public and private drainage systems facilities including all natural and constructed components

   b) A centrally located area for disposal of residuals should be established. Possible locations for this facility include:

      - Federal Way Public Works Department Maintenance Building
      - King County Star Lake Maintenance Facility
      - Lakota Treatment Plant
      - Kent decant station at Kent-Des Moines Road
      - Auburn decant station.

BW-20: Maintenance of Roadside Ditches

1. Roadside ditches should be cleaned during the dry season (June 15, through September 15) of each year, preferably with the use of a Ditch Master™ or other comparable horizontal auger. Where availability of staff and equipment limit the achievement of this recommendation basin-wide, priority for auger cleaning should be given in the following in descending order of preference:
   a) Ditches within 1/4 mile of Class 2 and 3 streams in RSRAs and LSRAs;
   b) Ditches within 1/4 mile of any other Class 2 and 3 streams; and
   c) All other ditches in the basins.

2. All vegetation that is cut in the maintenance process should be removed and recycled through composting. This material should be tested before re-use. BMPs should be developed for waste disposal if it contains high pollutant concentrations. Reseeding of all ditches and backslopes should be performed immediately after cleaning in order for a dense growth of vegetation to be established before the first fall storm.

3. Herbicide spraying should be avoided on road shoulders. Alternative vegetation controls should be used wherever feasible. Alternative vegetation control recommendations should be coordinated with results from the King County Roads and Engineering Division Integrated Pest Management for Roadside Ditch Maintenance Project.

4. The current King County program allowing residents to adopt-a-ditch and maintain neighborhood roadside ditches should be expanded by notifying all basin residents of this option through regular billing notices.

BW-21: Stormwater Infiltration Limitations

Stormwater infiltration facilities should be used in rural and low- to moderate-density land-use areas wherever soil conditions are conducive to replenish groundwater and augment summer flows. New development should be required to determine the feasibility of infiltration and to provide such

facilities to the extent possible. Infiltration facilities should not be used in high density areas with multifamily or commercial land uses (see also WHL-4, Chapter 4.1).

BW-22: Lake Water Quality Management Programs

1. Lakeside residents should organize and solicit support from their communities to engage in DOE Centennial Clean Water (Lake Restoration) Grants with sponsorship by their municipality or the SWM Division, as appropriate.

2. Household BMP programs should be developed for all lake watershed residents for the control of nutrients in stormwater runoff and onsite septic facility drainage.

Discussion of Recommendations:

Increased population densities result in the development of new pollution sources from homes and commercial/industrial land uses. Failed or failing onsite sewage disposal systems can release high quantities of fecal bacteria and nutrients that threaten public health and can contaminate surface waters. On average, three to five percent of these systems fail in any one year. Many of the systems in the planning area are more than 15 years old. Statistically, these systems have the highest risk of failure.

In most cases it is both less expensive and unnecessary to replace failing onsite sewage disposal systems with sewers. However, because of the potential public health and environmental risks, strong preventive and corrective measures such as a septic system maintenance district (BW-17.4) that can require regular maintenance of systems, are desirable in high risk areas. Public notification and education programs that emphasize the importance of regular system maintenance prevent moderate- and low-risk areas from becoming high-risk areas.

Excess fertilizers and detergents washed from sites during storm events can add nutrients to streams, lakes, and wetlands. Nutrients promote nuisance algae and aquatic vegetation while depressing oxygen levels which harm fish. Hazardous household materials like pesticides, herbicides, and other chemicals, when improperly applied or disposed of, can also degrade water quality. Public education recommendations in BW-17.1 are the most effective means to encourage alternatives and improve use and disposal practices of these materials.

Poorly managed application or disposal practices of chemical compounds on hobby farms and other agricultural or horticultural activities can also contribute to degraded water quality. Animal-keeping practices are also a threat. When animals are able to directly access streams, high concentrations of fecal bacteria are deposited in streams when animals defecate. Streambanks are also constantly trampled and riparian vegetation cannot be maintained or enhanced. Farm plans and fencing animals from the stream, with allowance for watering points (BW-17.5), can correct this situation.

Commercial and industrial uses such vehicle service stations and production plants use a wide range and large volumes of hazardous compounds including

volatiles, oils, solvents, and gasoline. When these materials are improperly stored, dispensed, or disposed of they can enter storm drainage systems that lack treatment facilities, and flow directly to the surface waters.

Specific BMPs have been developed by DOE to manage these materials at their source. Management practices, such as those recommended in BW-17.3, can include installing containment structures in areas where these compounds are used to keep spills from entering storm systems, covering high use areas to prevent contact with rain, installing oil/water separators, and maintaining a sufficient vegetated buffer between use areas and surface waters.

Parking lots and the large network of roads and highways are major sources of the high concentrations of solids, toxics, oils, and heavy metals that wash into the basins' surface waters during storm events. Maintenance of vegetated roadside ditches and biofiltration swales as recommended in BW-18 can be effective BMPs for improving road runoff quality. Swales also slow the conveyance of stormwater through shallow serpentine trenches.

Public and private stormwater conveyance and collection facilities including ponds, catch basins and pipes collect debris and residues that contain sediment and elevated pollutant concentrations. To remain effective as pollutant traps, BW-19 recommends these facilities must be routinely cleaned, especially where high concentrations of pollutants are generated, such as in parking lots and commercial impervious areas near surface waters. Due to the toxic nature of stormwater residuals, they are sometimes classified as hazardous materials which must be disposed of in specialized decant treatment facilities. These facilities are designed to prevent residual materials from coming in contact with surface waters or groundwater.

Traditional methods for maintaining roadside ditches include the removal of vegetation to increase conveyance of stormwater and reduce the incidents of road flooding. However, this practice conveys both pollutants entering ditches and sediment eroded from the unprotected ditches to surface waters. If, as recommended in BW-20, vegetation is not removed, roadside ditches can provide an extensive and effective stormwater biofiltration system. Basin Plan recommendations such as increasing culvert sizes and constructing detention facilities will compensate for any minor capacity that may be lost by changing road ditch maintenance practices. Volunteer maintenance programs where residents regularly cut vegetation and clear debris from ditches in their neighborhood reduce the need for herbicide applications and lower maintenance costs while providing a way for citizens to be involved in improving water quality.

Stormwater infiltration to replenish groundwater is a generally desirable objective in the Hylebos Creek and Lower Puget Sound basins. However, limits must be placed on the density or intensity of land uses that can infiltrate runoff to reduce the risks of groundwater contamination as recommended in BW-20. Loss of groundwater recharge, where these limitations occur, is judged as a lesser impact to the aquatic system than the potential contamination of subsurface water. Although some loss is inevitable with urban development, other measures to promote the recharge of good quality runoff should help to reduce the groundwater losses.

The source controls, maintenance practices, infiltration limits recommended in the water quality recommendations, combined with better code enforcement

(BW-33 to BW-36), and sub-basin recommendations can significantly reverse the water quality degradation in the Hylebos Creek and Lower Puget Sound basins. In the long term, water quality can be restored and maintained at acceptable levels for beneficial uses.

3.6 PLAN MONITORING AND UPDATE

Introduction:

In preparing this Basin Plan, many assumptions and predictions were developed about the future of the Hylebos Creek and Lower Puget Sound basins. Although these assumptions and predictions are based on the best available information, new information may require a re-evaluation of the Plan's analyses, recommendations, or implementation strategy. At the same time, new state and federal regulations will require significant local efforts to monitor the success of nonpoint source water quality programs.

The recommendations below address the six key elements of a comprehensive programs for Plan monitoring and update: database management (BW-23); flow and development monitoring (BW-24); sediment transport (BW-25); regional coordination (BW-26); water quality (BW-27 to BW-31); and annual progress report (BW-32).

Recommendations:

BW-23: Database Management and Update

A basin-specific database that includes land-use characteristics, natural landscape features, and other mapable basin features, should be developed. The database should be updated annually or after Plan amendment. It is preferable that the database be computerized, geographically based, and readily available to King and Pierce Counties; the Cities of Des Moines, Federal Way, Fife, Kent, Milton, and Tacoma; the Puyallup and Muckleshoot Indian Tribes; and appropriate state and federal agencies. Monitoring data generated in these entities for the basins should be included in the database. Development of this database should be coordinated by the Stream Steward with recommendations BW-16 to BW-22 and BW-24 to BW-31.

BW-24: Flow and Development Monitoring

1. All capital improvement projects in the basins should have a thorough physical and biological survey of the reach influenced by the project. Flow data should be collected for a minimum of one year prior to construction. To ensure proper performance, flows entering and exiting major detention facilities should be monitored for at least two years after construction. The performance of these facilities should be evaluated using these flow data. Operations should be adjusted as needed.

2. Flow gages at the outlets of the West and East Branches of Hylebos Creek should be maintained to evaluate basin performance and changes over time.

3. A continuous stage recording gage should be established in the Midway Landfill sub-regional detention pond. The performance of this facility should be assessed and operations adjusted as needed (see Project 3321, North Lower Puget Sound sub-basin).

4. Continuous recording flow gages should be installed on the major inflow tributaries to Panther Lake. In addition, a staff gage should be

installed to record lake levels. This information should then be used to assess the current detention performance of the lake, and to design any additional flow control projects (see Project 2430, West Hylebos Sub-basin).

5. Field investigation of the Hylebos Creek and Lower Puget Sound basins should be conducted at least annually to identify flow-related changes in the surface water system and major conveyance system additions.

BW-25: Sediment Transport Monitoring

To track channel incision, channel cross-sections should be located on tributaries at knickpoints on 0014B below Panther Lake in the West Hylebos ravine and on tributary 0006 in the 1,000-foot reach below S 368th Street in Regency Woods. These sections should be resurveyed every two years, with baseline surveys made in the first year of monitoring to identify the success or potential adjustments to basin management policies affecting channel stability. In addition, recommended channel stabilization projects and sediment deposition areas should be monitored annually, with particular attention to those on the West Branch Hylebos Creek below the West Hylebos Wetland (Project 2433) and at S 373rd Street, and on lower Joes Creek (Project 3329). Results should be incorporated into the annual report (see BW-32).

Water Quality Monitoring

BW-26: Regional Monitoring

A program of long-term monitoring for water quality practices should be developed following implementation of major basinwide and sub-basin recommendations. The objective of the program should be to determine relative improvements in channel stability, erosion, sediment flux, and water quality. Program goals, data sharing opportunities, standard procedures, and the location of sampling sites should be determined by all implementing jurisdictions in coordination with the Stream Steward (BW-38). When water quality problems are identified, appropriate follow-up actions should be taken. These actions should be included in the annual reports (BW-32).

BW-27: Sampling Methods

Sampling methods used in the program should be consistent with standard protocols identified in the following references: "Recommended Protocols for Measuring Conventional Water Quality Variables in Fresh Water of the Puget Sound Region" (EPA, 1990); "Guidance for Conducting Water Quality Assessments" (DOE, 1989); and "Standard Methods for Examination of Water and Wastewater" (APHA, 1985).

BW-28: Short-Term Runoff Event Monitoring for Water Quality Constituents

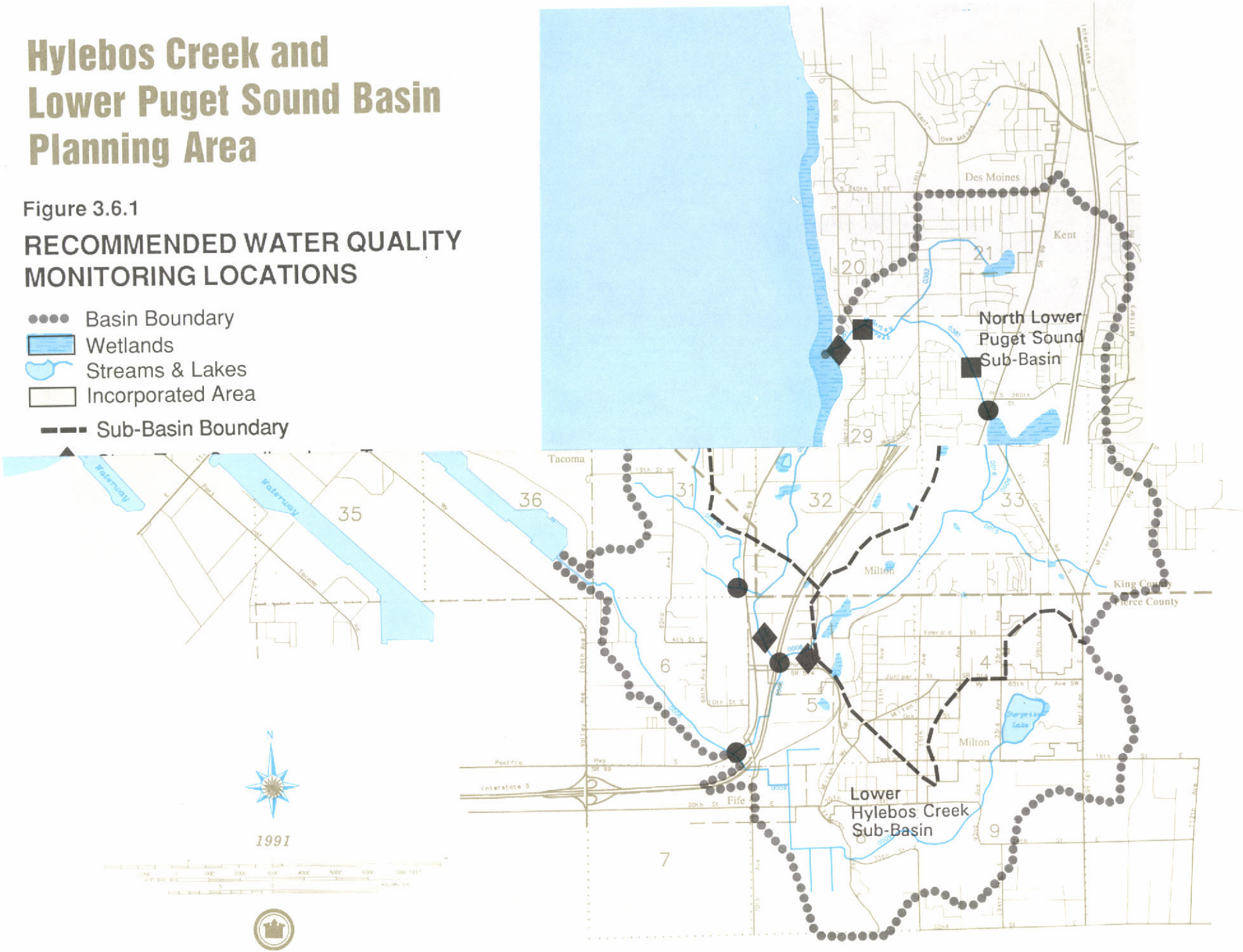
Potential sampling sites for this program are show in Figure 3.6.1. In addition, the 1989-1990 SWM Supplemental Storm Event Monitoring Program (see Figure 5.5.1) should be used to help identify additional storm event monitoring sites. Sites should be located above and below problem areas through this program. The inventory of all storm drains and businesses (BW-19) should also be used. The following general variables should be considered for analysis: nutrients, solids, metals, oil/grease, and bacteria.

Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 3.6.1

RECOMMENDED WATER QUALITY MONITORING LOCATIONS

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Sub-Basin Boundary



BW-29: Short-Term Highway Runoff Monitoring

WSDOT is developing a program to control the runoff from freeways and highways in the Puget Sound Basin (see BW-18). A sampling program should be developed that includes storm event monitoring of highways before and after BMP implementation. Variables to be monitored should include metals, solids, phosphorus, oil/grease, and hydrocarbons.

BW-30: Short-Term Monitoring of Fecal Bacteria Source Areas

1. An inspection and monitoring program for sanitary sewer lines should be implemented by the Federal Way Water and Sewer District in specific areas for the purpose of identifying sewer line leaks. This program should involve video inspection of older sewer mains and trunks (e.g., greater than 15 years old) in "high-suspect" areas. These include areas in which sewage collection systems were installed adjacent to, or within, stream channels or wetlands. Additionally, these "high-suspect" areas should include those locations that were identified as having high fecal coliform bacteria densities measured during storm events in the 1989-1990 SWM Supplemental Storm Event Monitoring Program. Sewer line leaks identified should be repaired as soon as possible.

2. Monitoring to determine areas with a high risk of onsite sewage disposal system failure (BW-17.4), should also include sites identified during the SWM Supplemental Storm Event Monitoring Program (Figure 5.5.1).

BW-31: Long-Term Monitoring for Water Quality Trends

Water quality monitoring should assess long-term trends associated with increased urbanization of both basins. Targeted monitoring areas should be established at the mouths of LSRAs and RSRAs identified in Chapter 2.1. The following general list of variables are recommended to be sampled: pH, conductivity, temperature, dissolved oxygen, turbidity, flow, solids, nutrients, metals, oil/grease, bacteria, and sediment. Sediment monitoring should be conducted in depositional areas near the mouths of important main stem or tributary creeks (Figure 3.6.1). An analysis of the sediment samples should include the following compound groups: acid extractables, base-neutral extractables, pesticides, herbicides, PCBs, and metals. Grain size, total organic compounds, and percent solids should also be measured to aid in data interpretation. Sediment samples should be obtained once every three to five years. If sediment results indicate there may be high concentrations of these compounds, further sampling is recommended to identify sources and pursue source controls.

BW-32: Annual Report and Plan Amendment

1. A citizens' committee should be established to assist the Stream Steward (BW-38) in an annual review of progress toward implementing the Plan and in recommending needed changes.

2. An annual report, that includes recommendations from the citizens' committee, should be prepared by the Stream Steward near the end of each winter season. The report is to be used for input to the SWM Division budget process of King County; and for the Cities of Des Moines, Federal

Way, Kent, Milton, and Tacoma; and the Puyallup and Muckleshoot Indian Tribes for the upcoming year. This report should:

a. Describe the status of, and schedule for, Plan implementation;
b. Interpret monitoring results and significant unpredicted changes in the condition of the basins;
c. Recommend adjustments to management of the basins based on identified significant changes; and
d. Identify appropriate processes, such as basin plan amendment or capital project list changes, costs, and staffing requirements for basin management changes.

Discussion of Recommendations:

Highly urbanized surface water systems, such as the Hylebos Creek and Lower Puget Sound basins, include a number of strongly interrelated elements. Among them are land use, storm flows, stormwater facilities, water quality, and sensitive areas. To be fully understood and effectively utilized, monitoring information gathered about the effect of the Plan on these elements, should be incorporated into a computerized information system. This information can then be more readily accessed and used to assess progress in Plan implementation and in managing surface water resources in the future.

Continuous stream flow data provide the information needed to ensure public and private detention facilities are functioning as designed. It also identifies where changes may be needed in operating these facilities or in setting detention standards. Regular monitoring of channel incisions provides a direct indicator of the effectiveness of upstream flow controls. Monitoring of sediment deposition areas and channel stabilization projects will track the success of these projects.

The water quality monitoring program will identify nonpoint sources of pollution, help in evaluating the effectiveness of BMPs, and establish a database with which to follow progress towards meeting water quality standards in the two basins. It is anticipated that this program will also be necessary to comply with the federal NPDES and state monitoring requirements.

In King County, these requirements will necessitate water quality monitoring of other basins with watershed plans and specific projects throughout the County. Since the basins overlap other counties and municipalities, it is appropriate that regional monitoring programs be coordinated with the entities involved.

3.7 CODE COMPLIANCE

Introduction:

Streams, wetlands, and lakes in the Hylebos Creek and Lower Puget Sound basins have changed substantially in recent time due to land clearing and development-related activities. At least 300 acres of wetlands are known to have been lost in the basins since 1936. Small streams in parts of the upper Hylebos Creek watershed have been piped, placed in roadside ditches, or filled in. Closed depressions that once stored water have been filled. Some of these natural features were lost due to legal activity such as fills of less than 500 cubic yards, but many others were lost due to illegal draining, ditching, or filling. In addition, sedimentation from construction sites has degraded water quality and eliminated aquatic fish habitat. If current and future regulations to protect surface water features are not enforced adequately, the continued loss of, and impact to, these features will result in further increases in instream flows, flooding, and aquatic and riparian habitat damage.

Recommendations:

BW-33: Enforcement/Inspection Staff

Additional enforcement and inspection staff should be hired to reduce development-related code violations, particularly in significant resource areas such as the lower West Branch and lower East Branch Hylebos Creek and lower Joes Creek. Staffing should be adequate to ensure that, in combination with other measures such as seasonal clearing restrictions (BW-9), development does not contribute sediment to downstream watercourses and does not eliminate protected natural drainage features. Added staff should be assigned based largely on permit activity. Areas of high resource value should also receive a larger share of inspectors' attention. If possible, individual inspectors should be wholly assigned to projects within these basins. Added enforcement staff should include personnel for construction-related inspections and sufficient staff to respond to surface water management complaints in developed areas.

The effectiveness of increased efforts should be evaluated and expanded as needed to reflect future assessments of needed staffing levels plus any future changes in permit activity. In addition, any new regulations, such as changes to the Sensitive Areas Ordinance or clearing limitations (King County, 1990), the Federal way Zoning Code (Federal Way, 1990), the Environmentally Sensitive Areas Ordinance (Des Moines, 1990), or Design Manual, may require additional code enforcement staffing.

BW-34: Citations

A system for issuing citations with civil penalties, analogous to traffic tickets but with greater penalties, should be established for violations of drainage and environmentally sensitive areas ordinances.

BW-35: Penalties

The list of potential penalties for code violations should be expanded to include:

1. Rectifying the impacts,

2. Compensation for impacts not fully rectified,

3. Required participation in surface water-related public education programs,

4. Required participation in stream and wetland restoration as community service work, and

5. Tougher penalties for repeat violations.

Significant civil fines should be levied against developers, contractors, property owners, and federal, state, or local agencies for violation of surface water and sensitive area regulations in all six jurisdictions in the two basins. A significant fine means a fine of a set percentage of the project value (10 to 50 percent) applied each day that a violation remains uncorrected.

BW-36: Violation Reporting

Reporting of code violations should be simplified by:

1. Development of a standard violation reporting form for County and City field employees, and

2. Publication of a central telephone number in the blue pages of the telephone book for information on how to report surface water-related violations of the City and County codes.

3.8 EDUCATION AND PUBLIC INVOLVEMENT

Introduction:

The actions of basin residents and development activity have significant effects on habitat and water quality in these stream systems. Many harmful activities such as wetland filling, removal of streamside vegetation, or disposal of used oil and household chemicals into storm drains may be occurring because residents are not aware of the consequences of their actions. Reporting of illegal activities by both citizens and government employees may be hindered because of unfamiliarity with procedures for reporting such problems.

Recommendation:

BW-37: Education and Public Involvement

A surface water education program for basin residents, developers, and staff of the Cities of Des Moines, Federal Way, Kent, Milton, Tacoma, the Puyallup and Muckleshoot Indian Tribes, and King County should be established to improve public knowledge of, and participation in, solutions to surface water-related problems. This program should be coordinated with the numerous public and private efforts already in place including those of the King County SWM Division, the County Extension Service, the State Conservation District, Trout Unlimited, Puget Sound Steelheaders, Federal Way Community Council, and many others. At least the following topics and activities should be included:

a. Riparian and stream ecology and citizen roles in protecting aquatic ecosystems, including programs to remove and reduce litter on both public and private properties.
b. Nonpoint pollution prevention (BW-17). Special emphasis should be placed in the drainage area tributary to Panther Lake (WH-6);
c. Lake management district formation (BW-22);
d. Onsite sewage maintenance district formation (BW-17.4);
e. Jurisdictional code requirements and enforcement procedures;
f. Best management practices for construction; residential areas; and commercial, industrial, and agricultural activities;
g. Action-oriented projects involving the citizens in Plan implementation such as streamside revegetation (BW-16), fish egg planting, and water quality and biomonitoring (WH-7, EH-4, CS-2);
h. Streamside residents best management practices brochure;
i. Community signs that interpret the value of resources and acknowledge good streamside management;
j. Monitoring activities (i.e., lake gages, rain gauges, fish counts);
k. Storm drain stenciling;
l. Educational displays such as the Washington State Parks proposed West Hylebos Wetland Interpretative Center, demonstration areas, and traveling exhibits;
m. Television and radio media events; and
n. Informational articles in local newspapers.

Discussion of Recommendations:

Public awareness is a critical aspect of environmental protection and citizen participation. This recommendation seeks to limit damage through education and prevention and, hence, reduce costs for future remediation. Many of these items can be implemented through the Stream Steward recommendation (BW-38).

3.9 STREAM STEWARD

Introduction:

Review of past basin plans demonstrates that implementation is most successful if staff is assigned specifically to carry it out. Although Countywide and city efforts may achieve some success, they would not be as effective in reaching citizens and affecting resources in the Hylebos Creek and Lower Puget Sound area as would a program that focuses specifically on these basins. This approach would ensure more timely and successful implementation of many Basin Plan recommendations.

Recommendation:

BW-38: Stream Steward

A Stream Steward should lead the implementation of the basin management program. The Steward will be a full-time professional staff person who covers all six jurisdictions of the Hylebos Creek and Lower Puget Sound basins included in southwest King County and the portion of Pierce County in the basin planning area. Responsibilities of the Stream Steward should include:

- Facilitate the negotiation and completion of stream improvement projects (Chapter 4, Sub-basin Recommendations), including regional detention facilities, stream stabilization projects, conveyance upgrades, and basin revegetation (BW-16);
- Facilitate adoption and implementation of basinwide recommendations to protect sensitive areas (BW-1 through BW-15) and for code compliance (BW-33 through BW-36).
- Educate the basins' residents and the business and development communities about the affect of their actions on water quality and surface water resources and how current practices can be corrected (BW-37);
- Communicate citizen reports of violations to appropriate enforcement officials;
- Encourage civic groups and businesses to donate time and funds for programs such as adopt-a-stream-or-a-wetland to improve these resources;
- Assist citizen-based stream, wetland, and lake protection efforts;
- Assist in coordinating the development of monitoring programs (BW-24 to BW-31) including the collection of field data in the basins; and
- Prepare an annual report (BW-32) which describes the watershed management accomplishments achieved in the basins and recommends needed changes in the Plan or in management of the basins.

3.10 TAX INCENTIVES

Introduction:

Implementation of the sensitive area protection recommendations in this Plan (Section 3.3) will require owners of stream, wetland, and steep slope areas to forego some types of development to protect these areas from environmental damage. Incentives should be in place to encourage preservation of lands with sensitive areas and to avoid the development impacts that are currently fragmenting these systems and disrupting their hydrologic and biologic functions. Incentives should discourage subdivision and subsequent development of lands containing sensitive areas and provide the means for responsible, perpetual care of these areas.

Recommendations:

BW-39: Current-Use Taxation

Current use taxation programs should be expanded to include properties that contain stream and wetland buffers within RSRAs and LSRAs as identified in this Basin Plan. A rating system should be adopted by all jurisdictions in the basins to evaluate the public benefit of accepting these areas into the open space system in exchange for private tax concessions.

BW-40: State Assessment Procedures

The statutes governing appeals of property-tax assessments should be amended to allow simplified appeals where downzones or sensitive areas designations have affected potential development opportunities. The appeal results should apply without need for further property-owner action until the next regular valuation becomes effective.

BW-41: Conservation Easements and Land Trusts

Encourage private donations of conservation easements for streams, wetlands, and their buffers in RSRAs, LSRAs, and wildlife corridors to public and private caretaker agencies. Public caretaker agencies include the King County Parks Division and private conservation groups include the Trust for Public Lands. Similar programs can also be established in Des Moines, Federal Way, Kent, Milton, and Tacoma.

Discussion of Recommendations:

Property taxes that take into consideration sensitive surface water features on parcels can encourage landowners to minimize development of resource lands. The King County Open Space Program has addressed this problem by providing incentives such as current-use taxation and conservation easements. Current use taxation is established under RCW 84.34 and allows a major portion of taxes on property in unincorporated and incorporated King County to be deferred if land is maintained in open space uses.

Through the use of conservation easement or land trust, a landowner can permanently donate some or all of the development rights to a parcel of land to a governmental agency or private charity. This donation permanently reduces the market value of the donated property, resulting in reduced property taxes. Donation also can be used for one-time federal income tax deductions (26 CFR Parts 1, 20, 25, and 602). Also, property owners availing themselves of these opportunities can reduce future liability for drainage problems due to development of their property while reducing future flooding.

Tax incentives can supplement other resource protection programs but alone are not a reliable way to protect threatened resources. Incentives can reward landowners who take initiative in resource protection. If incentives are not provided however, a higher property assessment may increase landowner expectations that resource lands should be developed to maximum density. As a result, greater enforcement costs and greater resource loss may be incurred.

Changes in the development potential of property should be reflected in an updated tax assessment as rapidly as possible. The County Assessor's Office makes these changes as part of their regular valuation procedure, but only on a two-year cycle.

3.11 PROGRAM MANAGEMENT

Introduction:

Three issues affect the implementation of Plan recommendations:

1. Consistent surface water policies and management practices among all entities in the basins, including the cities, Indian Tribes, utility districts, Pierce and King Counties, and state agencies;

2. Consistent ranking of Basin Plan recommendations among basins in the King County SWM Division Service Area; and

3. Availability and distribution of funds for Plan implementation.

Recommendations:

BW-42: Annexations and Incorporations

If annexations or incorporations remove areas of the basins from King County's jurisdiction, interlocal agreements should be drafted to ensure that city surface water management plans are consistent with, or more protective than, this Basin Plan. King County and other cooperators on this Basin Plan should oppose those proposed annexations that do not meet this standard.

BW-43: King County SWM Division CIP Funding Policy

Implementation of the Basin Plan in King County will follow the recommended policy identified in the SWM Strategic Plan. All capital improvements projects in King County will be funded at a level to at least begin initial design work during the calendar year following Basin Plan adoption.

Discussion of Recommendations:

The Plan recommendations are interrelated and should be implemented as a whole. These recommendations allow for consistent implementation of Plan recommendations in County community planning areas and incorporated areas. If parts of the Plan are not implemented, greater flows, flooding, erosion, and/or habitat damage may result.

Chapter 4

Sub-Basin Recommendations

CHAPTER 4: SUB-BASIN RECOMMENDATIONS

4.0 INTRODUCTION

The basinwide recommendations made in Chapter 3 address general problems in the planning area by recommending administrative actions that will protect against future degradation. Chapter 4 recommends solutions to the significant and specific problems in the basins primarily through capital projects designed to moderate the cumulative effects of insufficient stormwater controls, poor construction practices, and inadequate management of water pollutants. Thirty-two significant problems which require capital projects, special regulations, or studies were identified in the basins. These problems were documented by extensive field observation, computer modeling of current and future storm flows, and broad public comment.

The significant problems are divided into priority groups, Category A and Category B (Tables 2.3.1 a and b). Category A problems are the most significant because of their current threat or impact to elements in the built or natural environment. These problems include flooding of homes, flooding of major streets, and damage or potential damage to important stream or wetland resources such as lower Joes Creek and the West Hylebos Wetland. Category B problems pose a lesser threat or risk to these elements. A third group, Category C problems, are not included in the Plan since they do not meet the criteria for significance described in Chapter 2.4. Additional details regarding Category A, B, or C problems may be found in the summary discussion in Chapter 5, the detailed discussion in King County, 1990a, and in the site specific analysis in King County, 1990e.

The sub-basin recommendations identify 33 capital improvement solutions that address Category A and B problems (Table 2.3.2) in the five sub-basins in the planning area: East and West Branch Hylebos Creek and North, Central, and South Lower Puget Sound sub-basins. The two primary objectives of these solutions are to reduce flooding by controlling peak storm flows and to help improve instream habitat by stabilizing key stream reaches. Criteria used to determine the level of flood protection and channel improvement afforded by these projects are discussed in Chapter 2.4. A third major objective is to meet state and federal requirements through source controls and a variety of structures.

The sub-basin recommendations include programs and regulations, such as enhanced onsite detention standards or water quality controls; capital projects, including detention ponds, channel stabilization projects, or culvert upgrades; and further studies to analyze local drainage or water quality conditions. The two most costly types of projects are regional detention ponds and channel stabilization projects.

Regional ponds will help replace some of the natural stormwater controls (e.g., infiltration areas, wetlands, and other depressions) now lost to the systems. They will store stormwater then gradually meter out the discharge at rates that will reduce flooding and limit severe channel scour. These facili-

ties will also capture contaminants thus lowering concentrations of pollutants such as oils, heavy metals, and nutrients. Plate 4.0.1 illustrates a typical regional detention pond with the water quality controls including an oil collection device and a vegetated multi-cell design combined with a biofiltration swale that enables plant life to uptake pollutants.

While the regional detention facilities will reduce flooding and stream damage, streams will still be subject to a higher peak flow regime than under pre-development conditions. Recommended stream stabilization projects can reduce channel erosion and help affected reaches accommodate these higher flows. As shown in Plate 4.0.2, these projects typically involve placing large organic debris (LOD) in the channel to dissipate energy and strengthen the streambed and streambank. The LOD replenishes debris that is no longer available to the system due to an insufficient supply of trees in the riparian corridor (see also BW-16). In some instances, the stream stabilization may involve relocating a sewer line or bank armoring. These projects will enable the reach to accommodate the higher flows, resist incisions, and allow spawning and rearing habitat to recover. In West Branch Hylebos Creek, reductions in downstream sediment deposition that result from these projects will also decrease the need for channel dredging in the reach above S 373rd Street. Habitat in RSRAs and LSRAs, such as the lower East Branch Hylebos ravine, Lower Joes Creek, and Dumas Bay will also benefit from lowered sediment loads.

Implementation of the recommended projects in this chapter cannot restore the two basins to pre-development conditions. However, if the recommendations are implemented quickly, in conjunction with the basinwide recommendations, they can have a substantial affect on reducing current and future flooding, improving water quality and aquatic habitat conditions.

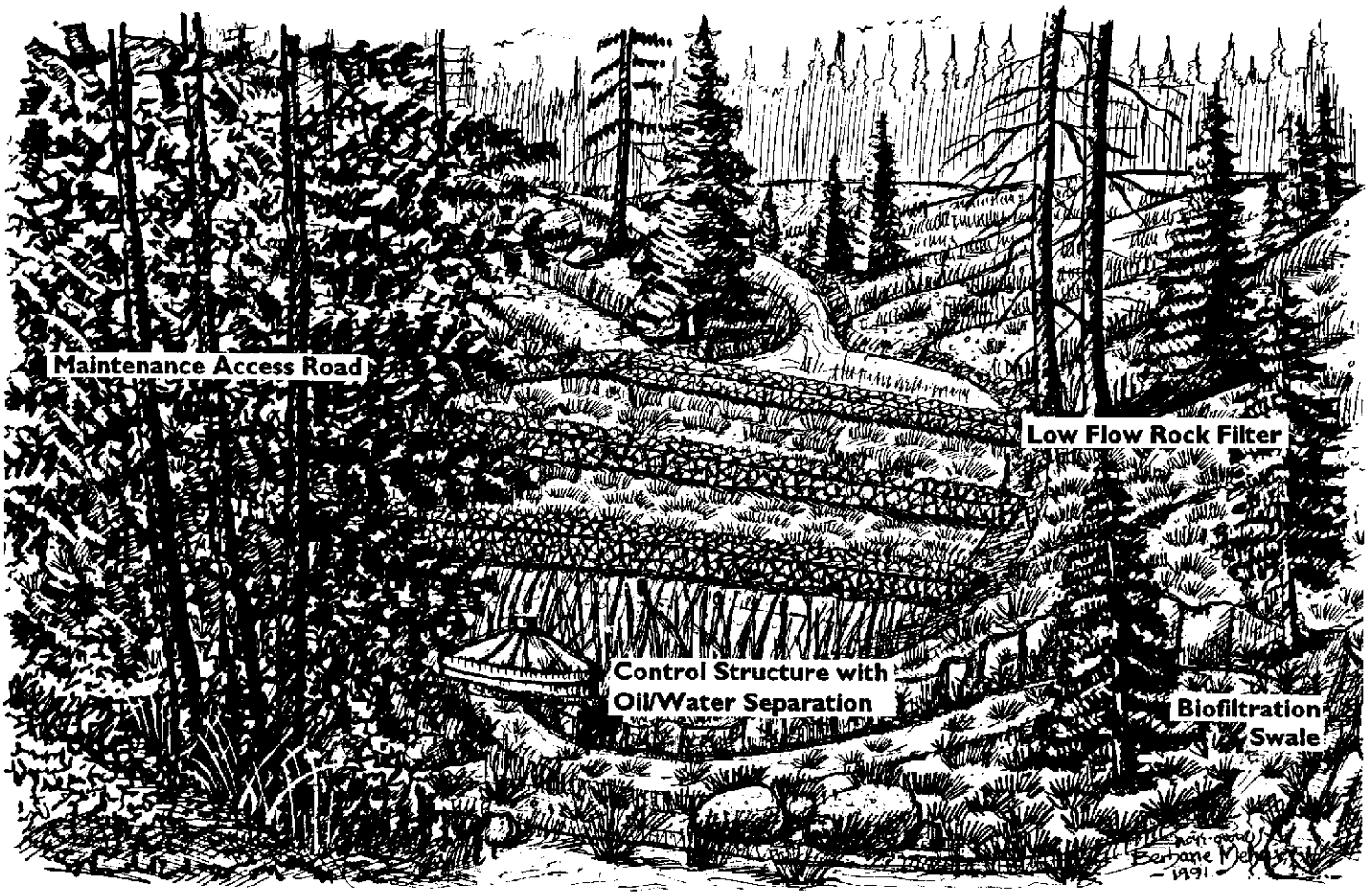


Plate 4.0.1 Typical 3-Cell Regional Stormwater Detention Pond

Plate 4.0.2 Large Organic Debris (LOD) Placement for Stream Stabilization

4.1 WEST BRANCH HYLEBOS CREEK

Introduction

The West Branch Hylebos Creek sub-basin occupies a 4,300-acre area between I-5 and Puget Sound. For convenience, the sub-basin may be divided into three distinct and diverse areas: the Northeast, Northwest, and South (Figure 4.1.1). The Northeast area consists of tributaries 0014A and 0014C and includes the heavily urbanized area along S 320th Street and part of the West Campus Office Park. The Northwest area includes tributaries 0014B and 0014 north of S 356th Street. This area encompasses Panther Lake and an area of historically high infiltration northwest of Panther Lake. The South area includes the rest of the sub-basin south of S 356th Street. This area has lower development density than the northern areas and contains the majority of the remaining fish habitat in the sub-basin. Land use in the sub-basin is currently dominated by commercial uses in the Northeast area, commercial and single-family residential in the Northwest area, and rural and single-family residential in the South area.

Flow increases in the sub-basin under future land use are most dramatic from the Northwest area, owing to the relatively undeveloped state of the area under current (1987) land use and the recent addition of 580 acres from subcatchment WH15 which historically did not contribute surface flows to the downstream system.

Flow increases from the Northeast area under future land use are predicted to be much lower because of the high level of existing development. Most of this existing development has inadequate flow controls. Flows from this area are predicted to increase from 25 to 50 percent under future land use without flow controls; however these future flows are nearly 3.5 times larger than under historic (forested) conditions. High flow increases under future land use from the Northwest area combine with moderate increases from the Northeast resulting in high (100 to 150 percent) increases in flow between current and future land use without flow controls in the South area (see Figure 5.3.1).

Existing high flows, especially from the Northeast area, have caused several problems in the sub-basin (Figure 4.1.2). These problems include flooding of residences and commercial buildings near SR 99 at S 336th Street, flooding of S 320th Street, high flows and water quality impacts to the West Hylebos Wetland, erosion downstream of the West Hylebos Wetland, and heavy sedimentation and flooding of a residence at S 373rd Street. Predicted high flows from the Northwest area will cause flooding and instream erosion between Panther Lake and the West Hylebos Wetland, further degrade the West Hylebos Wetland, and contribute to erosion and sedimentation in the lower reaches. Increased flows in the future would further degrade or completely eliminate the remaining fish habitat in this sub-basin, which currently exists only below the West Hylebos Wetland on tributary 0014 and in the lower reach of tributary 0013.

Through a combination of reduced recharge and high rates of groundwater pumping as a result of urban development, groundwater is being reduced in the West Hylebos area. This reduction has been manifested in declines in both water-well levels and stream base flow.

Figure 4.1.1

WEST BRANCH HYLEBOS CREEK SUB-BASIN

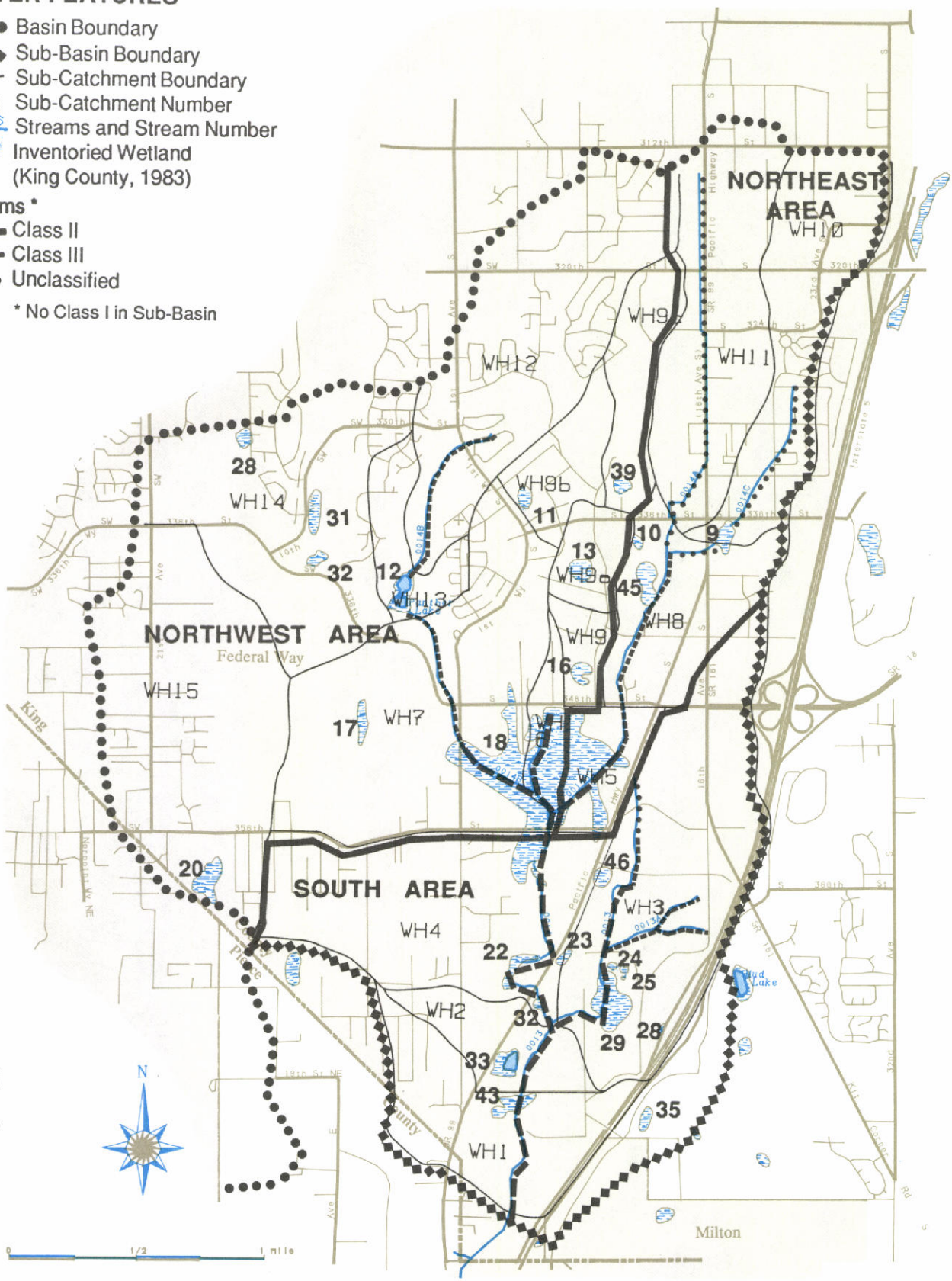
WATER FEATURES

- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- WH3 Sub-Catchment Number
- 0016 Streams and Stream Number
- 1 Inventoried Wetland (King County, 1983)

Streams *

- Class II
- Class III
- Unclassified

* No Class I in Sub-Basin



Location Reference

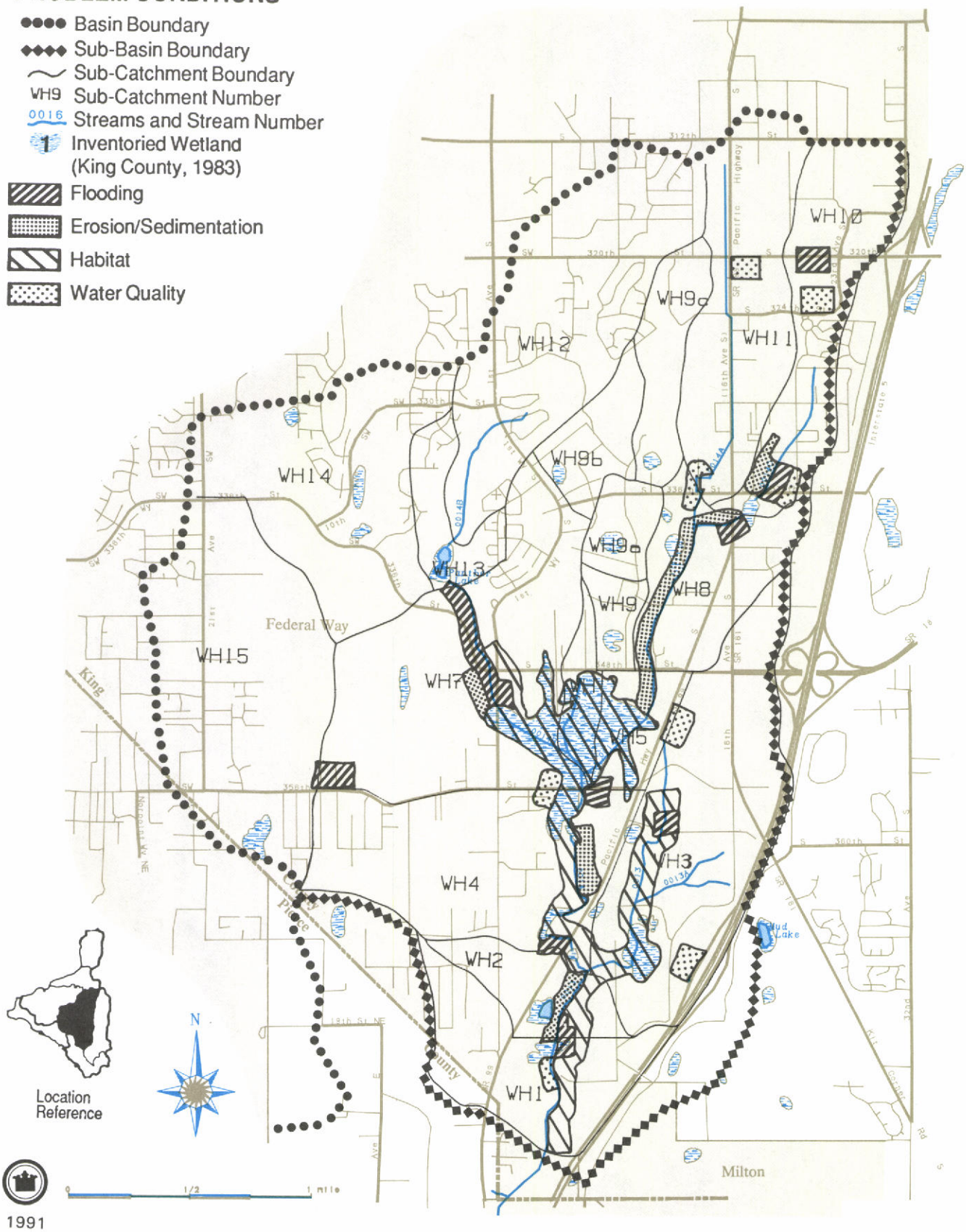
1991

Figure 4.1.2

WEST BRANCH HYLEBOS CREEK SUB-BASIN

PROBLEM CONDITIONS

- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- WH9 Sub-Catchment Number
- 0016 Streams and Stream Number
- 1 Inventoried Wetland (King County, 1983)
- Flooding
- Erosion/Sedimentation
- Habitat
- Water Quality



1991

The most significant water quality problem is located in the South area at the headwaters of tributary 0013 downstream from a commercial area. The highest concentrations of metals and solids in the sub-basin were observed at this location. Water quality was also found to be degraded by livestock activities on tributary 0013 near S 373rd Street. High concentrations of metals and fecal bacteria were noted at the commercial area along S 320th Street in the Northeast area. High metals and a significant oil/grease sheen were noted on tributary 0014B at S 336th Street. High concentrations of metals and solids were also detected downstream in the West Hylebos Wetland.

Solutions to the majority of problems in this sub-basin rely on reducing existing high flows and pollutants from the Northeast area, and reducing predicted future flow increases from the Northwest area. Solutions in the South area, by contrast, rely more on regulatory than structural solutions. These regulations include lower densities and buffers to protect existing high quality stream corridors, supplemental onsite detention standards to reduce future flows, and BMPs to improve water quality. Problems that are not addressed by the recommendations below are noted in the Current and Future Conditions Report (King County, 1990a) and in the final list of identified problems (King County, 1990e).

Recommendations (Figure 4.1.3)

Programs and Regulations. Several programs and regulations are proposed for this sub-basin. These include onsite detention standards that are more restrictive than the basinwide standard upstream of S 359th Street in sub-catchment WH3, programs to improve water quality, stream corridor protection regulations, lower densities, and stormwater infiltration guidelines.

The basinwide recommendation for onsite detention (BW-2) reduces post-development 2- and 10-year flows to pre-development levels.

Direct discharge to any lake or wetland is not acceptable in this sub-basin because of a lack of detention capacity and concerns for water quality impacts. The current practice of not providing onsite detention upstream of Panther Lake should be discontinued because the current configuration of Panther Lake does not allow for enough capacity to detain flows under build-out conditions. Onsite detention upstream of Panther Lake should be designed according to the basinwide standard (BW-2).

WHL-1: Supplemental Onsite Detention

Supplemental onsite detention (BW-3) is recommended in sub-catchment WH3 north of S 359th Street. Predicted high flows from this commercially zoned area under the basinwide recommendation (BW-2) would cause erosion and sedimentation of the Spring Valley Wetland, an LSRA.

WHL-2: S 320th Street Area Water Quality

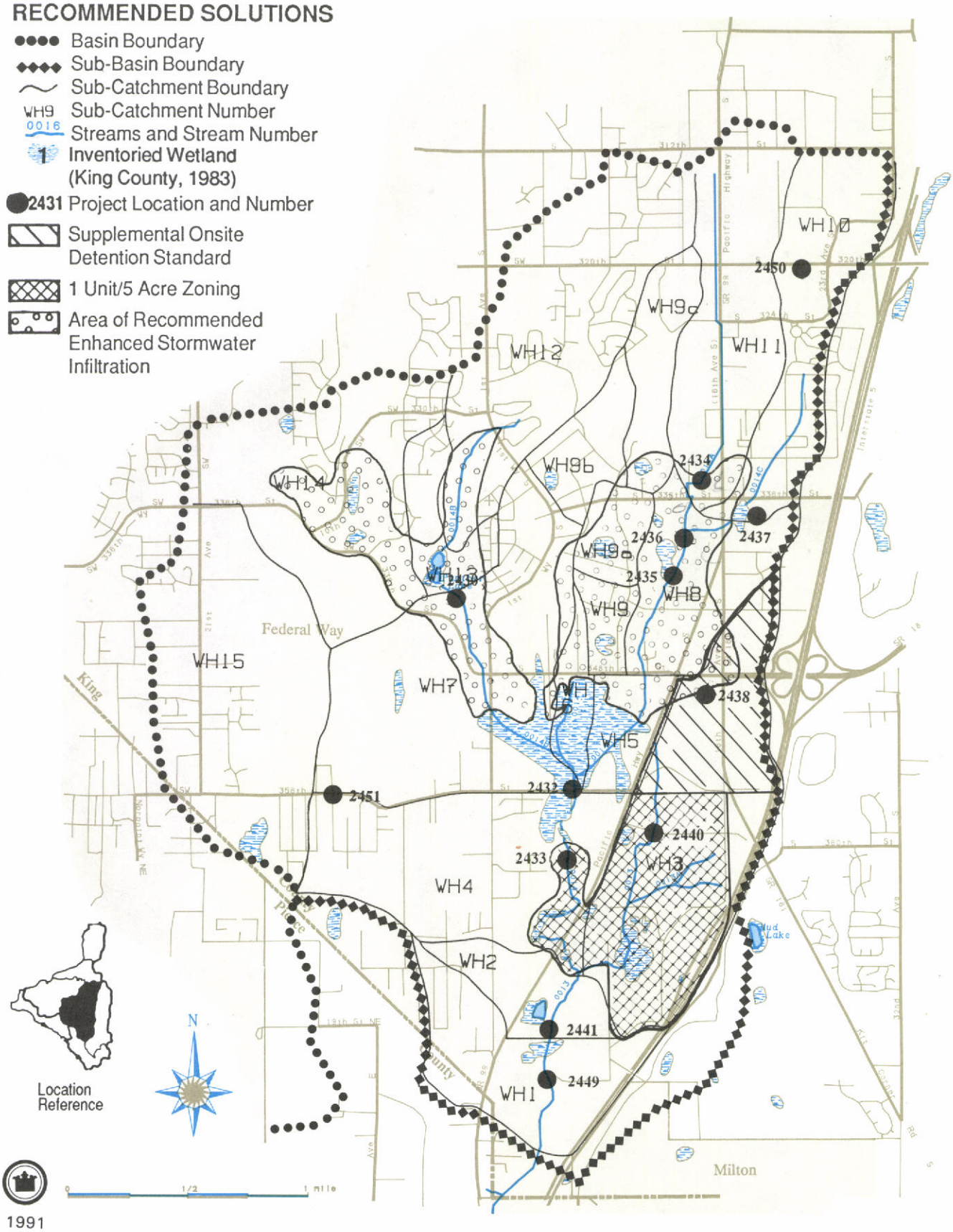
Sampling results show significant concentrations especially of heavy metals and fecal coliform bacteria immediately downstream of this area. The following BMPs are recommended to prevent these contaminants from entering surface water.

Figure 4.1.3

WEST BRANCH HYLEBOS CREEK SUB-BASIN

RECOMMENDED SOLUTIONS

- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- WH9 Sub-Catchment Number
- 0016 Streams and Stream Number
- 1 Inventoried Wetland (King County, 1983)
- 2431 Project Location and Number
- Supplemental Onsite Detention Standard
- 1 Unit/5 Acre Zoning
- Area of Recommended Enhanced Stormwater Infiltration



1991

1. A program of enhanced parking lot cleaning should be established for all commercial areas located along S 320th Street in the Northeast area. High concentrations of pollutants were measured downstream of this location in 1989. Many of these pollutants attach to dust particles and may thus be removed by parking lot cleaning. Two approaches are recommended: 1) sweeping by use of a vacuum, or 2) flushing with water and immediately cleaning of the catch basins. This should be performed twice per year -- in the fall (e.g., before October 1) and in early spring (e.g., before April 1, after the winter wet season).

2. The two detention ponds at SeaTac Mall should be retrofitted with coalescent plate oil/water separators installed at the outlet of each pond. The outlet of the east pond should also be retrofitted with a control valve to increase detention time and thereby enable more pollutants to be removed from stormwater. The design of this control valve should be coordinated with project 2450 in examining backwater effects of culverts crossing S 320th Street.

WHL-3: Evergreen Industrial Park Area Water Quality

As a result of extremely high concentrations of total phosphorus, copper, lead, zinc, and oil/greases sampled in storm drains in the Evergreen Industrial Park, the following source control BMPs are recommended to prevent degradation of water quality downstream:

General BMPs (from Water Quality Best Management Practices Manual for Commercial and Industrial businesses prepared for the City of Seattle by Resource Planning Associates, 1989)

- BMP 1.20 Vehicle or Equipment Washing and Steam Cleaning
- BMP 1.50 Container Storage
- DOE requirements for generators of dangerous wastes.

Specific BMPs

- Berms should be placed at the entrance and exit of truckwash bays;
- Pre-washing of trucks outside of the bays should not occur;
- All businesses should be required to have roofs and berms at the entrances and exits of all vehicle bays to prevent contact between precipitation and hazardous or toxic materials and/or their release to surface water;
- Drains leading to oil/water separators should be installed under roofs. The type of oil/water separators should be coalescent plate and they should be connected to the sanitary sewer. The spraying or washing of any equipment, tools, parts, or products should be conducted in these areas only; and
- All storm drains should be stenciled "Dump No Wastes, Drains to Hylebos Creek." All storm drains should have absorbent pillows placed in them. These drains should be maintained and cleaned twice a year (in March following the wet season and in September following the dry season).

WHL-4 Hylebos Creek Wetland 28 Water Quality Improvement

Stormwater from the WSDOT weigh station on I-5 should be treated through a coalescent plate oil/water separater or an equivalent or better treatment facility if available before it is discharged to Hylebos Creek Wetland 28.

It is acknowledged that there are other sources of nonpoint pollution originating from businesses upstream of the Evergreen Industrial Park. In addition to the general and specific BMPs listed above for the Evergreen Industrial Park, a stormwater monitoring program should be developed to identify and isolate additional nonpoint pollution sources originating from these upstream commercial and industrial uses. (See Basinwide Recommendation BW-28, Short-Term Runoff Event Monitoring for Water Quality Constituents).

For a broader perspective on source control and stormwater treatment BMPs see Section 3.5, Management of Nonpoint Source Water Pollution.

WHL-5: Stream Corridor Protection

A minimum buffer of 150 feet should be required from the ordinary high water mark on each side of the stream for tributary 0014 between the West Hylebos Wetland and tributary 0013 and on tributary 0013 downstream of S 359th Street to the King/Pierce County line (BW-4). Maintenance of intact vegetated stream corridors dominated by large conifer trees is necessary in this LSRA to promote stream stability and fish habitat. Trees adjacent to streams provide shade, nutrients, and holding places for fish during high flows. The preferred types of trees are conifers based on their capacity to achieve large sizes and resist rot after their death.

WHL-6: Enhanced Stormwater Infiltration

Upstream of the West Hylebos Wetland (Figure 4.1.3), particularly in the vicinity of tributaries 0014A and 0014B (Panther Lake area), all development proposals should be required to carefully evaluate infiltration potential in accord with the conditions of recommendation BW-21. Zoning in this area should minimize high-density land use so the infiltration potential is maximized. Site designs should maintain the greatest feasible area of undisturbed, preferably forested, land. Drainage systems of existing structures (e.g., roof drains) should be retrofitted to maximize infiltration potential.

WHL-7: Nonpoint Source Water Quality Control Program

A priority nonpoint source water quality control program should be established (BW-17) including the elements of public education and involvement listed in BW-37.

WHL-8: Spring Valley and West Hylebos Wetland Biomonitoring

A biomonitoring program to supplement regular water quality monitoring should be established to provide continuous assessment of biological effects of water quality conditions entering the West Hylebos and Spring Valley Wetlands. Fish held in streamside aquaria could be subjected to streamwater and monitored

regularly by local volunteers to detect any incident of acute toxicity from the stream.

WHL-9: Floodplain Protection

Until the floodplain study recommended in Project 2449 (see below) is completed, a floodplain analysis of tributary 0013 between the King and Pierce County boundary and S 364th Street should be required whenever any development is proposed within 10 vertical feet of the ordinary high water mark, measured at the cross-section of the stream nearest to the proposed development. The floodplain analysis should include the determination of a "zero-rise floodway" as defined by the King County SAO. Development should be required to comply with development standards contained in the SAO.

WHL-10: Reduced Densities in Spring Valley

Densities of no more than 1 unit per 5 acres (BW-1) are recommended for an area bounded approximately by I-5 to the east, SR 99 and 8th Avenue S to the west, S 373rd Street (extended) to the south, and S 359th Street to the north (Figure 4.1.3). This area currently has the potential to develop to a density of 3 units per acre. These lower densities are needed to protect Class 3 and potentially unstable drainage swales on slopes to the east of the Spring Valley Wetland, an LSRA.

WHL-11: Low Density Stream Corridor Protection Zoning

The ravine between the West Hylebos Wetland and the SR 99 crossing on tributary 00014 (RM 0.0 to 0.9), an LSRA, should be zoned 1 unit per 5 acres (BW-1) to protect the sensitive habitat area.

WHL-12 Recommendations of the 1979 Pacific Highway South Study

Recommendations of the 1979 Pacific Highway South Study relating to: 1) the removal of the SR 99 stormwater pipe restrictors, 2) the diversion of a portion of the flow from tributary 0014A to 0014C, and 3) the stabilization of 0014C downstream of SR 99 should be reevaluated in the context of the basin plan analyses and recommendations. According to the 1979 study, the stabilization of 0014C should occur in conjunction with the implementation of the Kitts Corner Regional Pond (Project 2437); the removal of restrictors and the flow diversion can only be implemented after the construction of the S 336th "South" Regional Pond (Project 2435) and the S 336th Street Wetland Restoration (Project 2436).

Capital Improvements. Four flow control projects are recommended in this subbasin. Three of these are designed to control flows from the Northeast area, the remaining one to control flows from the Northwest area. Four projects are proposed to solve local flooding problems. These projects are located at S 320th Street, S 359th Street, and two along S 356th Street. Projects are also proposed to stabilize the eroding ravine area downstream of the West Hylebos Wetland, an RSRA, to remove deposited sediment, and to fence livestock away from the stream in the floodplain area north and south of S 373rd Street.

1. **Project 2437: Kitts Corner Regional Pond**

Construct a detention pond in Hylebos Wetland 9 (King County 1983), provide a water quality treatment facility upstream of the detention pond, and replace culverts crossing SR 99 near S 336th Street. This project will provide approximately 32 acre-feet of storage.

Estimated Cost: $640,000
Location: Federal Way

2. **Project 2436: S 336th Street Wetland Restoration**

Restore the historic hydraulic function and revegetate Hylebos Wetland 10, which was drained in the mid-1980s and resulted in considerable loss of stormwater storage (approximately 10 acre-feet), biofiltration capacity, and habitat.

Estimated Cost $25,000.
Location: Federal Way
(Costs shown reflect wetland revegetation only.)

3. **Project 2435: S 336th Street "South" Detention Pond**

Construct a detention pond on tributary 0014A in an existing damaged wetland. This project will provide wetland enhancement and mitigation for the detention pond. Flows entering this facility would be reduced by an average of 25 percent. This project, in combination with onsite controls and upstream detention, will reduce flows 48 percent below 1987 conditions.

Estimated Cost $436,000
Location: Federal Way

4. **Project 2430: Panther Lake Enhanced Detention**

Add approximately five feet in height to the existing berm at the outlet and most of the perimeter of Panther Lake to increase the stormwater storage capacity. This project will also include mitigation and enhancement to the wetland. (See also BW-24.4, Monitoring Recommendations.)

Estimated Cost: $2,007,000
Location: Federal Way

5. **Project 2432: S 356th Street Conveyance Upgrade**

Construct a trestle to carry two additional lanes of S 356th Street across tributary 0014, to improve traffic flow and upgrade culverts beneath the existing lanes at the road crossing. Existing hydrology at the crossing must be maintained to minimize impacts to the number one rated wetland located at the crossing. The culvert upgrade will allow passage of fish and flood flows, and prevent road flooding.

Estimated Total Road Widening Cost: $2,500,000
Location: Federal Way

(This project is a King County Roads Division Project. No costs will be charged to SWM Division funds.)

6. **Project 2433: West Hylebos Ravine Channel Stabilization and Habitat Improvement**

   Reposition existing and place additional logs in the channel in the ravine and import LOD to the reaches below the ravine. These actions will dissipate flow energy, minimize sediment delivery downstream, and improve habitat (see also BW-25, Monitoring Recommendation). To maximize stability and safety during storms, the size of trees and logs must be larger than the storm flow can transport.

   Estimated cost: $348,000
   Location: Federal Way

7. **Project 2440: S 359th Street Culvert Replacement**

   Replace culvert crossing of S 359th Street to repair a road washout. Include an overflow structure and design the culvert to allow for fish passage. Restore disturbed channel and banks. (This project has been substantially completed by King County crews as of this writing.)

   Estimated cost: $82,000
   Location: Federal Way

8. **Project 2441: S 373rd Street Channel Maintenance and Fencing**

   Continue current dredging of channel in vicinity of S 373rd Street on a limited, as-needed basis, fence livestock away from the creek, provide adequate watering access, and revegetate the stream corridor. Dredging should be coordinated with the tribal fish planting schedule and the Washington Department of Fisheries to minimize impacts to the fishery resource to the fullest extent possible. Re-evaluate dredging needs upon construction of upstream flow control and channel-stabilization projects.

   Estimated cost: $113,000 ($10,000 for each subsequent dredging)
   Location: Federal Way

Further Studies. Several problems were identified that require a level of study that is beyond the scope of this Plan. Poor water quality measured at S 356th Street on tributary 0014B and in the headwaters of tributary 0013 need further study to determine the cause and recommend solutions. Floodplain delineation of the lower reaches of tributary 0013 is needed to prevent further floodplain encroachment in that area. The complex network of storm drains which contribute to flooding near S 320th Street and the numerous closed depressions along S 356th Street require a level of detailed analysis that is beyond the scope of this Plan.

1. **Project 2434: S 336th Street Improper Storm Sewer Hookup Study**

   During water quality sampling, stream flows were cream-colored on tributary 0014A at S 336th Street. The cause of this is probably illegal

discharge to storm sewers. This study would locate the source and recommend action to eliminate the illegal discharge.

Estimated cost: $20,000
Location: Federal Way

2. **Project 2438: Tributary 0013 Headwaters Water Quality Monitoring**

The goal of this study is to identify and isolate contaminated drains and implement BMPs to reduce pollutant loading entering storm drain systems. The intent of the recommendations from the study will be to reduce solids and heavy metals entering detention ponds and improve downstream water quality.

Estimated cost: $15,000
Location: Federal Way

3. **Project 2449: Tributary 0013 Floodplain Study**

Floodplain mapping should be completed for the reach of tributary 0013 upstream of the King/Pierce County line (approximately one-half mile) to include the floodplain area near the S 373rd Street crossing. The 100-year floodplain for this area has not been delineated on FEMA mapping. It is important to map this area so that future developments can be regulated or prevented in this broad floodplain area and future public or private costs for protection can be avoided.

Estimated cost: $10,000
Location: Federal Way

4. **Project 2450: S 320th Street Stormwater System Design Study**

Perform engineering survey of existing drainage system and design conveyance upgrade in vicinity of S 320th Street and 20th Avenue S. This study will recommend solutions to existing local flooding on S 320th Street.

Estimated Cost: $54,000
Location: Federal Way

5. **Project 2451: SW 356th Street Drainage Study**

Conduct hydrologic modeling of several closed depressions and complete preliminary engineering design of a stormwater drainage system to solve local flooding of structures in the area surrounding the closed depression.

Estimated Cost: $78,000
Location: Federal Way

Discussion of Recommendations, Alternatives, and Effects

The majority of problems in this sub-basin are the result of existing development in the headwaters, especially from the Northeast area. Predicted future flow increases are largely attributed to increased density in the Northwest area and the connection of surface drainage from subcatchment WH15 to Panther Lake. The approach to solutions in this sub-basin is to control flows from existing development with structural projects, generally in the upper sub-basin, and to control flows and preserve remaining habitat through regulations in the relatively undeveloped South part of the sub-basin.

The S 320th Street Stormwater System Design Study (Project 2450) will identify the cause of, and recommend solutions to, local flooding problems along S 320th Street. The SW 356th Street Drainage Study (Project 2451) will recommend solutions to flooding problems surrounding several closed depressions near SW 356th Street and 11th Avenue SW.

Kitts Corner, S 336th Street Wetland Restoration, and S 336th South Detention Ponds (Projects 2435, 2436, and 2437) in combination with onsite detention controls (BW-2) will effectively reduce future flows discharging from the Northeast area to below 1987 land-use conditions. These flows are still well over double the pre-development flow rates; however, erosion should be substantially reduced since the channels have already expanded to some extent in response to the current flows.

Available new detention sites in the Northeast tributary area are limited owing to the high level of existing development there. Existing detention in this area is also very limited, because most of the development predates significant onsite detention regulations. Two detention ponds located at SeaTac Mall are exceptions. However, retrofitting these ponds would not solve the flooding and erosion problems downstream due to their upper location in the basin. The Kitts Corner and S 336th Street South Regional Detention Ponds, and the S 336th Street Wetland Restoration projects provide the only locations to achieve any significant flow control from the Northeast area.

Recommendations made in the Pacific Highway South Drainage Study (Kramer, Chin, and Mayo, 1979) to remove culvert restrictors beneath SR 99 that currently provide detention, to divert a portion of the flow from tributary 0014A to 0014C, and to stabilize a reach of tributary 0014C downstream of SR 99 should be reevaluated in the context of the basin plan analysis and recommendations.

Based on well data collected for the South King County Groundwater Management Advisory Committee (SKC GWMAC, 1989; King County, 1990a), groundwater flow north of the West Hylebos Wetland suggests that a zone of recharge to water-supply aquifers is located in this area. This area coincides with relatively infiltrative surface soils, providing a good opportunity to limit the effects of urbanization on recharge where such efforts could be quite effective (WHL-5). Limitations on land use affect both the amount of area that would eventually be covered by impervious surfaces and the potential contaminants that might otherwise be included in the recharging surface water.

The Enhanced Detention of Panther Lake (simulated without onsite detention controls upstream) reduced flows under future land use an average of 68 per-

cent; however, the flows are still two times larger than existed under 1987 land use without subcatchment WH15 tributary to the lake. If these higher flows are not reduced, instream erosion upstream of, and damage to, the West Hylebos Wetland, erosion in the ravine, and subsequent sediment deposition at S 373rd Street will continue to worsen. Culverts crossing 1st Avenue S will also have to be upgraded to prevent additional new flooding of 1st Avenue S. However, the additional five feet of berming proposed in the Panther Lake Enhanced Detention Project (Project 2430) will impact the biological functions of the lake. Wetland mitigation costs associated with this project may be nearly 44 percent of the total project.

To address these problems, several alternatives are possible. One alternative is to increase detention in the area upstream of Panther Lake. This detention could be achieved with a combination of supplemental onsite detention (WHL-1), enhanced detention in Panther Lake, and additional regional detention in the area immediately upstream of Panther Lake. Locating additional regional detention ponds in this area may be infeasible because there are few undeveloped areas.

Another alternative to providing detention around Panther Lake is a high-flow bypass to divert storm flows from the Northwest area around the West Hylebos Wetland RSRA, the highly erosive ravine area downstream of the wetland, and the LSRA stream corridor in the lower part of the system. In addition to protecting the key habitat areas, the bypass would also reduce the potential for flooding at downstream road crossings, especially at 1st Avenue S and S 356th Street. Erosion in the ravine area downstream of the West Hylebos Wetland and the resultant sediment deposition at S 373rd Street would also be greatly reduced, resulting in less frequent dredging of this area. Water quality would not be improved because the by-pass accepts flows only above the 10-year storm level. The vast majority of "first flush" events, the most severe water quality events, would not be carried by the pipeline because they are typically smaller than a 10-year event.

As part of the bypass design, approximately 3,000 feet of open channel biofiltration swale adjacent to SR 99 would be included. However, flows discharging from the pipeline would increase flood peaks by 10 to 15 percent at the King/Pierce County line, resulting in flows that are three times higher than under 1987 land use. Currently, the flood peak from the West Branch Hylebos Creek arrives at the County line several hours later than the peak in the East Branch. The pipeline would reduce this "lag time" and thus increase the combined peak flow from the two branches and the potential for greater flooding in the lower reaches of Hylebos Creek. The high-flow bypass was rejected in favor of providing additional regional detention at Panther Lake. The high-flow bypass does not reduce the potential for flooding at the Pierce County line. Increasing the detention at Panther Lake reduces the future land-use flows from 145 cfs to 39 cfs. Thus, the potential for damage from high flows within the basin and flooding at the County line with enhanced detention is much less than with the bypass.

The reduction of high flows from the upper sub-basin is only one component needed to reduce erosion and maintain viable habitat in the lower reaches. The West Hylebos Ravine Channel Stabilization and Habitat Improvement Project (Project 2433) will reduce the amount of erosion in the ravine below the West

Hylebos Wetland and increase channel diversity and produce fish habitat in reaches downstream of SR 99. The channel stabilization will be accomplished through the introduction of large logs and effective repositioning of existing logs. These logs will be of sufficient size so as not to mobilize during storm events. The maintenance of low density land use in this area (WHL-10) will ensure that in the future wood can be recruited from natural sources. This will also reduce human intrusion which is known to destroy aquatic habitat.

The maintenance of vegetative corridors is also critical to the sustained viability of fish in the lower reaches. Although the South area has been subjected to flow increases more than twice historic rates, the stream channels have shown considerable resiliency in many areas. This resiliency is due in large part to the existing wooded corridors present in the South area. Large conifer trees in the stream provide energy dissipation for high flows, reduce the amount of erosion, and create places for fish to find refuge during high flows. This effect can only be maintained though the continued recruitment of coniferous wood into the stream system. The corridor recommendation (WHL-4) will provide continued coniferous wood recruitment into the creek as well as buffer the creek from human intrusion.

Tributary 0013 headwaters lie within a commercial industrial area. High flows and pollutants from this area have degraded the Spring Valley Wetland, an important habitat resource, located downstream. Large areas of commercial land remain to be developed in this area. Thus, flows and pollutants could be substantially increased in the future.

Supplemental onsite detention (WHL-1) is proposed for the commercial area north of S 359th Street in subcatchment WH3 to reduce these high flows and pollutants. The Spring Valley density reduction (WHL-9) will reduce erosion and pollutants entering the Spring Valley Wetland primarily from the slopes to the east. Current mitigation practices and regulations are not sufficient to protect the first order streams in this area from erosion or total destruction.

An alternative to the supplemental detention in the commercial area north of Spring Valley is a bypass pipeline, which would carry peak flows around the wetland and erosive areas downstream to the Pierce/King County line. This pipeline would include a biofiltration swale to reduce pollutant loadings. The cost of this project would be almost $5 million and would do nothing to reduce the already high flows entering Pierce County.

Regional detention upstream of the Spring Valley Wetland was considered and rejected because of an apparent lack of feasible sites. Habitat areas in tributary 0013 could be increased with better fish migration access upstream of S 359th Street. The 359th Street Culvert Replacement Project (2440), in combination with supplemental onsite detention (WHL-1), density reductions (WHL-9), low-density stream protection zoning (WHL-10), and pollutant reductions (Project 2438), could provide usable habitat to the headwaters of tributary 0013 under future land use.

If flow control measures upstream of S 373rd Street are effective at controlling storm flows, the potential for sediment deposition and flooding at

S 373rd Street will be reduced. However, since this area is currently, and has been a historically sediment deposition area, continued dredging of gravels from the stream channel will still be necessary (Project 2441), although much less frequently than now. Dredging must be coordinated with the Muckleshoot and Puyallup Tribes' fish plantings and with the Washington State Department of Fisheries to minimize impacts to the fishery resource. Flooding of the residence at S 373rd Street will most likely continue although at a reduced frequency even with flow control in the upper basin, because the house is constructed in the natural floodplain.

Floodproofing of the existing flooded house was considered as an alternative to the dredging option. However, the floodproofing alternative does not protect the roadway from flooding. Purchase and removal of the flooded residence was considered and rejected. This option would eliminate the flooding risk of the house, but would do nothing for the flooding of S 373rd Street. Relocating the channel away from the house was also examined, but this alternative would also require major roadway work and bridge relocation. Successful implementation of this option is also dependent upon upstream flow control and reduced erosion and sediment deposition. An instream sediment trap upstream of S 373rd Street was also considered and rejected. It was determined that a sediment trap would cause damage to an existing riparian wetland in that area and significantly degrade a stream reach with a high potential for restoration. Also, substantial wetland mitigation costs would be incurred for the project.

4.2 EAST BRANCH HYLEBOS CREEK

Introduction

The East Branch Hylebos Creek sub-basin, shown in Figure 4.2.1, is an elongated area east of I-5 and includes both unincorporated King County and the City of Milton. In addition to North Lake, Lake Killarney, and the Weyerhaeuser Pond, the sub-basin has four streams (0016A, 0016, 0006 and 0015) in its upland plateau that converge into the tributary 0006 ravine below SR 161. The upper reach of tributary 0016A was originally the headwaters of tributary 0013 in the West Branch Hylebos Creek sub-basin but was diverted during the construction of I-5 in the mid-1960s. The low-gradient reaches of the tributaries flow over an upland till surface prior to entering the steeper gradients of the ravine, which are underlain by a deposit of easily eroded sand and gravel of the Vashon advance outwash.

In 1987, a large portion of the sub-basin contained rural and undeveloped areas. Only small pockets of high-density single-family residences presently exist in Milton and east of I-5 between SR 18 and SR 161. The future land use of the sub-basin is expected to convert into mostly high-density single-family and multifamily residences. The loss of the forest cover in the presently undeveloped portions of the sub-basin, in combination with the till surface deposits will produce significant increases in the unmitigated peak stream flows. Almost the entire stream system in the sub-basin is predicted to have 50 to 100 percent increase in peak flows above existing (1987) conditions. Tributary 0015 will experience the most dramatic change, with predicted future flow increases of over 150 percent without flow control mitigation.

Aquatic habitat and water quality in the East Branch Hylebos Creek sub-basin have already been degraded by a 50 to 75 percent flow increase over forested conditions. Channel erosion and increased sediment loads have reduced the amount and quality of available habitat in the ravine, which historically contained excellent spawning and rearing areas for salmonids. The ravine, which has been designated as a Regionally Significant Resource Area (RSRA), currently has a substantial amount of very large in-channel coniferous woody debris with a dense high canopy available for future wood recruitment.

Salmonid populations have also been affected by poor water quality stemming from an accumulation of pollutants from unidentified upstream sources, destruction of riparian zones along residential developments near SR 161, poor waste management practices in the Enchanted Village Amusement Park, short-circuiting of onsite detention ponds in the Regency Woods development, and lack of erosion control and riparian zone encroachment along the ravines of tributaries 0006 and 0016. Several of these problems have been addressed, but most remain to be corrected.

In addition to these water quality problems, the sub-basin has three significant flooding problems that are, in turn, related to three channel erosion problems (Figure 4.2.2). Each flooding problem occurs along stream reaches of tributaries 0016, 0006 and 0015 upstream of SR 161; the related channel erosion and degraded water quality are most evident in the ravine areas downstream of each respective road crossing. The sub-basin has a

Figure 4.2.1

EAST BRANCH HYLEBOS CREEK SUB-BASIN

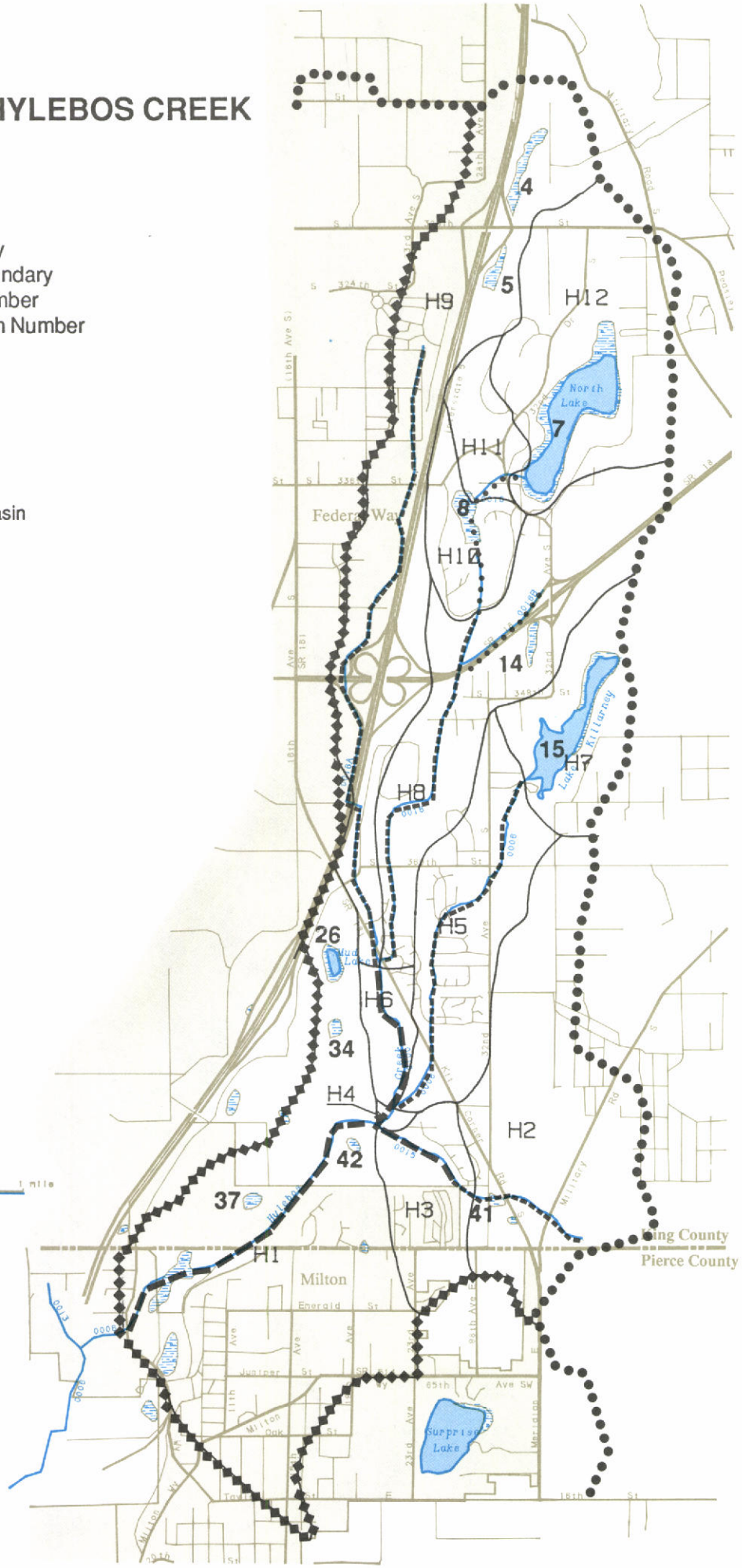
WATER FEATURES

- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- VH3 Sub-Catchment Number
- 0015 Streams and Stream Number
- 2 Inventoried Wetland (King County, 1983)

Streams *

- Class II
- Class III
- Unclassified

* No Class I in Sub-Basin



Location Reference

1991

0 1/2 1 mile

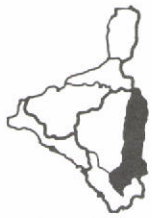
N

Figure 4.2.2

EAST BRANCH HYLEBOS CREEK SUB-BASIN

PROBLEM CONDITIONS

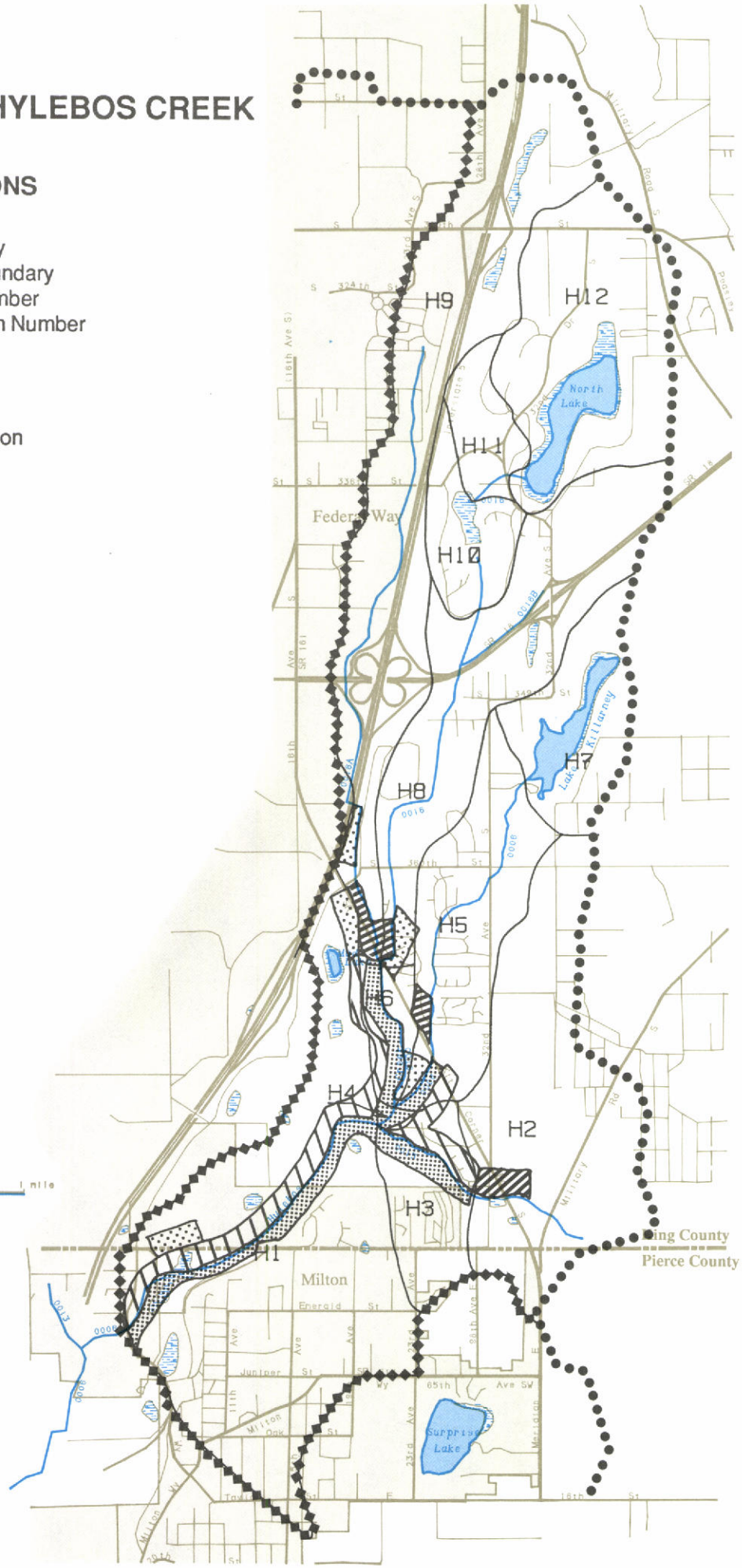
- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- WH9 Sub-Catchment Number
- 0015 Streams and Stream Number
- 2 Inventoried Wetland (King County, 1983)
- Flooding
- Erosion/Sedimentation
- Habitat
- Water Quality



Location Reference

1991

0 1/2 1 mile



variety of other, less hazardous problems, such as degraded habitat in the Weyerhaeuser Pond, that are not addressed by the recommendations below but are noted in the Current and Future Conditions Report (King County, 1990a) and in the final listing of identified problems (King County, 1990e).

Recommendations (Figure 4.2.3)

Regulations and Programs. Sub-basin recommendations for the East Branch Hylebos Creek include locally more restrictive onsite detention and the protection and biomonitoring of the ravine, an RSRA. The basinwide recommendation for onsite detention (BW-2) will prevent peak 2- and 10-year flows from future development from increasing. This standard should be applied in Milton as well. For further reduction, a supplemental onsite standard should be applied to those areas in the sub-basin that presently have rural and undeveloped land uses in order reduce future flows to channel-stabilizing levels.

EH-1: Supplemental Onsite Detention

Supplemental onsite detention should be applied in subcatchment H2 in the East Branch Hylebos sub-basin according to BW-3 in order to effectively reduce future peak flows. This supplemental standard should be applied until the recommended SR 161 Regional Detention Pond (Project 2446) is constructed. Upon completion of the regional pond, onsite detention should be designed according to the basinwide recommendation (BW-2), pending appropriate flow controls as shown by flow monitoring data.

EH-2: Stream Corridor Protection

A stream buffer to protect this RSRA is required along the tributary 0006 ravine (an RSRA) within subcatchment H1 (see BW-4). The buffer width should be at least 150 feet from the ordinary high water on each side of the stream or 50 feet beyond the top of hillslope on each side of the ravine, whichever is further from the ravine. Maintenance of intact vegetated corridors dominated by conifer trees along the stream are necessary to maintain stream stability and sustain fisheries in this resource area.

EH-3: Low Density Stream Protection Zoning

The East Branch Hylebos ravine, an RSRA, should be zoned rural at 1 unit per 5 acres to protect the significant resource (see BW-1). This low-density area encompasses the ravine (RM 6.0 to 6.75) and includes the King County inventoried wetland, Hylebos Wetland 37.

EH-4: East Branch Hylebos Ravine Biomonitoring

A biomonitoring program to supplement regular water quality monitoring should be established to provide continuous assessment of biological effects of water quality conditions entering the East Hylebos ravine. Fish held in streamside aquaria would be subject to stream water and monitored regularly to indicate incidents of acute toxicity from the stream.

Figure 4.2.3

EAST BRANCH HYLEBOS CREEK SUB-BASIN

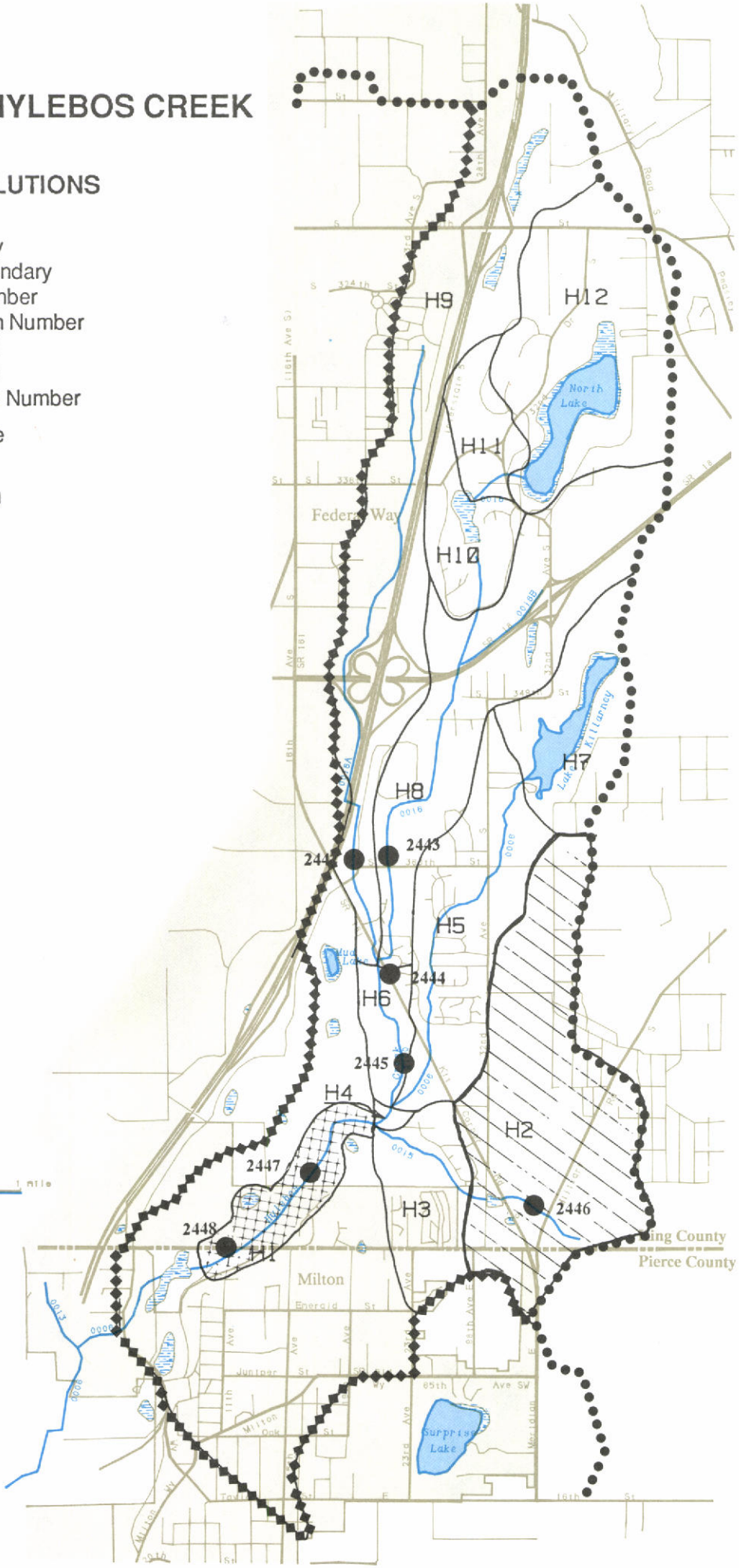
RECOMMENDED SOLUTIONS

- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- WH9 Sub-Catchment Number
- 0015 Streams and Stream Number
- 2 Inventoried Wetland (King County, 1983)
- 2431 Project Location and Number
- Supplemental Onsite Detention Standard
- 1 Unit/5 Acre Zoning

Location Reference

1991

0 1/2 1 mile



N

Capital Improvements. Seven projects are recommended in this sub-basin to remediate the effects of past land-use changes and their related flow increases in the East Branch Hylebos Creek sub-basin.

1. **Project 2442: S 360th Street Regional Pond**

   Construct a regional detention facility on tributary 0016A at about S 360th Street (extended). This facility would reduce predicted future peak flows to stream stabilizing levels, reduce downstream channel erosion, and help to minimize the extent and frequency of flooding in the residential area just upstream of SR 161. The detention pond should include biofiltration in order to achieve water quality improvement.

   Estimated cost: $1,635,000
   Location: King County

2. **Project 2443: S 360th Street Embankment Protection**

   Construct an overflow structure at S 360th Street and tributary 0016, just downstream of the Evergreen Vale Apartments, to prevent road overtopping and flooding of multifamily residences. The existing culvert under S 360th Street should not be upgraded.

   Estimated cost: $205,000
   Location: King County

3. **Project 2444: SR 161 Conveyance Upgrades**

   Upgrade three culvert crossings at tributaries 0016A, 0016, and 0006 to convey the future 25-year flow in order to protect the roadway and residences from flooding.

   Estimated cost: $280,000
   Location: King County

4. **Project 2445: Tributary 0016 Channel Stabilization**

   Stabilize the channel and the migrating knickpoints near RM 0.3 and 0.5 to reduce channel erosion and habitat degradation.

   Estimated cost: $16,000
   Location: King County

5. **Project 2447: East Branch Hylebos Water Quality Improvements**

   Retrofit four onsite detention ponds in the Regency Woods development to create two-cell ponds which more fully remove sediment from stormwater. Construct a biofiltration swale in the roadside ditch along SR 161 near tributary 0016A. Construct a berm within the onsite detention pond near S 363rd Place and revegetate the streambanks along tributary 0016 near 21st Place S and along tributary 0006 near RM 6.0 to improve water quality.

Estimated cost: $568,000
Location: King County/Milton

6. **Project 2448: East Branch Hylebos Channel Stabilization and Habitat Improvement**

   Reposition existing LOD and import new LOD to the upper (about RM 6.75) and lower (about RM 6.0) portions of the reach to effectively stabilize channel areas and diversify aquatic habitat.

   Estimated cost: $318,000
   Location: King County/Milton

7. **Project 2446: SR 161 Regional Pond**

   Construct a regional detention facility on tributary 0015 at SR 161 to prevent flooding and reduce downstream channel erosion. Replace the culvert under 28th Avenue S to convey the future 100-year flow. Stabilize the knickpoint at the outlet of Wetland 41 with a log weir in order to maintain existing water levels in the wetland.

   Estimated cost: $450,000
   Location: King County

Further Studies. No further studies are recommended for the East Branch Hylebos Creek sub-basin.

Discussion of Recommendations, Alternatives, and Effects

Diversion of the tributary 0013 headwater drainage into 0016A, along with urbanization in the upper half of the sub-basin, have produced increased flows that now overwhelm highway culverts, erode downstream channel areas, and add poor-quality runoff into the stream system. Because the sub-basin contains areas that are only moderately developed, the opportunity exists to reduce future peak flows locally by applying onsite standards, and to control existing flows with regional detention ponds.

Two sites are available for regional detention on tributaries 0016A and 0015. Each would effectively reduce peak flows below existing levels. Tributary 0016A, which drains most of the I-5 corridor in the sub-basin, generates the largest peak flow of the three tributaries. Detaining this flow in a regional pond at S 360th Street (Project 2442) would reduce peak flows to channel stabilizing levels in the immediate downstream reaches of tributaries 0016A and 0016. It would also hold future flows in tributary 0006 ravine at existing levels.

An alternative detention pond was analyzed that could detain two-thirds of the area tributary to 0016A. The pond could be located upstream of SR 18 and could discharge to tributary 0016, a flow diversion. Although the project would effectively reduce flows to less damaging levels in tributaries 0006 and 0016A, the flow diversion would also increase flows in tributary 0016 to unacceptably high levels.

A large, existing onsite pond at tributary 0016 and S 360th Street is currently attenuating flows. This site provides storage that effectively prevents flooding of downstream streets and residences. Only minimal modifications to this existing site are recommended (Project 2443) in order to protect its road embankment. The existing culvert at S 360th Street and tributary 0016 should not be up-sized. The loss of detention in this area along with the release of additional flows through a larger sized culvert would result in significant downstream flood damage.

Regional detention on tributary 0015, which has severe channel erosion and is predicted to experience one of the largest flow increases in the sub-basin, would provide flow reductions similar to the S 360th Street pond. This regional facility (Project 2446) would also improve the future flow conditions downstream in the tributary 0006 ravine. Until the regional pond at SR 161 and tributary 0015 is constructed, supplemental onsite detention (BW-3) for new development in subcatchment H2 is recommended.

Currently, onsite standards in the King County Surface Water Design Manual, and its modifications as described in BW-2 would apply to unincorporated areas within the sub-basin. Consistency in the application of these standards could be attained if the City of Milton adopts similar standards.

Reducing flows to stabilize channel conditions, by constructing regional facilities and applying supplemental onsite standards, offers the benefit of less frequent and less severe flooding. The most notable advantage is the prevention of flooding within a residential area located just upstream of SR 161 along tributary 0016A. Existing housing is directly adjacent to the streams and prohibits increasing the channel size. With new detention facilities constructed on tributaries 0016A and 0015, and the existing detention maintained on 0016, floodproofing would entail simple culvert upgrades along SR 161 (Project 2444).

Channel erosion, degraded water quality, and loss of aquatic habitat result from increased flows caused by urbanization and streamside land uses. Stream corridor encroachment causes a loss of riparian zone area which is necessary to support salmonid and wildlife populations, maintain good water quality, and minimize channel erosion and sideslope mass wasting. Flow reduction projects are the ultimate, long-term solutions to unstable flow regimes. However, the essential near-term corrective actions are projects that remediate the physical in- and off-channel problems. In-channel projects that reposition or import LOD (such as Project 2448) can provide immediate stabilization benefits for eroded stream beds and banks, and can improve the habitat diversity. These projects do not require extensive designs, although high capital costs can be incurred when sufficiently large LOD must be brought to the project site.

Off-channel improvements such as retrofitting existing onsite detention ponds to maximize water quality improvement, constructing biofiltration swales, revegetating streamside corridors, and implementing best management practices, are near-term actions. These improvements along with in-channel stabilization, large stream buffers, and rural zoning in the East Branch Hylebos ravine will increase the likelihood of retaining the stream stability and salmonid resource in this sub-basin.

The East Branch ravine has been identified as an area with high quality fish habitat. It is located downstream from heavily urbanizing areas, thus making it highly susceptible to acute, highly toxic pollution events resulting from accidental or intentional inputs of pollutants. Such events are unlikely to be detected with normal sampling programs because of their infrequent occurrence, nevertheless, they can result in serious harm to the aquatic biota. In addition, these events may result in significant contribution of contaminant accumulation in organic tissues and sediments. A biomonitoring program (EH-4) would document these events and provide a measure of severity of the problem. This program would be ideal for implementation by a Stream Steward (BW-38) and for utilization of volunteers in regular monitoring and maintenance of the fish. Biomonitoring of this stream reach is proposed as part of the overall plan to ensure its continued usefulness as high quality habitat for production of salmonids.

Both flow reduction and physical improvements to the stream system are necessary to address existing and future problems within the sub-basin. These efforts, complimented with stream corridor regulations (EH-2 and EH-3), are necessary to protect the significant resource areas in East Branch Hylebos Creek.

4.3 NORTH LOWER PUGET SOUND

Introduction

The North Lower Puget Sound sub-basin (Figure 4.3.1) occupies a relatively narrow strip of land between I-5 and Puget Sound. Its drainage is dominated by McSorley Creek, whose two branches (tributaries 0381 and 0382) originate in an upland wetland and then incise sharply through till deposits on their paths to the Sound. Woodmont Creek (tributary 0383) follows a similar, but much shorter, path.

Land use here is presently dominated by high-density single-family development, with significant undeveloped land only along lower McSorley Creek in Saltwater State Park and around the large wetland (Lower Puget Sound Wetland 2) at the head of tributary 0381. The Midway Landfill lies in the upper headwaters of tributary 0382.

Flows in the sub-basin show an erratic pattern of future increases. Changes are greatest at the headwaters of McSorley Creek (0381) and in tributary 0382 just above its confluence with the main stem. In this area, increases of more than 50 percent are typical, assuming build-out conditions without onsite detention. Elsewhere, increases are less but still locally substantial, particularly through the State Park. In contrast, existing flows already reflect two- to four-fold increases over forested conditions.

Water quality data in this sub-basin are available only for McSorley Creek. Fecal coliforms, total nutrients, and metals all show high levels during storm-event sampling, reflecting the impacts of upstream land use. The marginal fish habitat in the sub-basin that still remains is restricted to McSorley Creek, from the State Park upstream to SR 99 on tributary 0381. An intertidal wetland, an LSRA, lies at the mouth of this creek.

The limited size of the sub-basin has generated only a small number of significant surface-water problems. All problems are associated with McSorley Creek (Figure 4.3.2), particularly high flows in its two tributaries. Two problems lie in the upper sub-basin; the third, flooding and sedimentation at the mouth of the creek, reflects the downstream consequences of upstream development. This stream channel was prone to sedimentation and flooding at the mouth in an undeveloped state. The significance of the downstream problems are heightened by land uses adjacent to the stream channel. Those problems that do not pose hazardous conditions are not addressed by the recommendations below, but they are noted in the Current and Future Conditions Report (King County, 1990a) and in the final listing of identified problems (King County, 1990e). These include all existing and anticipated conditions along Woodmont Creek, the other major stream in this sub-basin.

Figure 4.3.1

NORTH LOWER PUGET SOUND SUB-BASIN

WATER FEATURES

- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- VH3 Sub-Catchment Number
- 0392 Streams and Stream Number
- 1 Inventoried Wetland (King County, 1983)

Streams *

- Class II
- Class III
- Unclassified

* No Class I in Sub-Basin

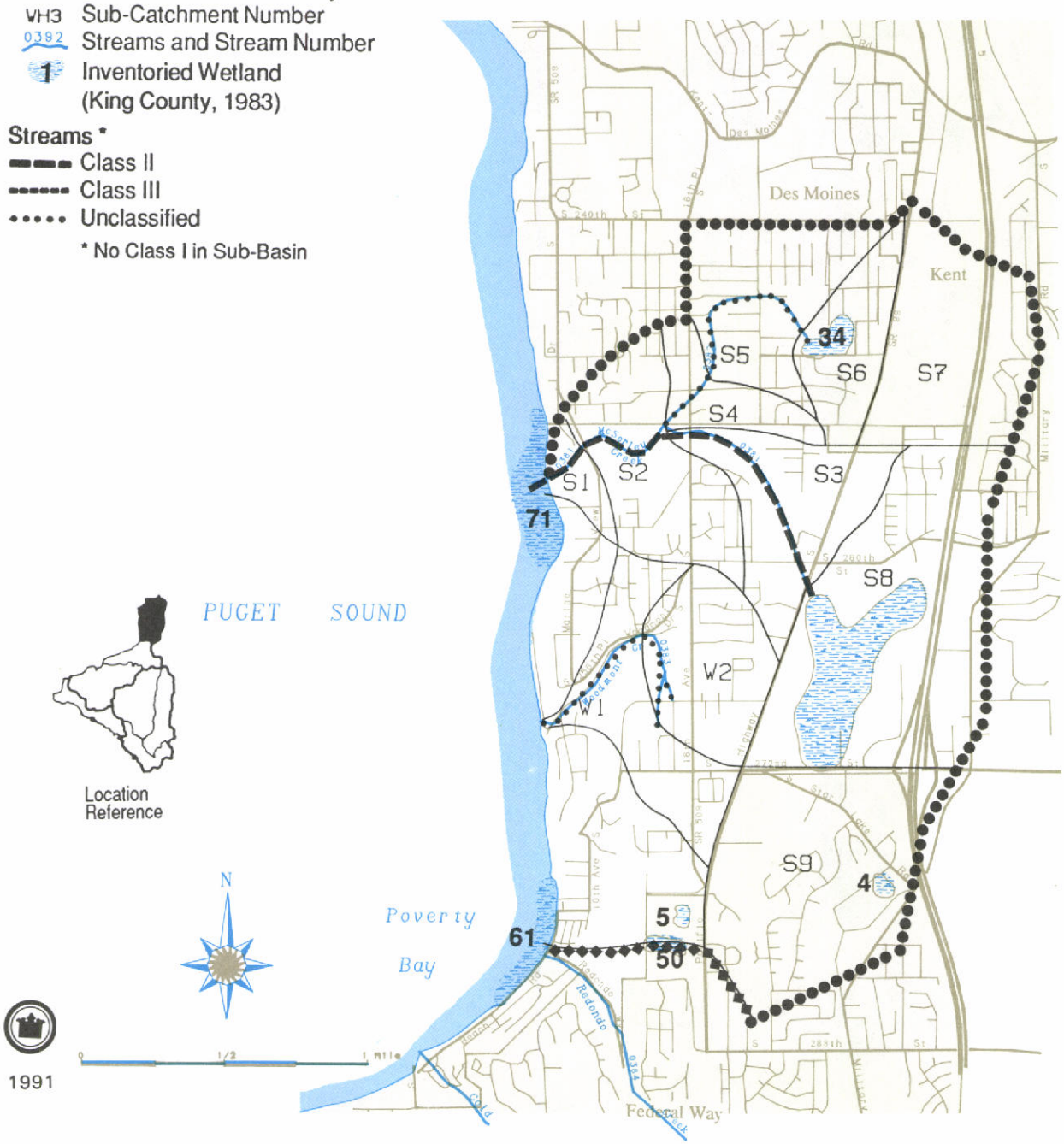
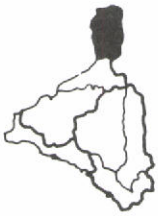


Figure 4.3.2

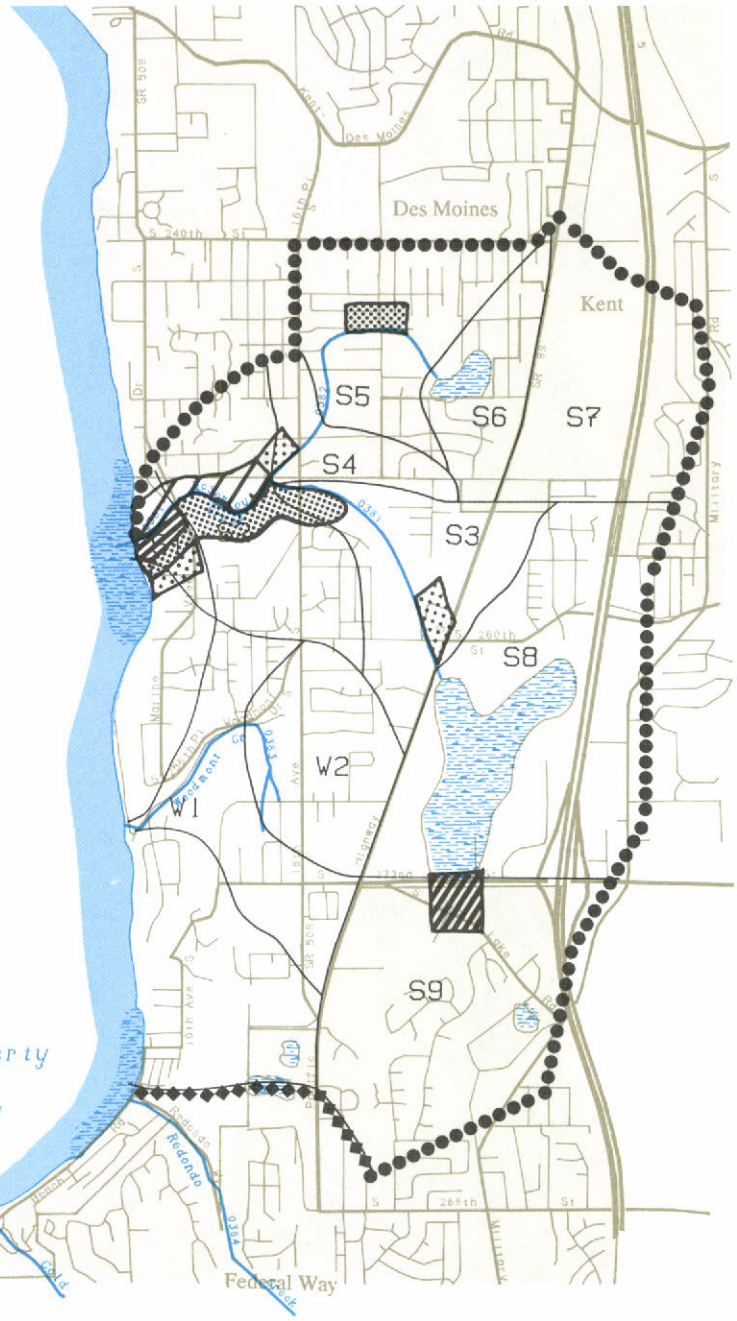
NORTH LOWER PUGET SOUND SUB-BASIN

PROBLEM CONDITIONS

- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- VH9 Sub-Catchment Number
- 0392 Streams and Stream Number
- 1 Inventoried Wetland (King County, 1983)
- Flooding
- Erosion/Sedimentation
- Habitat
- Water Quality



Location Reference



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Recommendations (Figure 4.3.3)

Regulations and Programs. Using the basinwide recommendation for onsite detention (BW-2), flow increases from future development are limited to less than half of their unmitigated values (i.e., if no onsite detention were required). In the main stem of McSorley Creek, where most of the high-flow-related channel instability is now occurring, flow increases are held to moderate levels and are not substantially improved by more restrictive areawide controls. Supplemental onsite detention requirements are therefore not recommended in this sub-basin. In some cases, however, less restrictive detention may be feasible and acceptable.

NS-1 Reduced Onsite Detention

Direct discharge to Puget Sound is an acceptable detention alternative to the basinwide onsite detention standard (BW-2) in this sub-basin, where the discharge can be accomplished after appropriate biofiltration and other water-quality treatment.

Capital Improvements. Three projects are recommended in this sub-basin, primarily to limit the impacts of development-induced flow increases.

1. Project 3323: S 272nd Street Conveyance Upgrade

   Improve conveyance of tributary 0381 across S 272nd Street and S Star Lake Place with enlarged culverts; retrofit upstream detention ponds for enhanced water-quality control.

   Estimated cost: $448,000
   Location: Federal Way, King County

2. Project 3320: 20th Avenue S Conveyance Upgrade

   Upgrade trash rack on tributary 0382 at 20th Avenue S to King County Design Manual standards to avoid future out-of-bank flows; stabilize and revegetate streambanks.

   Estimated cost: $38,000
   Location: Des Moines

3. Project 3322: Lower McSorley Creek Sediment Control

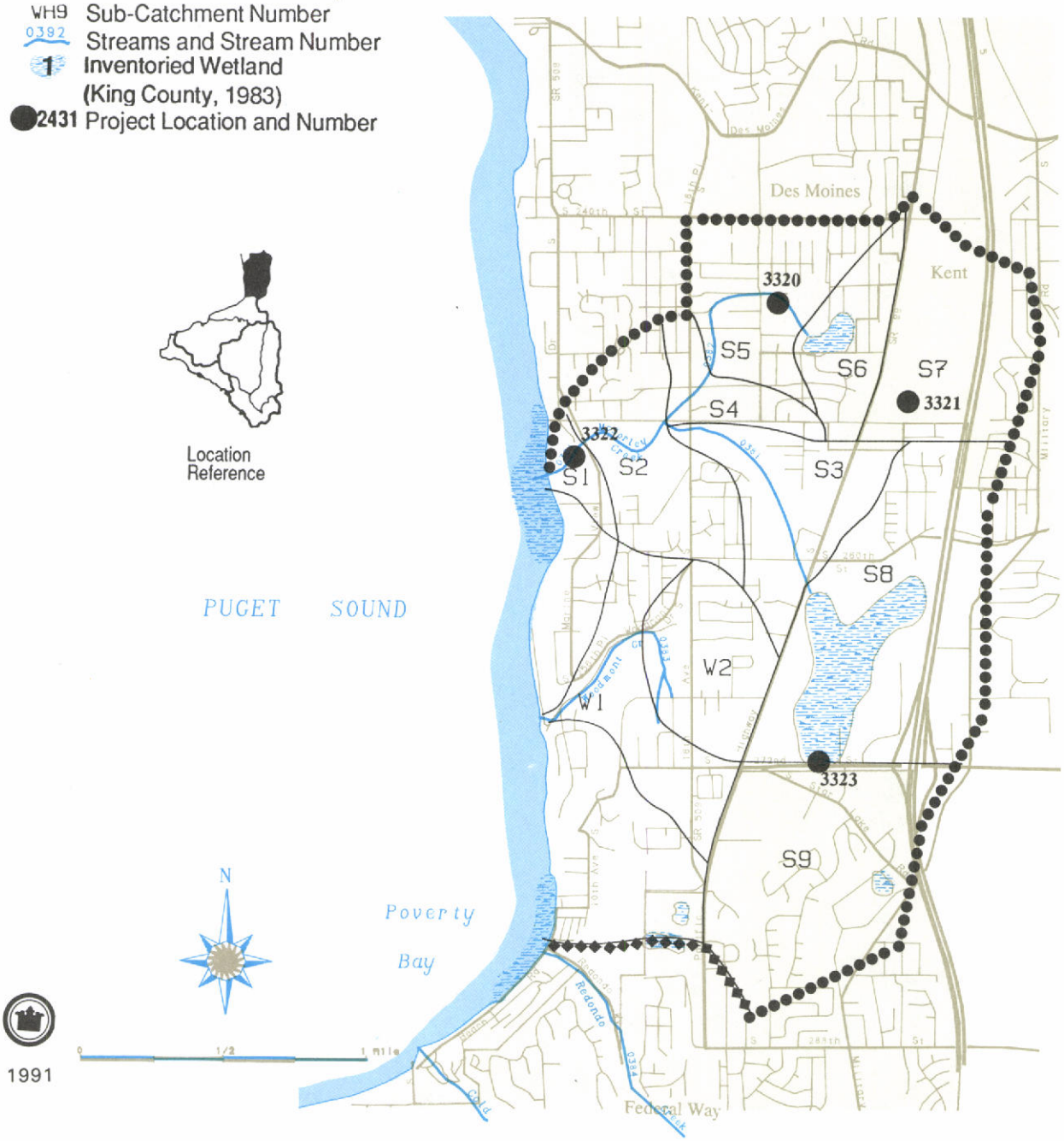
   Construct porous rock berm adjacent to lower McSorley Creek to permit free drainage but to confine out-of-bank coarse sediment near the stream and away from developed areas. Redesign access road crossing to maintain 100-year flow capacity. Reinforce road berm and restrict traffic during storm events as needed to accommodate high flow conditions across roadway and parking area. Prepare habitat enhancement plans for stream channel on State Park property.

Figure 4.3.3

NORTH LOWER PUGET SOUND SUB-BASIN

RECOMMENDED SOLUTIONS

- ●●●● Basin Boundary
- ◆◆◆◆ Sub-Basin Boundary
- ~ Sub-Catchment Boundary
- WH9 Sub-Catchment Number
- 0382 Streams and Stream Number
- 1 Inventoried Wetland (King County, 1983)
- ●2431 Project Location and Number



Estimated cost: $46,000
Location: Washington State Park

Further Studies. Uncertainties regarding the detention of water at the Midway Landfill, and its subsequent discharge into McSorley Creek near the confluence of tributaries 0381 and 0382, suggest that further hydrologic analysis is needed. Because the Midway detention pond was constructed to hold substantial volume, this site likely could be easily and successfully retrofitted if such a result is determined to have significant benefits. Operation of the pond should fully utilize this detention volume during large storm events.

1. **Project 3321: Midway Detention Pond Retrofit Study**

   Washington State Parks Department and the City of Seattle should evaluate Midway detention pond performance and operation using final pond construction specification and continuous hydrologic modeling; determine outlet configuration to minimize downstream peaks at the mouth of McSorley Creek that now exceed 120 cfs (see also BW-24.3, Monitoring Recommendations).

   Estimated study cost: $40,000
   Location: Kent

Discussion of Recommendations, Alternatives, and Effects

Problems in this sub-basin are largely a result of increased flows from urbanization, which in turn travel through a drainage system with little intrinsic storage or attenuation. Because the area is largely developed, most of the problems resist simple, proactive solutions. As a result, the solutions seek to make tolerable the effect of high flows from an already developed area.

Available new detention storage sites of adequate size in the sub-basin are particularly limited. Extensive undeveloped areas are rare and lie mainly in the headwater reaches where even extraordinary flow control would have minimal effect farther downstream. In addition, they are, in large part, occupied by significant or outstanding wetlands (Lower Puget Sound Wetlands 34 and 2) in which enhanced stormwater detention would have significant resource impacts.

Existing detention in the sub-basin is also very limited, because most of the development predates significant onsite detention requirements. Only Wetland 2, with natural live storage in excess of 100 acre-feet (King County, 1983), provides substantial flow attenuation. Because of the high storage capacity of that wetland, the upstream flow problems along tributary 0381 should be addressed via improved conveyance together with an emphasis on water-quality pretreatment to the wetland inflow (Project 3323).

Flooding and sedimentation problems at the mouth of McSorley Creek reflect the problems of flow control throughout the rest of the sub-basin. Because of the limitations on new detention described above, possibly mitigated in part by adjusted control from the Midway detention pond (Project 3321), some future

flow increases through Saltwater State Park are likely and the current level of high flows is inevitable.

Land uses adjacent to the stream channel, however, amplify the severity of those flow increases. Park activity is located directly on the alluvial fan that the stream has constructed during past high flows, and that the flow will continue to construct during future events. The recommendations for this area (Project 3322) therefore acknowledge the future water and sediment regimes and seek to minimize their impact.

Other measures would also have beneficial effect. The recommended habitat enhancement plans, particularly in the lower reaches here, would have multiple benefits. These include reducing sediment delivery to the lower park area, improving aquatic habitat in lower McSorley Creek and the high-quality intertidal wetland and LSRA (Lower Puget Sound Wetland 71), and improving water quality by reducing fine sediment loads. Construction of such improvement projects, even if piecemeal, would have an incremental benefit on the lower system. They provide the only feasible method of reducing the problems that already befall the lower reaches of this sub-basin.

4.4 CENTRAL LOWER PUGET SOUND

Introduction

The Central Lower Puget Sound sub-basin drains upland areas through two major streams, Redondo Creek (tributary 0384) and Cold Creek (tributary 0385); and a host of intermittent channels farther west (Figure 4.4.1). The upland area is underlain by till and locally overlain by outwash. The steeper slopes leading down to Puget Sound expose a sequence of older, deeper deposits of past glaciations and interglaciations. Moderate erosion of the sandier deposits on this slope is common along the channels here, as is landsliding near the contacts between sandy and underlying silty deposits.

Flows in the sub-basin are predicted to be minimally increased in the future, but they are dramatically greater now than prior to development. Between 1987 and full build out, modeled flows typically increase by no more than 10 to 20 percent even without onsite detention. In contrast, the differences between forested and 1987 conditions are typically three- or four-fold for a given recurrence interval.

Water-quality conditions in this basin affect both streams and lakes. Observed high concentrations of fecal coliforms, metals, and total suspended solids stem from high-density development, numerous arterial roads and two state highways, and a now-abandoned petrochemical disposal site. The mouth of Redondo Creek, in particular, was rated the single worst water-quality site of any in the Hylebos and Lower Puget Sound basins during the 1989-1990 storm season sampling program. Water here discharges into Lower Puget Sound Wetland 61, a number-one rated intertidal wetland and an LSRA. Degraded water quality at this site is particularly problematic.

Surface-water problems here are numerous but most are not severe, reflecting the limited extent of the drainage system and the substantial alterations that have already occurred to many of the streams. The habitat value of this sub-basin is also rather low. Significant problems, therefore, are few in number (Figure 4.4.2). Those problems that do not pose hazardous conditions are not addressed by the recommendations below. They are noted in both the Current and Future Conditions Report (King County, 1990a) and in the final listing of identified problems (King County, 1990e). These recommendations also do not address the recent failure of the Redondo Beach Road Seawall, caused by wave action during high winds in December 1990.

Recommendations (Figure 4.4.3)

Regulations and Programs. Because the sub-basin is largely built out, onsite flow control for new development could be only moderately effective. No supplemental detention beyond the Basinwide Recommendation (see BW-2) is therefore recommended. In some cases, however, less restrictive detention may be feasible and acceptable.

Figure 4.4.1

CENTRAL LOWER PUGET SOUND SUB-BASIN

WATER FEATURES

- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- VH3 Sub-Catchment Number
- 0387 Streams and Stream Number
- 5 Inventoried Wetland (King County, 1983)

Streams *

- Class II
- Class III
- Unclassified

* No Class I in Sub-Basin

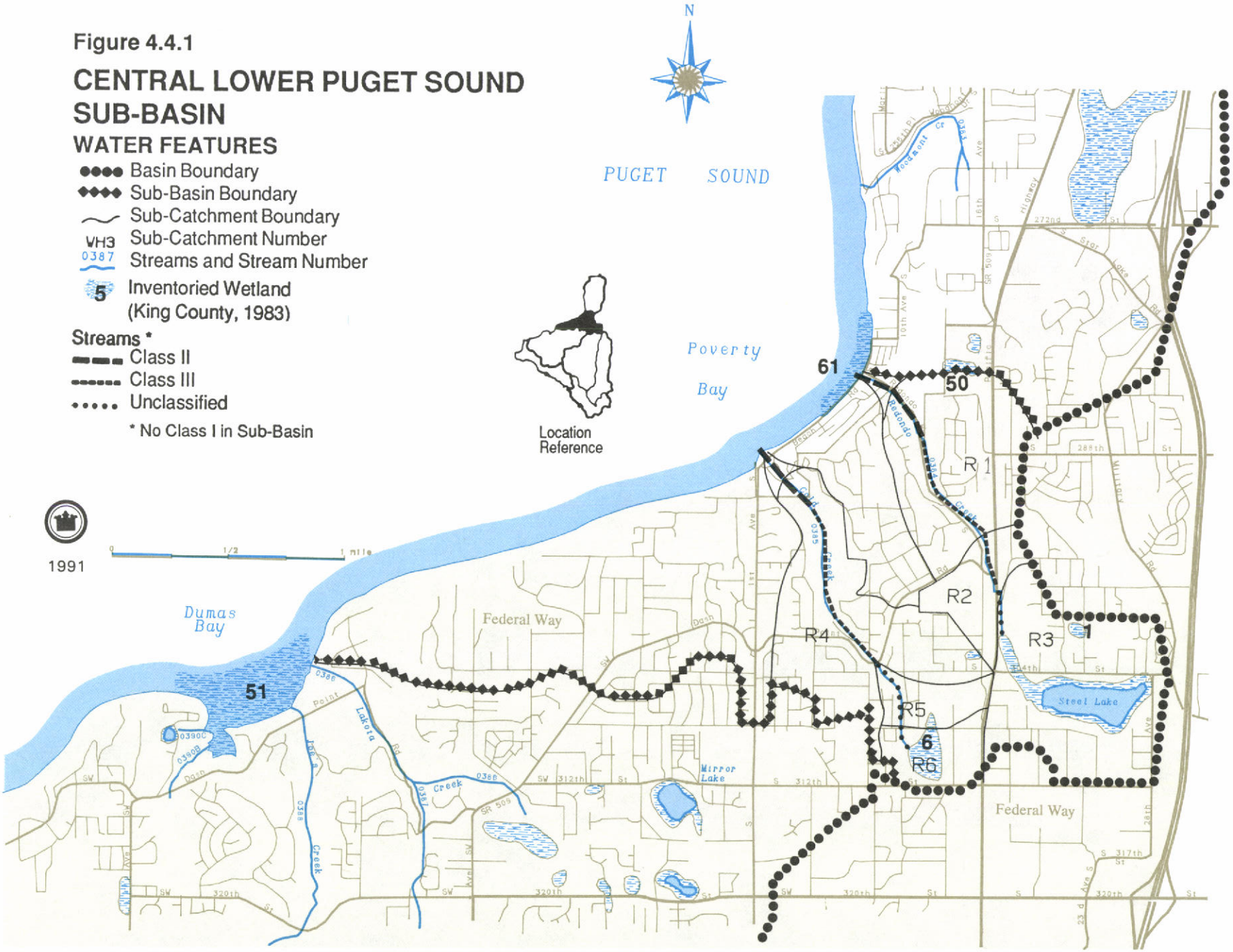


Figure 4.4.2

CENTRAL LOWER PUGET SOUND SUB-BASIN

PROBLEM CONDITIONS

- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- VH9 Sub-Catchment Number
- 0387 Streams and Stream Number
- Inventoried Wetland (King County, 1983)
- Flooding
- Erosion/Sedimentation
- Habitat
- Water Quality

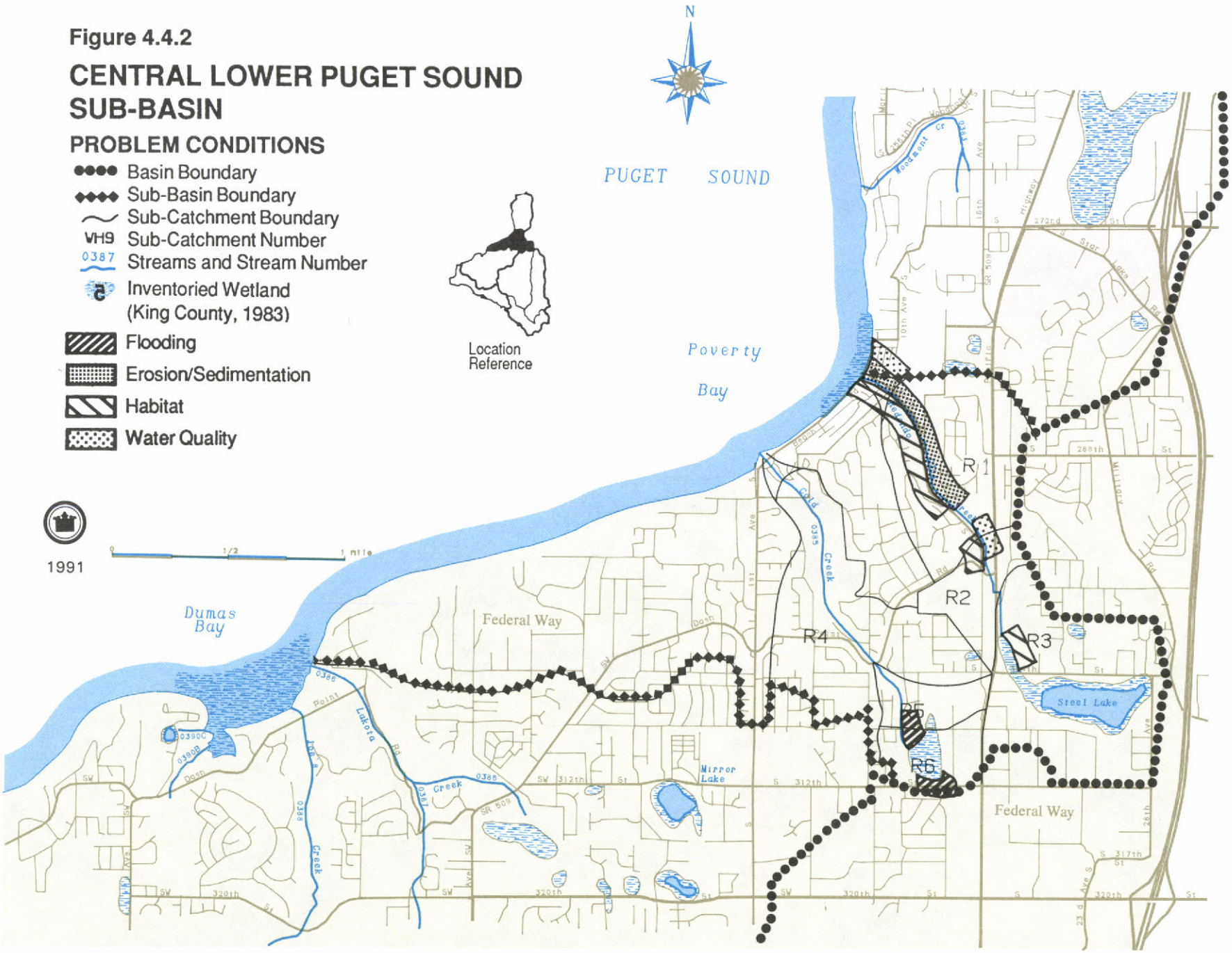
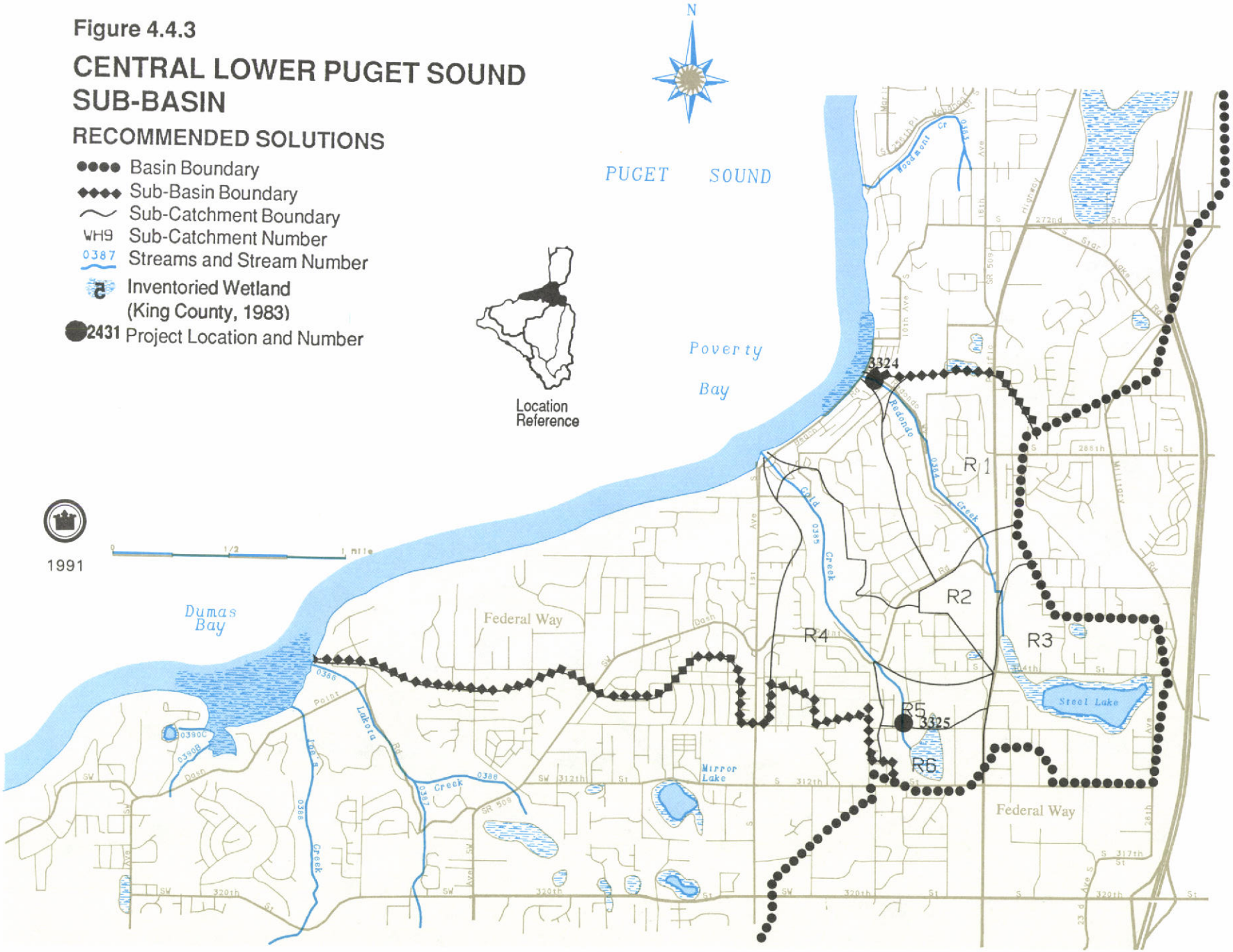


Figure 4.4.3

CENTRAL LOWER PUGET SOUND SUB-BASIN

RECOMMENDED SOLUTIONS

- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- WH9 Sub-Catchment Number
- 0387 Streams and Stream Number
- Inventoried Wetland (King County, 1983)
- 2431 Project Location and Number



CS-1 Reduced Onsite Detention

Direct discharge to Puget Sound is an acceptable detention alternative to the basinwide onsite detention standard BW-2 in this sub-basin where the discharge can be accomplished after appropriate biofiltration and other water-quality treatment.

CS-2 Redondo Creek Biomonitoring

In addition to further study of water quality (Project 3324), establish ongoing biomonitoring program at mouth of Redondo Creek, using fish held in streamside aquaria to indicate incidents of acute toxicity of the streamflow.

Capital Improvements. Only one project in the sub-basin is recommended to address a significant flooding problem.

1. **Project 3325: Easter Lake Outlet Improvements.**

   Regrade lake outlet swale, improve pipe inlet, and construct berm as needed to prevent excessive lake-level rise and flooding of retirement home.

   Estimated cost: $79,000
   Location: Federal Way

Further Studies. Water-quality data suggest that the area tributary to Redondo Creek is contributing a particularly high concentration of pollutants to the stream system and thence to Puget Sound. The petrochemical disposal site near the head of the sub-basin may be continuing to discharge from the subsurface into the surface-water system, although the information needed to confirm and address this problem is beyond the scope of the Basin Plan.

1. **Project 3324: Redondo Creek Water Quality Study**

   In addition to biomonitoring (CS-2), conduct detailed assessment of the composition and sources of urban pollutants recognized in Redondo Creek and develop strategies for their removal prior to discharge into Puget Sound.

   Estimated study cost: $22,000
   Location: Federal Way

Discussion of Recommendations, Alternatives, and Effects

Because of the limited number of significant surface-water problems recognized in this sub-basin, recommendations are also limited in both scope and effect. Lowering the outlet control on Easter Lake (Project 3325) will reduce the likelihood that local lakeside flooding, most recently observed during the January 1990 storm. This action, however, will eliminate some of the active storage in Easter Lake and so increase discharge into Cold Creek. This

downstream channel has already been severely impacted by existing development in the basin, with the channel above SW Dash Point Road displaying evidence of highly erosive flows.

The impact of this erosion, however, is limited by the relatively undeveloped land surrounding the creek, the low habitat value of the creek in its present condition, and the large number of culverts and other grade controls that limit the total amount of possible incision. Enhancing detention at Easter Lake would only slightly mitigate these problems, because of the lake's position high in the sub-basin. Any enhancement here, however, would exacerbate the more immediate problem of flooding around the lake. Correction of this increased problem would in turn require some combination of floodproofing, berms, or relocation. It was judged inappropriately costly for the minimal downstream benefits so achieved. Enhancing the detention capacity of any existing detention ponds in the upper basin was also considered. However, facilities are nearly non-existent, and their potential additional storage volume is trivial in comparison to the minimum requirements for effectiveness.

The recommendations for additional study of Redondo Creek water quality (Project 3324) and for biomonitoring (CS-2) reflect the severity of the existing problem, the resource value of the downstream receiving waters, and the difficulty of identifying all pollutant sources and potential solutions in the limited time and scope of this Basin Plan. During the 1940s and 1950s, waste oil was dumped into an old gravel pit near the head of this tributary, which has since been converted to a park (Sacajawea). The State Department of Ecology conducted a preliminary assessment of the site itself in 1988; some testing of groundwater wells at some distance from the site in 1989 showed no contaminants. As a result, the contribution of the dump to contaminants observed during the 1989-1990 storm event sampling of Redondo Creek is presently unknown. Irrespective of ultimate sources, identification and elimination of the pollutants in Redondo Creek which discharge to Puget Sound would improve habitat conditions for shellfish and other marine species.

Biomonitoring, however, can begin prior to study completion. It would provide continuous assessment of acute toxicity of water-quality conditions on fish as the flow enters Puget Sound. Such effects are not likely to be detected with normal sampling programs because of their infrequent occurrence. Yet they can result in serious harm to the aquatic biota. Biomonitoring can document the incidence of these events and provide a measure of the severity of the problem.

4.5 SOUTH LOWER PUGET SOUND

Introduction

The South sub-basin is the largest in the Lower Puget Sound basin, draining over 3.5 square miles through Lakota Creek (tributaries 0386 and 0387) and Joes Creek (0388 and 0389) (Figure 4.5.1). Joes Creek, in particular, is the most extensive and complex system in the basin; it also is the least developed to date, although that condition is changing rapidly. Stream habitat value in this LSRA is therefore highest of any of the Lower Puget Sound drainages, but degradation is accelerating. The tributary area of Lakota Creek, in contrast, is already almost completely built out. Past flow increases and stream-channel alteration here have already eliminated much, though not all, of the resource value of this stream. Future changes to this channel are not likely to worsen conditions appreciably. Some opportunities for effective remediation do exist.

Land use in the sub-basin is predominantly established high-density single-family neighborhoods. These developments are concentrated in the headwaters of Lakota Creek and the east tributary of Joes Creek (0389). In contrast, the lower reaches of both drainages flow through largely undeveloped ravines; the headwater area of the west branch of Joes Creek (0388) above Twin Lakes was also lightly developed as of 1987.

Future flow increases in this sub-basin closely follow the anticipated pattern of future development. Only in the west, where large areas of undeveloped land were still present in 1987, are future flow increases dramatic. Above the confluence with tributary 0389, for example, flows in 0388 are predicted to more than double; conversely, modeled flows in the easterly tributary (0389) change by only about 10 percent.

Based on the average of all sampling sites, this sub-basin was the most polluted of any in the 1989-1990 storm event sampling program. Water-quality conditions were similar to, but generally more severe than, those observed in the Central Lower Puget Sound sub-basin. High fecal coliforms, metals, suspended solids, and phosphorus were commonly measured. They probably originate from the extensive areas of residential development throughout the sub-basin. The streams of this sub-basin discharge directly into Dumas Bay, an outstanding intertidal wetland (Lower Puget Sound Wetland 51) and an RSRA.

Significant problems in this sub-basin are associated with both Lakota and Joes Creeks (Figure 4.5.2). Most involve the impact of high flows in easily eroded stream channels, which in turn increase the sediment loads to the downstream system. In addition, a recurring flooding problem at Twin Lakes on the west branch of Joes Creek has worsened significantly and now affects several lakeside residences. Other, less significant problems in the sub-basin that are not addressed by the recommendations below are noted in the Current and Future Conditions Report (King County, 1990a) and in the final listing of identified problems (King County, 1990e).

In tributary 0391A, severe erosion associated with a development project has recently deposited considerable volumes of sediment throughout downstream

Figure 4.5.1

SOUTH LOWER PUGET SOUND SUB-BASIN

WATER FEATURES

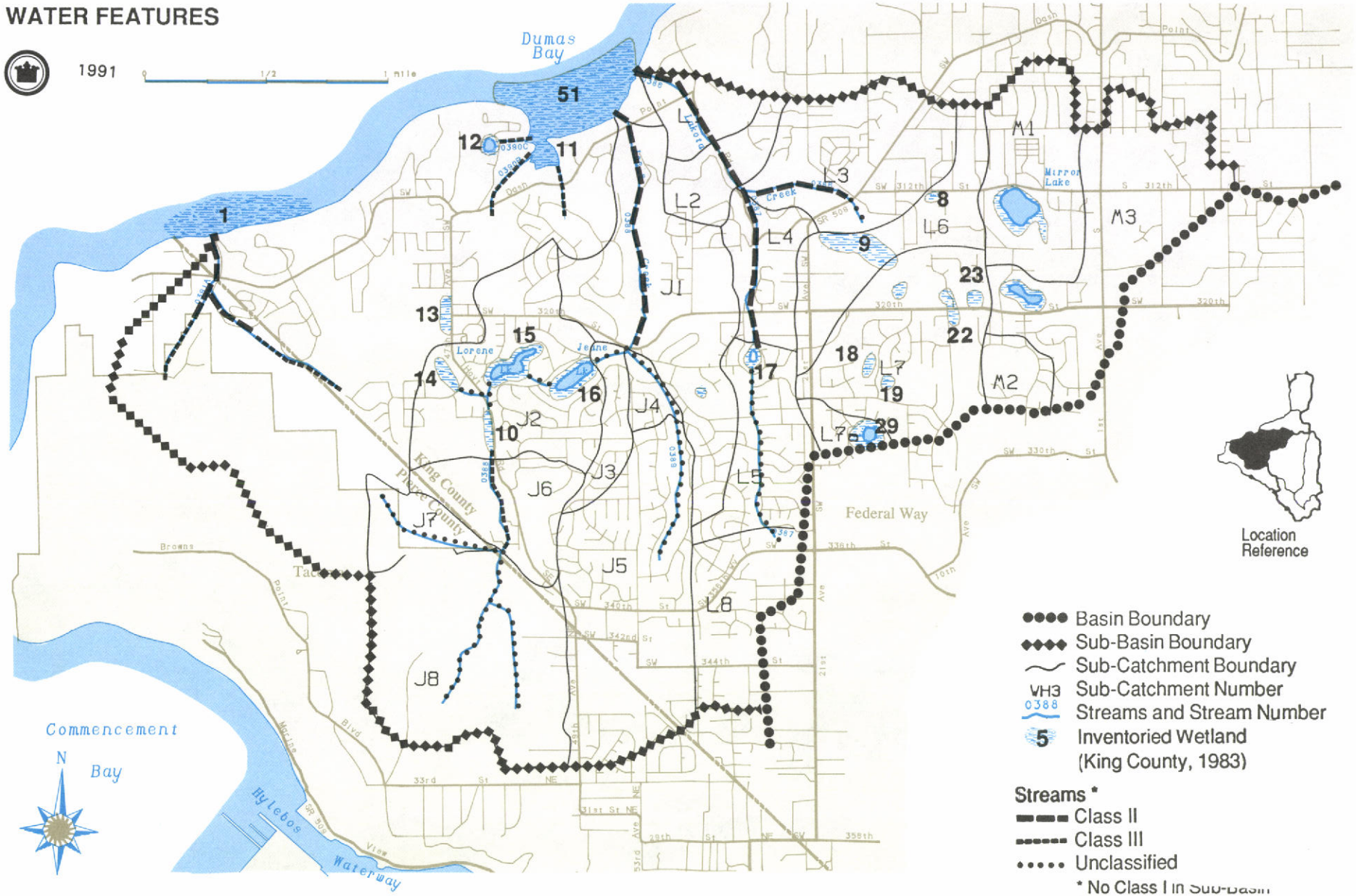
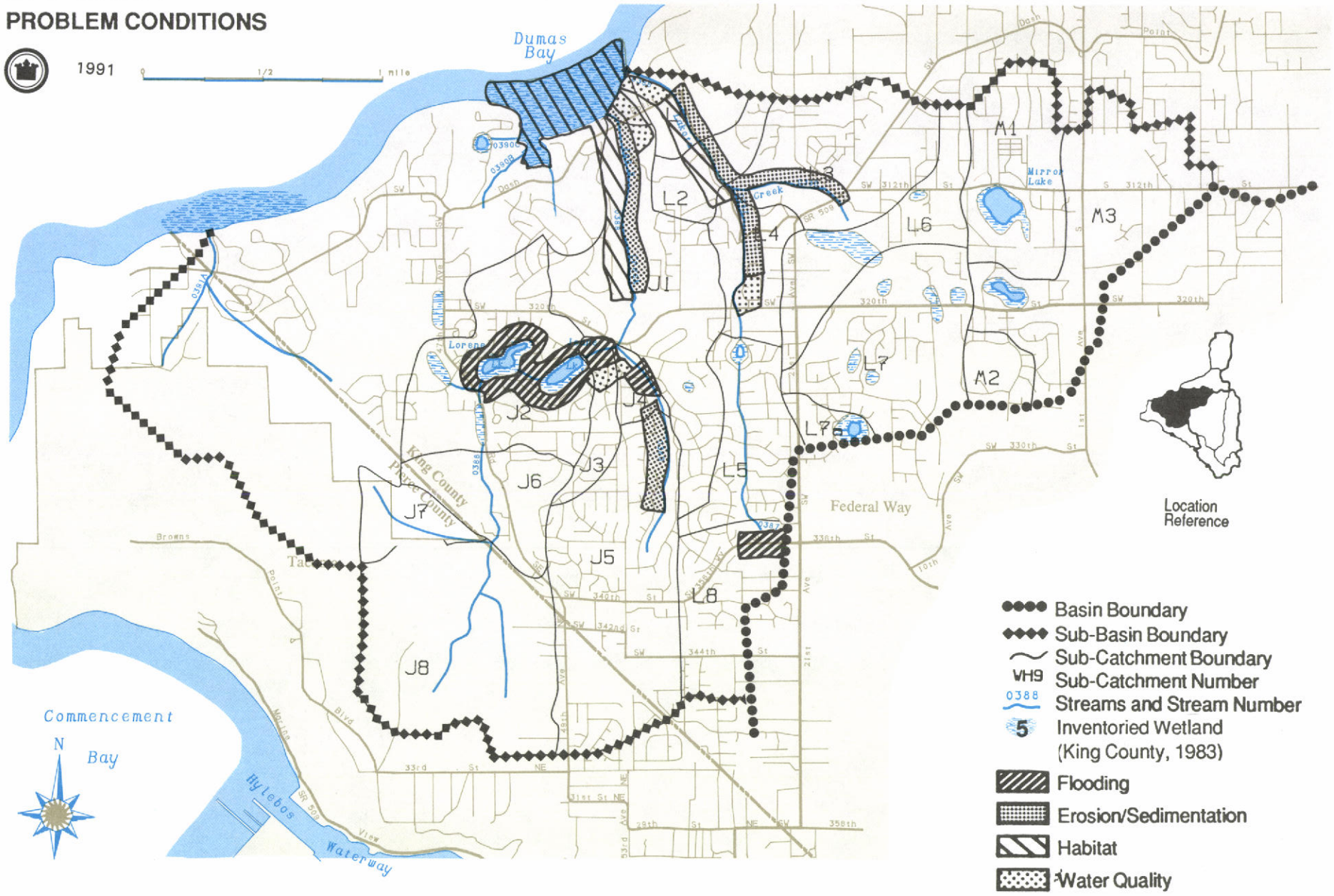


Figure 4.5.2

SOUTH LOWER PUGET SOUND SUB-BASIN

PROBLEM CONDITIONS



reaches and into the intertidal wetland (Lower Puget Sound Wetland Number 1), an LSRA. It appears that storm flows from this site have also damaged a culvert crossing. Due to the limited fishery resource in this tributary, however, habitat impacts are also limited. According to the Plan criteria, these conditions are not sufficiently severe to be considered significant flooding or habitat problems.

Recommendations (Figure 4.5.3)

Regulations and Programs. Because of the degree of existing development in the sub-basin, supplemental onsite detention requirements beyond those in the Basinwide Recommendations (BW-2) are not particularly effective in most areas to achieve significant flow reduction. Thus they are not recommended.

Two exceptions to this recommendation are warranted. In the southwestern part of the sub-basin, in the tributary area to the upper west branch of Joes Creek (0388), supplemental onsite detention standards can help minimize what could otherwise be a future three-fold increase in flows of a given frequency. Conversely, less restrictive detention standards adjacent to Puget Sound may be feasible and acceptable:

SL-1: Supplemental Onsite Detention

In areas tributary to the inlet of Lorene Lake, the upper Twin Lake (subcatchments J6, J7, J8, and the southwest part of J2 of the HSPF model), apply the Stream-Protection Standard (see BW-3) to all new development in order to minimize impacts to Twin Lakes and to help limit future flow increases in lower Joes Creek.

SL-2: Reduced Onsite Detention

Direct discharge to Puget Sound is an acceptable detention alternative to the basinwide onsite detention standard (BW-2) in this sub-basin where the discharge can be accomplished after appropriate biofiltration and other water-quality treatment.

SL-3: Onsite Detention Outfalls

The discharge of all onsite systems above the lower canyons of Lakota and Joes Creeks should be tightlined directly to the main channels or to Puget Sound following detention and water-quality treatment. Top-of-slope or sideslope discharge points should be avoided, even into existing secondary channels, because of the particularly erosive hillside deposits here.

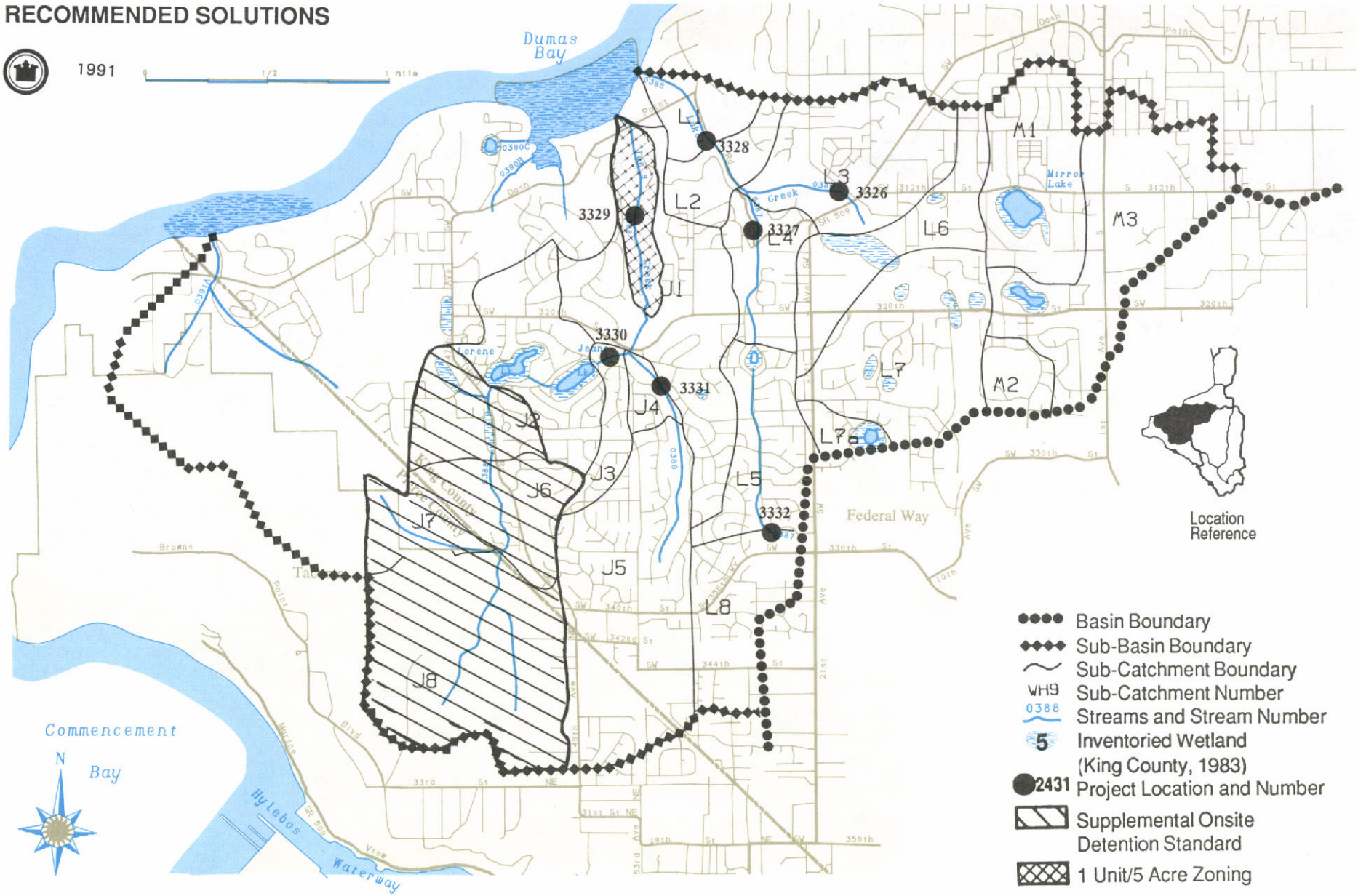
SL-4: Low Density Stream Protection Zoning

The ravine of lower Joes Creek, an LSRA, should be zoned for rural development at 1 unit per 5 acres (BW-1) to help protect this resource area. This low-density area encompasses the ravine (RM 0.0 to about 0.8, below S 320th Street) up to the prominent top-of-slope at about an elevation of 200 feet.

Figure 4.5.3

SOUTH LOWER PUGET SOUND SUB-BASIN

RECOMMENDED SOLUTIONS



SL-5: Stream Corridor Protection

A minimum buffer of 150 feet should be required from the ordinary high water mark on each side of Joes Creek, tributary 0388 between RM 0.0 and 0.8 (BW-4). Maintenance of intact vegetated stream corridors dominated by large conifer trees is necessary in this LSRA to promote stream stability and fish habitat in the lower reaches. Trees adjacent to streams provide shade, nutrients, and holding places for fish during high flows. The preferred types of trees are conifers based on their capacity to achieve large sizes and resist rot after their death.

Capital Improvements. Because of the intensity of existing land use and the paucity of favorable sites in the sub-basin, regional detention projects cannot feasibly reduce existing high flows in the channels here. Instead, the recommended projects seek to minimize the impacts of these high flows, through a combination of channel stabilization, removal of flow restrictions, and improvements to local conveyance systems.

1. **Project 3326: East Branch Lakota Creek Channel Stabilization and Conveyance Improvements**

   On upper tributary 0386, relocate sewer line and stabilize channel bank at RM 0.80-0.90; remove culvert at RM 0.85; tightline outfall from residential detention pond at RM 0.95.

   Estimated cost: $690,000
   Location: Federal Way

2. **Project 3327: West Branch Lakota Creek Channel Stabilization and Conveyance Improvement**

   On tributary 0387 adjacent to SW Dash Point Road and Decatur High School, relocate sewer line, bioengineer bank stability, and install stilling pool to dissipate flow energy, to protect channel banks adjacent to SR 509 and upstream sewer line, to minimize sediment delivery downstream, and to improve now-marginal aquatic habitat for fish usage.

   Estimated cost: $713,000
   Location: Federal Way

3. **Project 3328: Main Stem Lakota Creek Channel Stabilization**

   On lower tributary 0386, place bank armor, LOD, and revegetate to reduce existing channel erosion and downstream deposition.

   Estimated cost: $129,000
   Location: Federal Way

4. **Project 3332: Upper Lakota Creek Pond Retrofit**

   At the head of tributary 0387 near SW 336th Street and 25th Place SW, retrofit existing failed infiltration pond to function as non-infiltrative detention facility. Floodproof adjacent Parkway Apartments as needed with berm to prevent future flooding.

   Estimated cost: $354,000
   Location: Federal Way

5. **Project 3330: Twin Lakes Overflow Pipeline**

   Construct overflow pipeline from lower lake into conveyance system across SW 320th street and thence into lower Joes Creek, to maximum lake-level rise and prevent flooding of houses. Mitigate modest flow increases to lower Joes Creek with downstream detention storage in driving range and channel stabilization (Project 3329).

   Estimated cost: $842,000
   Location: Federal Way

6. **Project 3331: Olympic View Park Channel Improvements**

   Reconstruct inlet to culvert beneath SW 325th Street on tributary 0389 with berm and overflow swale to increase conveyance capacity and to avoid flooding of adjacent houses. Add channel roughness to dissipate energy of high flows and help limit channel incision. Remove trash.

   Estimated cost: $135,000
   Location: Federal Way

7. **Project 3329: Lower Joes Creek Channel Stabilization and Habitat Improvement**

   Place very large logs and whole trees in channel to protect eroding banks, minimize downcutting, and improve fish habitat in the lowermost mile of tributary 0388 (see also BW-25).

   Estimated cost: $491,000
   Location: Federal Way

Discussion of Recommendations, Alternatives, and Effects

Although most of the problems identified in this sub-basin are a result of high flows from past (and some future) development, reduction of those flows is particularly difficult. Even though these flows are unacceptably high, recommended actions seek to stabilize the channels and improve conveyance, because no feasible opportunities remain in the sub-basin to significantly reduce those discharges.

The two branches of Lakota Creek (tributaries 0386 and 0387) demonstrate this difficulty. On the east branch (0386), hydrologic modeling of the proposed

Lakota Wetland Regional Detention Pond shows the facility provides some protection to the adjacent playing fields, and is effective under 1987 land use, with flow reductions of about 50 percent at SW Dash Point Road. Under future land use, up to 30 percent flow control is provided but only for relatively frequent storm events. In both cases, the pond's effectiveness is diminished by new inflows from developed areas farther downstream. As a result, this pond only addresses a problem whose priority is below that of other ranked problems. Therefore, although aspects of this project may be pursued independent of the Basin Plan, it does not appear on the list of capital projects. Even if the pond were built, an additional detention volume of about 40 acre-feet in the tributary area downstream of its outlet would be needed to achieve flow control downstream to the confluence of tributary 0387 under existing conditions. In this already-developed area, potential sites could achieve only a small fraction of this need. Even with the limited benefit of the proposed pond, the drainage system between the wetland and SW Dash Point Road requires upgrading because it is prone to blockage and requires high maintenance. If a blockage were to occur, SW Dash Point Road could be flooded during a relatively small event because the runoff would be forced across the park then over the highway.

To reduce the potential for ballfield flooding, rapidly draining fill material could be placed to raise the fields. This improvement, together with placement of the existing outlet with a structure that resists clogging and constructing a secondary overflow channel, would reduce the likelihood that the fields would be flooded or that SW Dash Point Road could flood under future conditions. These projects can be carried out as part of parks improvement or drainage maintenance duties.

The west branch of Lakota Creek (0387) is even more severely constrained for regional detention facilities. Storage needs for flow control exceed 40 acre-feet but available sites of any size are almost completely nonexistent. Lake Ponce de Leon, for example, provides less than a single acre-foot of live (i.e. usable) storage.

Tightlines were also considered for these channels to reduce in-channel flows. On both branches, they were judged excessively costly (over 6,000 feet of pipe would be needed) for the level of protection so achieved.

Work on the east and west branch Lakota Creek projects could be phased in order to ease the funding requirements. The breakdown of elements is as follows:

<u>East (Project 3326)</u>

a.	Relocate sewer line; widen and stabilize channel	= $538,000
b.	Remove channel crossing berm	= $ 24,000
c.	Retrofit & tightline outlet of onsite detention facilities	= $128,000

West (Project 3327)

a. Relocate sewer line; widen and stabilize channel = $550,000
b. Modify high school parking lot; control runoff from SR 509 = $163,000

Regional detention facilities and tightlines were also considered on the two branches of Joes Creek (tributaries 0388 and 0389). Tightline options, either paralleling the existing channels or descending directly to Puget Sound from the head of Lorene Lake, were abandoned on the basis of initial cost estimates of $2 million or more and the availability of equally effective alternatives. Regional detention on tributary 0389 would require storage in the County Park of about 40 acre-feet, an amount that is physically unavailable.

Regional detention on upper tributary 0388 is a more complex option, because Twin Lakes are already providing some degree of flow attenuation. Presently, they provide about 20 acre-feet of live storage, an amount that has not proved fully adequate for attenuation of development-increased flows downstream (hydrologic modeling suggests that up to 2.5 times that volume would be needed in the future).

Increasing the storage capacity of the lakes to improve downstream conditions could occur by either increasing high-flow or decreasing low-flow lake levels. Increasing lake levels would worsen an existing and more hazardous problem, namely lakeside flooding. Floodproofing of the affected structures and roadways was evaluated and rejected because particularly unfavorable topography renders such measures infeasible. Decreasing low-flow lake levels to provide stormwater storage would annually expose the lake bottom between November and January and impact existing lakeside uses. This approach could also require significant dredging, incurring substantially greater costs and impacts. However, annual lowering of lake levels may improve water quality by removing nutrient-rich bottom waters (Cooke, et al, 1986). Potential future flow increases can be limited by supplemental onsite detention in the largely undeveloped upstream basin. However, significant land-use changes have already occurred since the model base year of 1987; some of that potential flow reduction has already been lost. Furthermore, that action by itself can only hold conditions to their present, problematic level.

In contrast, improved conveyance through the lakes area reduces flooding but also reduces live storage. Replacement storage downstream, such as in the driving range just north of SW 320th Street, provides only a tenth or less of the total detention needs of the tributary area. It is a recommended component of this project but by itself is not fully effective. Together with enhanced onsite detention upstream of Twin Lakes (see SL-1), however, flow increases in lower Joes Creek can be held to about 10 percent over 1987 levels.

In summary, achieving meaningful flow reduction on the tributaries of this sub-basin is largely impossible or very costly. Even where possible, in the Twin Lakes area, the flow to be controlled only contributes about one-third of the total flow to lower Joes Creek. Downstream improvements do not occur. As a result of these limitations throughout the sub-basin, existing conveyance systems need to be upgraded for higher capacity (Projects 3326 and 3330).

Stream channels need to be managed to accommodate increasing flows (Projects 3326, 3327, 3328, 3329, and 3331). These actions relieve the identified problems of roadway and residential flooding, under both present and future conditions. They also address the existing and projected conditions of channel instability, presently affecting all but one (upper tributary 0388) of the stream segments in the sub-basin. They may be required by the Washington State Department of Fisheries as mitigation for certain projects (e.g., 3329 for 3330). The certainty of successful channel stabilization, however, is lower than for ponds and pipes because the effects of local bank protection, flow diversion, and enhanced channel roughness cannot be precisely modeled. Additional site-specific design will be needed in all such cases to determine the best strategy of treatment. Follow-up monitoring and maintenance of all channel stabilization projects will be mandatory.

4.6 PRIORITY RANKING OF CAPITAL IMPROVEMENT PROJECTS

The 33 capital improvement projects and numerous programs, regulations, and studies recommended in Chapter 4 are intended to be implemented in several jurisdictions throughout the planning area. During the approval process, the City or County Councils in each of these entities will determine an acceptable order for implementation of the projects that the jurisdiction is responsible for, and the means by which these projects will be funded. To provide some guidance for that process, this section suggests a general approach to considering the priority of Plan CIPs based on the criteria discussed in Chapter 2.4. The suggestions for priorities to correct existing problems also should be viewed in context with the basinwide recommendations in Chapter 3. Implementation of these basinwide recommendations should begin immediately to prevent further degradation of the systems while steps are being taken to implement the corrective CIPs.

There are two general approaches for ranking and implementing priority CIPs. One approach is to list priorities to enable projects to be implemented consecutively over perhaps several decades. Historically, entities have implemented CIPs using this approach. The result has been improvement in some reaches; however, because of delays in implementing the other listed projects, systemwide deterioration has continued to take place. The second approach is to rank CIPs in groups of projects which can be implemented simultaneously to provide systemwide benefits. This latter method is likely preferable for addressing conditions in the Hylebos Creek and Lower Puget Sound basins because of the extent of systemwide failures that have taken place, and will continue to occur without timely and simultaneous implementation of several mitigation actions (CIPs and nonstructural recommendations.)

In general, most of the deterioration in the basins results from high volume and high velocity storm flows which have overwhelmed the capacity of stream channels, culverts, and drainage ditches and caused flooding and habitat degradation. The conventional approach to these problems has been to focus CIP expenditures on the damaged downstream reaches by using channel hardening projects, such as extensive rip rap. The expected result is to minimize localized flooding and reduce streambank erosion. Such an effort, however, would be counter-productive in these basins. Such projects tend to displace the existing problems to more downstream locations, to adversely affect aquatic habitat, and to be of limited value in reducing the overall volume of water in the system. In contrast, if upstream regional detention facilities are implemented first, they help to solve the root cause of the downstream problems. These upstream facilities can capture the bulk of the storm flows, meter the discharge downstream at stream stabilizing levels, and thereby reduce the stress placed on the entire system from the excessive flows.

It is recommended that the first group of priority projects should include implementation of regional detention ponds to control current flows (Criteria 1a and 3) and to minimize downstream effects on Regionally Significant Resource Areas (RSRAs) and Locally Significant Resource Areas (LSRAs) (Criteria 2 and 4c). In King County, for example, this would mean the first priority projects would include the S 360th Street Regional Pond (Project 2442) and the SR 161 Regional Pond (Project 2442). Implementation of these two facilities would

control current downstream flooding in the East Branch Hylebos Creek and would protect the ravine designated as a RSRA in the lower part of this sub-basin. Similarly, in Federal Way the same criteria would be met if the following projects were given the highest priority: the Panther Lake Enhanced Detention (Project 2430); the three ponds recommended in the vicinity of S 336th Street (Projects 2435, 2426, and 2437); the Twin Lakes Overflow Pipeline (Project 3330); and the Upper Lakota Creek Pond Retrofit (Project 3332). The City of Seattle Midway Detention Pond Retrofit Study (Project 3321) would merit early implementation under the same criteria.

Once flow controls are in place, a second set of priority projects can focus on problems in specific reaches. Of particular importance in this category are stream stabilization projects. These projects are a necessary follow-up to flow control projects. Stream stabilization projects reduce instream erosion, thereby improving habitat in RSRAs and LSRAs; minimize the sediment transport that fills downstream reaches and contributes to localized flooding; and limit the amount of sediment that is available to bind with pollutants and remain in the system (Criteria 2, 3b and c, and 4c). Other CIPs in this group include conveyance upgrades to minimize local flooding of structures and roads (Criterion 1a).

In King County, reach-specific projects would include channel stabilization on East Branch Hylebos Creek (Projects 2445 and 2448); SR 161 Conveyance Upgrade (Project 2444); and Lower McSorley Creek Sediment Control and Habitat Improvements (Project 3322). Projects which fall into this category in Federal Way include the channel stabilization and habitat improvements in the West Branch Hylebos, Lower Joes Creek, and Lakota Creek (Projects 2433, 3329, 3326, 3327, and 3329, respectively); and conveyance upgrades on S 356th Street and S 272nd Street (Project 2432 and 3323, respectively).

Projects such as special studies may be prioritized by entities according to the perceived value of the CIP in relation to the applicable criteria. For example, the S 320th Stormwater System Design Study (Project 2450), may be considered a high priority project due to the severity of flooding problems on S 320th Street (Criterion 1). Other projects may be ranked high due to their relationship to another high priority CIP. The S 336th Street Improper Storm Sewer Hookup Study may be considered a high priority project, for example, because improvements made as a result of this study can help the effectiveness of the water quality facilities in the S 336tn Detention Pond and the S 336th Street Wetland Restoration projects (Criterion 4c.). Biomonitoring projects in Spring Valley and West Hylebos Wetland, East Branch Hylebos Ravine, and Redondo Creek (Projects WHL-7, EH-4, and CS-2, respectively) however, may have lower priority and could be delayed until after regional detention ponds and nonpoint source controls have been implemented.

Chapter 5

Basin Overview

CHAPTER 5: BASIN OVERVIEW

5.0 INTRODUCTION

This chapter summarizes pertinent information regarding current and future conditions in the Hylebos Creek and Lower Puget Sound basins. The information has been used to determine the significant problems identified in this Plan and to recommend effective and environmentally sound solutions. Topics discussed are land use, geology, groundwater, stream erosion and deposition, hydrology, flooding, water quality, and habitat in these basins. A more detailed discussion of these subjects can be found in the Hylebos Creek and Lower Puget Sound Current and Future Conditions Report (King County, 1990a).

5.1 LAND USE TRENDS

Since the 1950s, population growth has increased in the planning area more rapidly than most other communities in King County. This is particularly true in Federal Way. Through the 1980s growth was explosive, increasing by almost 20,000 to a total current population estimated at 90,000. Most of the smaller communities in the basins also grew quickly during this period. By the year 2020, population in this area is expected to climb to an estimated 154,000 (King County Planning Division, 1989).

The several state highways crossing the planning area were dominant factors in stimulating growth and the current land-use patterns in the basins. These patterns are strongly related to the quality and quantity of surface water in the basins. This is particularly the case in the Hylebos Creek basin which receives storm flows from I-5, SR 18, SR 99, and SR 161. Most of the commercial and industrial uses in the basins have been located on or near these highways. These land uses tend to generate more stormwater runoff than residential uses. Thus, the combination of impervious surfaces on the highways, together with the collective effects of this particular land-use pattern, have been significant factors leading to the present degraded condition of Hylebos Creek.

Current Land Use

A computer simulation model was used to determine current and future flows analyzed in this report. Analysis of the basin began in 1988 based on a model that uses 1987 land-use patterns as current conditions and the 1986 King County Federal Way Community Plan and Area Zoning (King County Planning Division, 1986) for future conditions. The following discussion describes the current and future land use patterns used in this analysis. This description includes the jurisdictions in Pierce County for purposes of fully characterizing the planning area; however, only flows in the King County portion of the basins were modeled. A detailed discussion of modeled stormwater flows is in Section 5.3, Hydrology.

The 1987 current land use analyzed in the computer model for the planning area is displayed in Figure 5.1.1. This figure shows that the most highly intensive commercial uses in the basins are located in mid-upper and West Branch Hylebos Creek in proximity to I-5, SR 99, SR 161, and S 320th Street. High-intensity development has almost 90 percent site coverage by extensive impervious surfaces including highways, parking lots, and buildings that generate large volumes of stormwater and pollutants compared to other uses. Other highly intensive use areas include portions of the SR 99 corridor that drain into Cold, Redondo, Woodmont, and McSorley Creeks, and scattered locations elsewhere throughout the Lower Puget Sound basin.

Much of the moderate and high-density single and multifamily residential development (more than 3 units per acre and 25 to 60 percent site coverage) is in the Lower Puget Sound basin on the plateau, generally east of SR 509. In the Hylebos Creek basin, pockets of high-density single-family residential uses are concentrated in the northern and western parts of the West Branch.

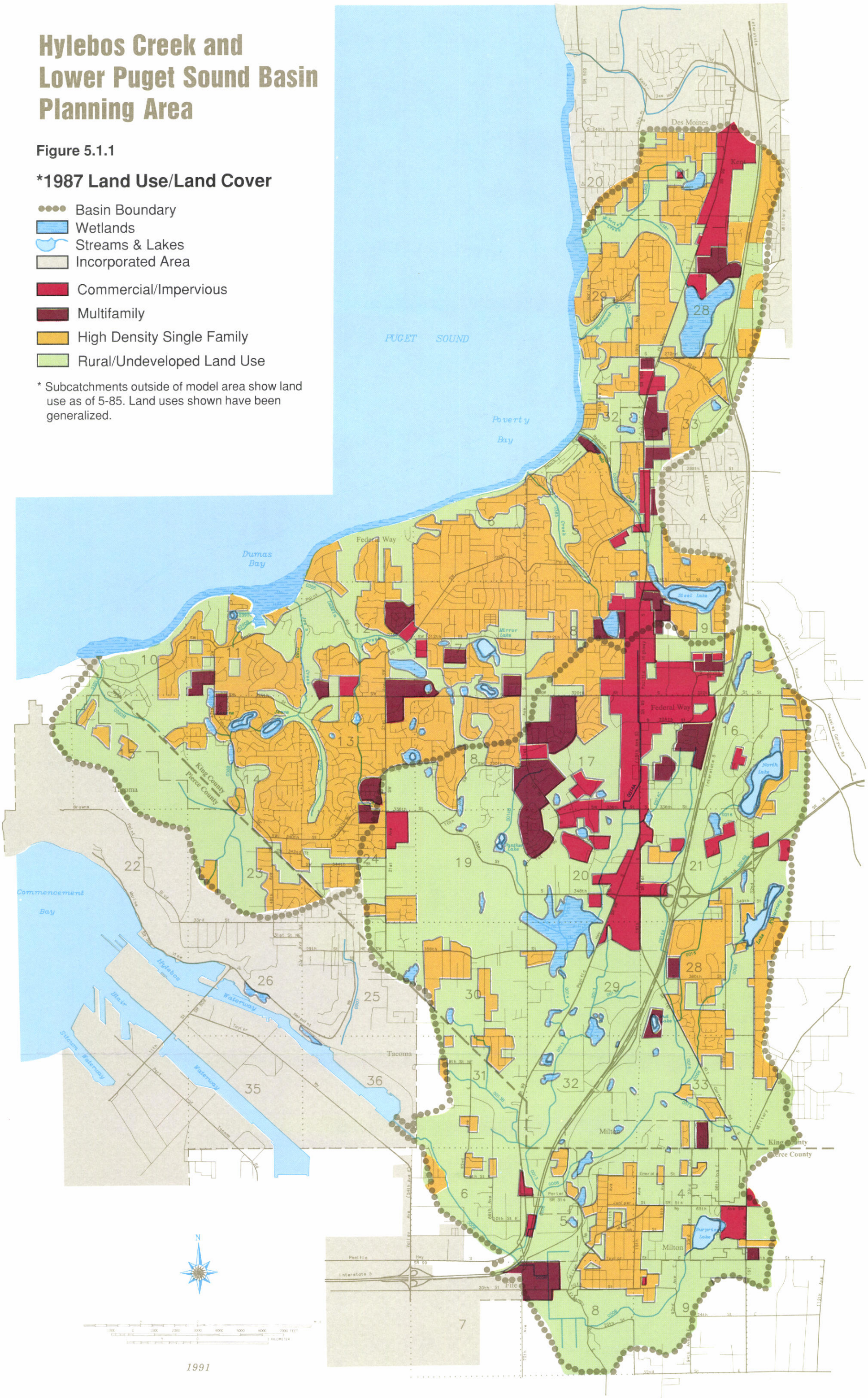
Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 5.1.1

*1987 Land Use/Land Cover

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Commercial/Impervious
- Multifamily
- High Density Single Family
- Rural/Undeveloped Land Use

* Subcatchments outside of model area show land use as of 5-85. Land uses shown have been generalized.



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These uses are also clustered in the vicinity of Milton and adjacent to lakes and major roads in East Branch and Lower Hylebos Creek sub-basins.

The remainder of the planning area is in low-density residential and other low intensity uses (fewer than 3 units per acre and less than 25 percent site coverage) such as agriculture, forest, or grassland. Because these uses generate less stormwater per acre, they help to buffer many of the sensitive areas in the basins from more stormwater damage. These areas include the steep slopes along the Puget Sound bluffs and stream corridors tributary to Puget Sound, major wetland systems in the mid- and lower reaches of West Branch Hylebos Creek, that provide primarily fish and wildlife habitat, and portions of the middle and lower reaches of East Branch Hylebos Creek that also support salmonid habitat.

Future Land Use

In 1986, King County adopted the Federal Way Community Plan and Area Zoning. The future land-use map for modeling the basin was patterned after this Plan. It was intended to be periodically updated as conditions changed. The future land-use patterns in the basin model were intended to represent maximum built-out conditions. This 1986 Plan map was modified to project the most intensive land-use patterns that could reasonably be expected according to all the plans and zoning maps available for the basins. The storm flows projected under future land use therefore represent the "worst case" conditions.

The 1986 Plan reinforced most of the current land-use patterns already in place. To a great extent, single-family residential areas were maintained. Low-density residential uses were planned for the sensitive areas in the lower reaches of Hylebos Creek and on the Puget Sound bluffs. Existing commercial, industrial, office park, and multifamily use areas were expanded and new locations for these uses were planned, primarily in the middle and upper portions of the Hylebos Creek basin.

According to this 1986 Plan, the unincorporated King County portion of the basin (East Branch Hylebos, Woodmont, and Redondo Creeks) would continue to develop in low to high single-family residential densities. The Plan also projected a combination of manufacturing park, in the upper part of East Branch Hylebos Creek in the vicinity of the Weyerhaeuser corporate campus, and a range of low- to high-density residential uses in the remainder of this sub-basin. A portion of the planning area that drains into McSorley Creek, within Kent and Des Moines, is expected to continue to be commercially developed along SR 99, while low to high density single-family residential uses are anticipated to the east and west of this corridor (City of Des Moines, 1981).

In February 1990, the City of Federal Way adopted the Federal Way Comprehensive Plan. This plan modified the 1986 County Plan somewhat by reducing multifamily and commercial uses in the western portion of the city. However, the general development pattern, projecting the most intensive use areas in West Branch Hylebos Creek, is similar to the 1986 County Plan. Figure 5.1.2 represents the future land-use map for the planning area. It is a composite of the 1986 County Plan, which governs unincorporated areas and the 1990 Federal Way Plan that regulates incorporated Federal Way.

Within Pierce County, it is anticipated that the Port of Tacoma will continue to develop with heavy commercial and industrial uses on Commencement Bay and its waterways. The trend away from existing agricultural uses toward heavy commercial and industrial uses along the I-5 corridor in Fife, Milton, and Tacoma is also expected to continue. On the eastern plateau, above the Lower Hylebos Creek valley, land use in Milton and unincorporated Pierce County is expected to remain primarily in commercial uses along SR 161 and in low- to moderate-density residential uses outside this corridor. The low-density residential area on the west plateau in Fife Heights is expected to become a mixed low- to moderate-density residential area in the future (Pierce County, 1964).

Hylebos Creek and Lower Puget Sound Basin Planning Area

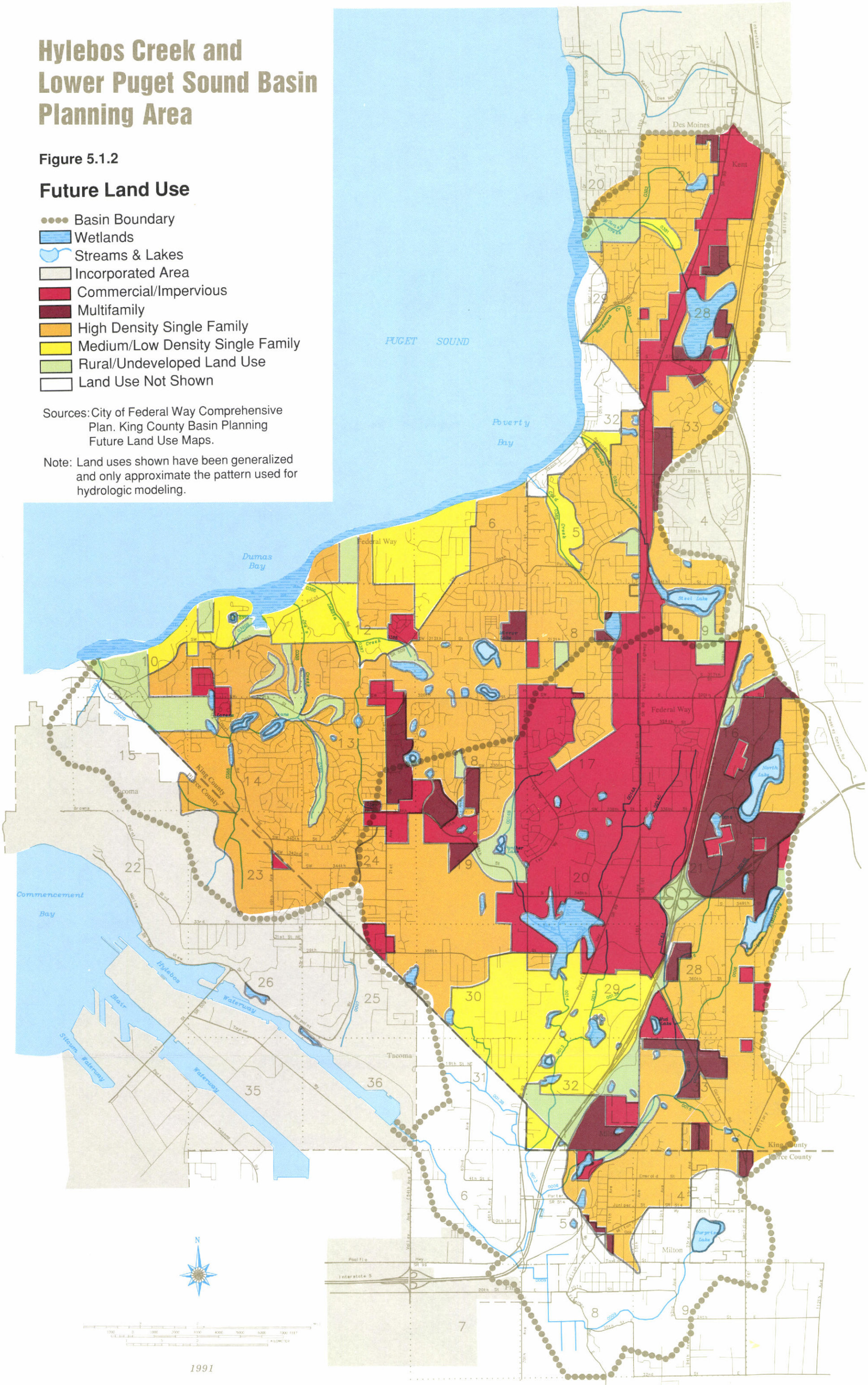
Figure 5.1.2

Future Land Use

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Commercial/Impervious
- Multifamily
- High Density Single Family
- Medium/Low Density Single Family
- Rural/Undeveloped Land Use
- Land Use Not Shown

Sources: City of Federal Way Comprehensive Plan. King County Basin Planning Future Land Use Maps.

Note: Land uses shown have been generalized and only approximate the pattern used for hydrologic modeling.



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5.2 GEOLOGY, GROUNDWATER, AND STREAM CHANNEL EROSION AND DEPOSITION

GEOLOGY

Introduction

The Hylebos Creek and Lower Puget Sound basins encompass a variety of geologic terrains. These terrains dramatically influence patterns of surface-water runoff, groundwater flow, and hillslope stability. Long an area of limited population and development activity, rapid growth in the last two decades has resulted in increased concern for the impacts of that development on the land and the constraints that are in turn imposed on human activity. This geologic information, summarized from the basins' Condition Report (King County, 1990a), provides an overview and a framework for both basinwide stream flow patterns and area-specific hazard evaluation.

Conditions

Physiography. The Hylebos and Lower Puget Sound basins drain an elongated upland plateau known as the Des Moines Drift Plain, bounded on the west by Puget Sound, the east by the Green-Puyallup valley, and the south by the Puyallup River floodplain and (now-filled) estuary. Hylebos Creek drains south over the surface of the drift plain, incising through the surface deposits to reveal the underlying geologic materials only in the lower reaches of the East Branch. In contrast, the Lower Puget Sound drainages have carved rapidly through the lip of the uplands, reflecting their greater steepness and thus greater competence for erosion. Wave action along the shores of Poverty Bay maintains a steep shoreline bluff in many areas and has probably caused significant steepening of these basins by bluff retreat, active since deglaciation of the region about 14,000 years ago.

Glacial History and Stratigraphy. Glacier ice originating in the mountains of British Columbia has invaded the Puget Lowland several times, leaving a discontinuous record of early to late Pleistocene glacial and interglacial periods (Easterbrook, 1986). The ice was part of the Cordilleran ice sheet of northwestern North America; it advanced into the Lowland as a broad tongue referred to as the "Puget lobe" by many authors since Bretz (1913).

In the study area, deposits of at least two and possibly three glaciations are exposed. Most widespread are those from the most recent ice advance and retreat, named the "Vashon" by Armstrong and others (1965) because of particularly good exposures on Vashon Island. These deposits underlie the upland plain, now truncated by Puget Sound to the west and the Green River valley to the east.

The most common surficial deposit of Vashon age is till, a compact mixture of silt, sand, and gravel deposited at the base of the glacier. Overlying the till and covering large areas of the southwestern and south-central planning area are broad areas of recessional outwash. These are mainly sand and gravel deposited by rivers emerging from the margin of the retreating ice. Outwash deposited earlier, during advance of the ice sheet, underlies the till and is

present throughout the area. In general, it is identified most often in well logs; but these advance outwash deposits are well exposed at the ground surface along the northwest- and southwest-facing slopes above Puget Sound and in the incised valleys of Joes Creek and East Branch Hylebos Creek. At Dumas Bay, the Vashon advance outwash is exposed at sea level along 1.5 miles of coastline. This exposure is part of a sub-sea-level channel that extends north through Maury Island and east-central Vashon Island (Booth, 1991), and back on to the mainland at Point Pully (three miles north of the study area; Waldron, 1962). In the south, the channel is traced by numerous water-supply wells.

Pre-Vashon glacial advances (also referred to as pre-Fraser advances; see Figure 5.2.1) are expressed by discontinuous, near-sea-level till exposures along the shores of Poverty Bay and near Milton; a till lens exposed in the Redondo area at about altitude 150'; and thick, widespread deposits of oxidized sand and gravel that apparently underlie most if not all of the planning area at depth. These river-lain deposits are interpreted here as having a glacial origin because deposits of equivalent coarse texture, mixed lithologies, great thickness, and lateral extent are not being deposited in the modern (non-glacial) landscape but are common throughout sediments of unequivocal glacial (namely Vashon) origin and age.

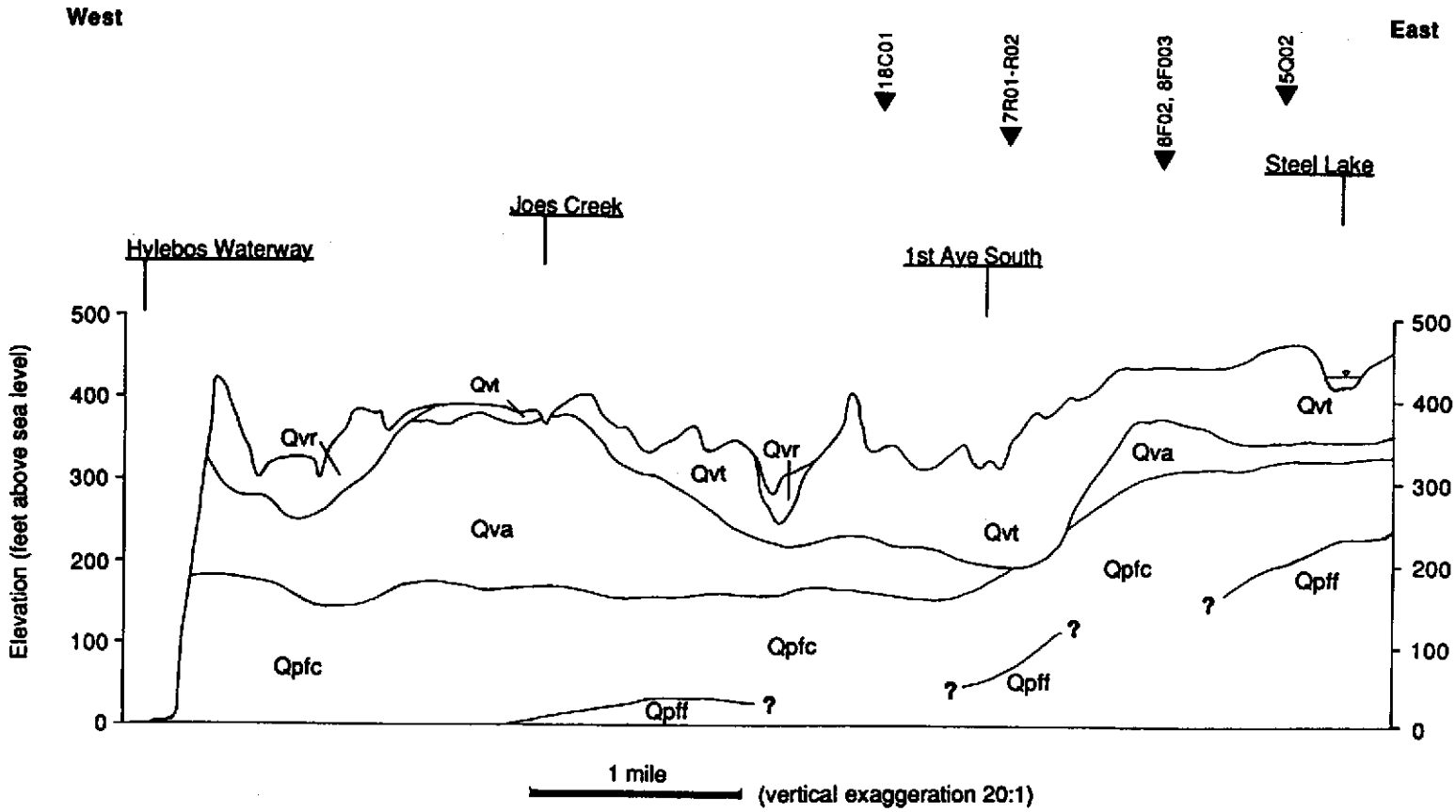
This geologic setting has several consequences for land use, hydrology, and stream-channel erosion and deposition in the Hylebos Creek and Lower Puget Sound basins. Overall, the deposits form a crude four-element sequence: locally thick and permeable deposits of Vashon recessional outwash or ice-contact deposits, overlying thin and relatively impervious Vashon till, overlying sand and gravel of either the Vashon advance outwash or other older glacial outwash, overlying a yet-older mixture of clay or till or other impervious sediment. This sequence results in two particularly significant conditions for surface water runoff:

- Streams are very erosive where they pass over the sand and gravel deposits that underlie the Vashon till, because of the lack of either cohesion or coarse sediment in that layer; and

- Soils are highly infiltrative, resulting in low or absent surface-water runoff, where thick undisturbed deposits of the recessional outwash are exposed at the ground surface.

Figure 5.2.1

HYLEBOS CREEK BASIN
GENERALIZED STRATIGRAPHY



Qvr	Vashon Recessional Outwash
Qvt	Vashon Till
Qva	Vashon Advance Outwash
Qpfc	Coarse-Grained Pre-Fraser Deposits
Qpff	Fine-Grained Pre-Fraser Deposits

18C01 Well-log Reference (SKCGWAC, 1989)

GROUNDWATER

Groundwater plays a variety of roles in the hydrologic function of the basins. By definition, groundwater is water that is found in zones of saturated geologic material beneath the surface. In the non-urbanized parts of the basins, far more of the water falling as precipitation moves as groundwater rather than as surface water. That water returns to the surface as springs and seeps, providing baseflow for perennial streams; it also provides drinking water to this rapidly growing area.

Conditions

Although groundwater exists by definition in all saturated geologic materials, it is accessible for water use or discharge to surface-water bodies only where it can move freely through those subsurface deposits. These freely transmitting deposits are characterized by relatively large pores and are known as aquifers. In the Hylebos Creek and Lower Puget Sound area, they are commonly deposits of sand and gravel. In contrast, deposits that restrict the movement of groundwater are called aquitards (if they are moderately restrictive) or aquicludes (if they are strongly restrictive). The composition of aquicludes is dominated by sil clay. The layering of geologic deposits in these basins has left a vertical sequence that includes successively deeper aquifers and intervening aquitards and aquicludes.

Although some of the deep aquifers may be significant for water supply, the shallower aquifers are particularly important to this basin plan. They are directly connected to lakes and streams; and to date they have also been the aquifers most intensively used for water supply.

Two distinctly mapped geologic deposits, which may be partly connected hydrologically beneath the surface, form the main shallow aquifer zone in this area. The Vashon advance outwash, found primarily in the western part of the planning area, and older sand and gravel, located in the northern and eastern part of the planning area, compose this zone (see Figure 5.2.1). Both deposits are capped with relatively impervious till over most of the area, and so they are partly isolated from both surface-water contamination and direct recharge.

The Vashon advance outwash is concentrated in an area that extends south and east from Dumas Bay and Dash Point through the lower East Branch Hylebos Creek and into the Milton area. It is penetrated by numerous water-supply wells along its entire length and is commonly known as the "Milton-Redondo Channel" in the hydrogeologic literature of the area (Robinson and Noble, 1987), providing much of Federal Way's water supply. Its major surface exposures are limited to coastal hillsides at the channel's northern end, which locally extend down to sea level; "windows" through the overlying till along the upper reaches of tributaries 0388 and 0389; and along the valley walls of the East Branch Hylebos Creek. Elsewhere in this zone, it is continued but entirely in the subsurface.

The older sand and gravel deposits are exposed both beneath the Vashon advance outwash along Hylebos Waterway and directly beneath Vashon till in the Des

Moines, Midway, and Redondo areas. Surface exposures are found only along Des Moines Creek (just north of the planning area) and on hillsides and in stream valleys above Puget Sound. Excavations now occupied by the Midway Landfill also penetrated into this deposit.

Groundwater Recharge

Recharge of aquifers through the overlying Vashon till is enigmatic over the region as a whole. Measured permeabilities through till are typically about four orders of magnitude (10,000 times) smaller than through outwash (Olmstead, 1969) and allow recharge of only about one inch per month. Yet the broad areal extent of the till, and the possibility that fractures and sandier zones may allow substantially greater recharge rates in more localized zones, suggest that this path of groundwater migration may be as, or more, important than the areas of direct surface exposure of aquifers.

Other recharge zones are associated with the thinner, uppermost aquifer that overlies the Vashon till, mainly the Vashon recessional outwash. Although broad areas of this outwash are exposed on the southern uplands of the Lower Puget Sound basin, that area is largely covered with roads and houses. As a result, recharge is probably low. The southern extension of this deposit, however, forms a fairly discrete channel of thicker deposits through the Panther Lake area and into the West Branch Hylebos Creek. Although of uncertain importance for the recharge of deeper aquifers used for water supply, this deposit has functioned in the past to substantially reduce and locally eliminate the surface-water discharge of the surrounding areas. But the recent inwashing of fine sediment, probably released from surrounding construction activity, has severely reduced the infiltration capacity of this deposit and thus increased the amount of surface-water runoff (see Hydrology Section).

Effects of Water-Supply Pumping

Quantitative analysis of groundwater changes, particularly the impacts of pumping for drinking-water use, is limited by the absence of a groundwater model for this area. Only semi-quantitative methods, averaged over the area as a whole, are available to provide any such information. In addition, some historical information on water yields, water-table levels, and base flows in streams provide some additional evidence for past and future changes.

There is no consensus on the percentage of groundwater recharge that can be removed by water-supply pumping before "unacceptable" impacts to surface-water bodies occur. This uncertainty reflects our fundamental ignorance on the quantitative aspects of groundwater movement in this (and, indeed, most) areas. In particular, monitoring data on withdrawal impacts is very spotty, a groundwater model to demonstrate surface-water connections is not available, and no analysis of surface-water conditions has yet established the framework for evaluating the consequences of any such impacts.

Relative to other regions, this basin area has rather good information on both water balance and pumping impacts. Recharge is estimated to vary between 15

to 17 inches per year (measured as a water volume of that thickness over the entire basin area; an undetermined error factor to this estimate should also be included). Of that recharge, about 15 percent was removed by water-supply pumping in 1977, but about 50 percent is now being extracted. The impacts of that increased extraction have been reflected by water-table declines of up to 50 feet in an isolated aquifer near Mirror Lake and 10-12 feet in the main Vashon advance outwash aquifer. In addition, baseflow into Coldbrook Springs near Redondo (on Cold Creek), probably fed by this aquifer, now has greatly reduced discharge, once reported as 3.3 cfs but now less than 1 cfs; and Hylebos Creek, reported in 1969 to have a baseflow of 8.5 cfs, showed levels of only 3 to 5 cfs during the summer months of gaging in this basin in water years 1987 and 1988. Equivalent or increased future pumping from the aquifers in this area are likely to have similar or increasing impacts on the surface-water bodies in these basins.

STREAM-CHANNEL EROSION AND DEPOSITION

Overview

The topography and distribution of geologic deposits imposed on the Hylebos Creek and Lower Puget Sound basins by glacial activity have exerted a profound effect on the pattern and processes of runoff. The central upland plateau collects water over much of the basin in low-gradient stream channels. Those channels of the Hylebos Creek basin flow south, following one of two distinct paths. The West Branch follows the course of a major recessional outwash channel, formed by outflow from the retreating Vashon-age ice sheet. In contrast, the East Branch drops precipitously off the edge of the upland plateau into a narrow canyon. The drainages of the Lower Puget Sound basin are similar to the East Branch Hylebos Creek, in that their present flow paths also drop abruptly off the edge of the plateau.

Two overriding conditions of the physical channels in the basin are manifest: most of the natural channels have been heavily impacted by high flows, and they also show evidence of abundant introduction of fine sediment. The first condition is particularly well displayed by the flume-like nature of many channel reaches, where the hydraulic and biologic diversity provided by pools, bars, and large debris has largely been stripped away. As a result, channel erosion, neighboring hillside erosion, and downstream deposition of channel- and culvert-clogging sediment are much higher than normal. The second condition is partly related to the first; channel erosion releases some fine sediment into the downstream system. But upland urban development, particularly construction during wet weather, generates far more of this material. These fines not only clog stream-bed sediment, affecting fish habitat, but also carry pollutants off the uplands into and through the stream system. As such, they also represent one of the major threats to water quality in the basin as well.

Stream-Channel Characteristics

The degree of downcutting and lateral erosion found along each of the major stream valleys correlates well with their location and underlying geologic

deposit. Most of the channels cut into sandy deposits, primarily of the Vashon advance outwash, on their decent from the upland plateau down to Puget Sound. This deposit is recognized here and elsewhere throughout the Lowland for its ease of erosion, by virtue of its relatively fine grain size and minimal cohesiveness.

The West Branch and Lower Hylebos Creeks are unique among the streams here, in flowing in a drainage course pre-established by glacial runoff of much greater magnitude than found in the streams of today. The valley so created is up to one-half mile wide in its lower reaches and is filled with a mixture of stream-deposited and lake-deposited sediment; the modern drainage has managed to cut only short and relatively shallow valleys in localized areas. As a result, erodible older sediments are nowhere exposed along the West Branch or its tributaries, and the profile of this channel shows no abrupt changes and few reaches of significant steepness.

As a result of these characteristics, the channel is intrinsically less susceptible to erosion and its flow less competent to transport sediment. Diversion of its northern headwaters during construction of I-5, highly infiltrative areas in the northwest part of the sub-basin, and modest buffering of peak flows by the West Hylebos Wetland have further reduced impacts of basin urbanization to date. The infrequency of significant erosion problems and presence of locally high-quality aquatic habitat despite high peak flows reflect these physical characteristics.

The channels of the North and Central Lower Puget Sound sub-basins (McSorley, Woodmont, Cold, and Redondo Creeks) flow only in part over steep, sandy deposits. In this part of the basin plan area, these deposits are thin, sandwiched between the Vashon till above and fine-grained sediment below. As a result, zones of intensive stream-channel downcutting are more limited than in the neighboring drainages farther west. Hillslope failures associated with these easily saturated, groundwater-perching deposits, however, are rather common.

Changes in Hydraulic Geometry

Cross-Section Changes. Using the method of comparing measured channel dimensions with an "index" or reference discharge permits prediction of future channel conditions. The HSPF model outputs provide 2-year flows under both 1987 and future conditions, a convenient reference discharge; the observed relationship between flows and equilibrium channel size is described in the Conditions Report (King County, 1990a). In general, future flow increases will yield increased channel sizes, with more sediment produced from those channels as a result. For example, flow increases of 1.5- to 2.5-fold, typical over most of the subcatchments in the East and West Branches of Hylebos Creek under future conditions without mitigation, yield a predicted channel expansion of 33 to 90 percent over existing conditions.

Where previous flows are anticipated to increase even more dramatically, the changes in the channel are even more pronounced. For example, flows from Panther Lake into the West Hylebos Wetland are predicted to increase almost 9-fold under future conditions without mitigation. This would result in a predicted 4.6-fold increase in channel size. Interestingly, some of this

channel expansion appears to have already occurred, probably reflecting substantial flow increases in this tributary since model calibration in 1987. Based on its measured stage in 1989, the channel in this vicinity appears to be experiencing flows about twice what is predicted under 1987 conditions. It also implies that more than half of the total future channel expansion has yet to occur.

Using a correlation between bankfull flow parameters and channel erosion described in Booth (1990), a threshold value for channel erosion can be determined. Presently, only a few of the main channel reaches fall under the threshold and so display no excessive erosion. These include the lower reaches of the West Branch Hylebos Creek (tributaries 0013 and 0014), the undiverted part of tributary 0013 on the flat till uplands, the equivalent segment of tributary 0014 through the West Hylebos Wetland, part of the lowermost reaches of Saltwater Creek (0381), parts of Lakota Creek just below its main confluence (0386), and parts of Joes Creek about 0.5 miles downstream of SW 320th Street (0388). In those reaches, impacted by the January 1990 storm, subsequent lower flows are anticipated to rebuild and restore a relatively undamaged stream channel.

Future flow increases may eliminate some of this restorative ability. In particular, without mitigation the West Branch Hylebos Creek is predicted to change from a "non-erosive" to "erosive" condition over an additional 0.6 miles along tributary 0014 in the vicinity of its confluence, both upstream and downstream, with tributary 0013. Upper 0013 is also predicted to approach threshold conditions under future flow conditions without mitigation. None of the "non-erosive" zones in the Lower Puget Sound drainages change fundamentally, mainly because the basins are already substantially built out and anticipate only moderate future flow increases.

Stream-Channel Incision. Incision differs from simple channel expansion by its magnitude and by its relationship to the flows that cause it. Whereas increases in the bankfull depth or width reflect a proportional increase in the flows that form the channel, incision reflects a disequilibrium entrenchment of the channel bed. A "bankfull channel" may still exist through an incised reach, but it lies at the bottom of a recently entrenched ravine or canyon of far greater significance to the system as a whole.

Although adequate erosivity of the flow is one of the necessary conditions for channel incision, other factors are also necessary. The channel must lack large organic debris or sediment that would otherwise dissipate some of the flow energy. The water must flow over a substrate that is itself easily eroded and not cemented (thus excluding, for example, unweathered till). The channel must also lie well above its "base level", namely the elevation below which it cannot fall (Puget Sound, for example, or a fixed culvert inlet). If base level lies nearby, an incising stream will rapidly reduce its overall slope as it downcuts, reducing its erosivity and so limiting its own further activity. If, on the other hand, base level is so far downstream that a local bed lowering does not noticeably change the overall channel slope, further erosion will continue unabated.

The combination of little immobile debris, easily eroded bed material, and distant base level, is achieved along several channel reaches in these basins.

Most pronounced of these are found along the tributaries of East Branch Hylebos Creek (0006, 0015, and 0016 below SR 161), where high discharges flowing over deposits of the Vashon advance outwash have yielded recent examples of substantial channel incision and knickpoint migration. Damage from the January 9, 1990 storm in these tributaries is among the most dramatic County-wide. Similar substrate conditions are located along the drainages of the South Lower Puget Sound sub-basin, although the proximity of Puget Sound reduces the possibility of significant downcutting. Yet the valley walls are also very susceptible to lateral erosion from increased flows, yielding observed problems of sideslope landsliding and bank failures that reflect these physical conditions. Elsewhere, most of the channel lengths of the Lower Puget Sound drainages flow over relatively unerodible sediment, and so their associated problems are comparatively less despite their greater slopes.

Deposition. Both channel expansion and channel incision yield sediment, which in turn must come to rest farther downstream in the system. Just as increasing erosivity and transporting ability are marked by increased flow depth or slope, so a reduction in transporting ability is caused by reductions in these parameters. The most significant reductions are typically in the slope, and they generally occur where the overall gradient of the landscape, and thus the stream channel flowing over it, flattens. Over many millennia, erosion and deposition tend to "smooth" the stream profile to allow efficient delivery of the entire sediment load to the mouth of the river; but the channels here in the basin plan area are relatively young and are still strongly affected by the glacial topography. They are also affected by local constrictions and backwaters from bridges and culverts, which tend to focus and so amplify any regional patterns of deposition.

The most profound flattening in the area occurs near the base of the Hylebos Creek basin, as the East and West Branches descend off the till-covered upland plateau onto the late-glacial lake bed near the County line. Coarse sediment is deposited first, followed by progressively finer material as the gradient drops progressively downstream. The deposition of sediment in this area is inescapable; the amount of sediment so deposited, however, will depend critically on the magnitude of erosion by upstream flows. Because of the magnitude of upstream erosion, deposition here is presently noteworthy not only across these two basins but also Countywide.

5.3 HYDROLOGY

The hydrology of the Hylebos and Lower Puget Sound basins was analyzed using the Hydrological Simulation Program-Fortran (HSPF) model (USEPA, 1984). The model was calibrated using two years of concurrent stream flow and precipitation records collected by the USGS within the basin during the 1987 and 1988 water years (King County, 1990f). A 39-year record of rainfall collected at the Seattle-Tacoma (Sea-Tac) International Airport was used to compute long-term flows at all sub-catchment points within the basins.

Current (1987) Conditions

Simulated flows for the current land-use scenario are based on 1987 land-use conditions (also used to calibrate the hydrologic model). In general, a larger percentage of the land area in the Lower Puget Sound basin has been developed with approximately 30 percent remaining forested, as compared to the Hylebos Creek basin where over 50 percent of the basin remains undeveloped under 1987 conditions. Despite the lower level of overall development in the West Hylebos sub-basin, the percentage of impervious surface in the West Branch Hylebos sub-basin is comparable to the percentage of impervious surface in the Lower Puget Sound basins. This indicates a much higher density of development, where it occurs, in the West Hylebos sub-basin.

Flows produced by the continuous HSPF modeling over the 39-year simulation period were used to determine return frequencies for peak flows under current conditions, using a Log-Pearson Type III analysis (U. S. Water Resources Council, 1977). Peak flow frequencies at the outlet of each stream system are shown in Table 5.3.1.

TABLE 5.3.1

MODELED FLOW FREQUENCIES AT STREAM OUTLETS
UNDER 1987 LAND USE

BASIN	Peak Annual Flow Frequency (CFS) 2 year	10 year	25 year	100 year
Joes Creek	94	134	151	175
Lakota Creek	58	81	92	106
Redondo Creek	60	87	100	117
Cold Creek	38	54	61	70
McSorley Creek	107	153	173	199
Woodmont Creek	48	69	79	93
East Hylebos	119	193	231	290
West Hylebos	121	189	227	287

Future Conditions

Land use for the future model scenario was derived by taking the most dense land use from: 1) existing land use, 2) existing zoning, 3) the King County Comprehensive Plan, and 4) the King County Federal Way Community Plan.

Under build-out conditions, approximately 94 percent of the Hylebos Creek basin will be developed at urban densities. The West Branch Hylebos Creek tributary area will continue to be composed primarily of commercial and residential land uses, but the amount of commercial area will nearly double over 1987 land use. The East Branch Hylebos Creek tributary area will continue to be dominated by single-family residential; however, multifamily developments will increase by a factor of ten over 1987 land use and single-family residential will increase by a factor of 2.5.

In the Lower Puget Sound basin, over 90 percent of the land area is assumed developed under the future land-use condition. Increases in land-use density are not as dramatic as in the Hylebos Creek basin because the Lower Puget Sound area has already approached build out.

Figure 5.3.1 shows the magnitude of peak flow increases between the 1987 and future land-use scenarios for each of the modeled creek systems in the basins. These percentage increases are based on the average of the predicted increases for the 2-, 5-, 10-, 25-, 50-, and 100-year flows and assumes no mitigation.

Peak flow increases at the basin outlets range from 10 percent to 90 percent. Large flow increases ranging up to eight-fold were computed at some interior subcatchment points, particularly WH13 and J6. The Hylebos Creek tributaries are predicted to have a much higher increase in peak flow than the Lower Puget Sound tributaries; a reflection of the relatively undeveloped state of and the higher land-use zoning in the Hylebos Creek basin.

The Hylebos Creek and Lower Puget Sound basins represent one of the most heavily developed areas relative to unincorporated areas in King County. Mitigating existing as well as potential problems identified by the future land-use modeling runs require reducing flows well below the current (1987) land-use flow level. Since many of the stream channels in the Hylebos Creek and Lower Puget Sound basins were formed by historic flows when the basins were forested, the stream channel will be stable only under a flow regime similar to what existed under forested land-use conditions. To establish the relative magnitude and examine the statistical characteristics of flows before development occurred in the basins, a model run was performed with all development densities replaced with forest cover.

Peak flow increases between forested and 1987 conditions range from 65 percent to over 300 percent at the basin outlets. Flow increases ranging up to 400 percent were computed at some interior subcatchment points, with the largest located in subcatchments L5 and WH11. Peak flows from the 1987 land-use condition are between 60 percent to 80 percent higher than they were under the forested condition, with the highest flow increases located in the headwaters where the land use is dominated by commercial development. These increases are still much lower than the Lower Puget Sound drainages, which have 1987 peak flows that are between 120 percent and 300 percent higher than under

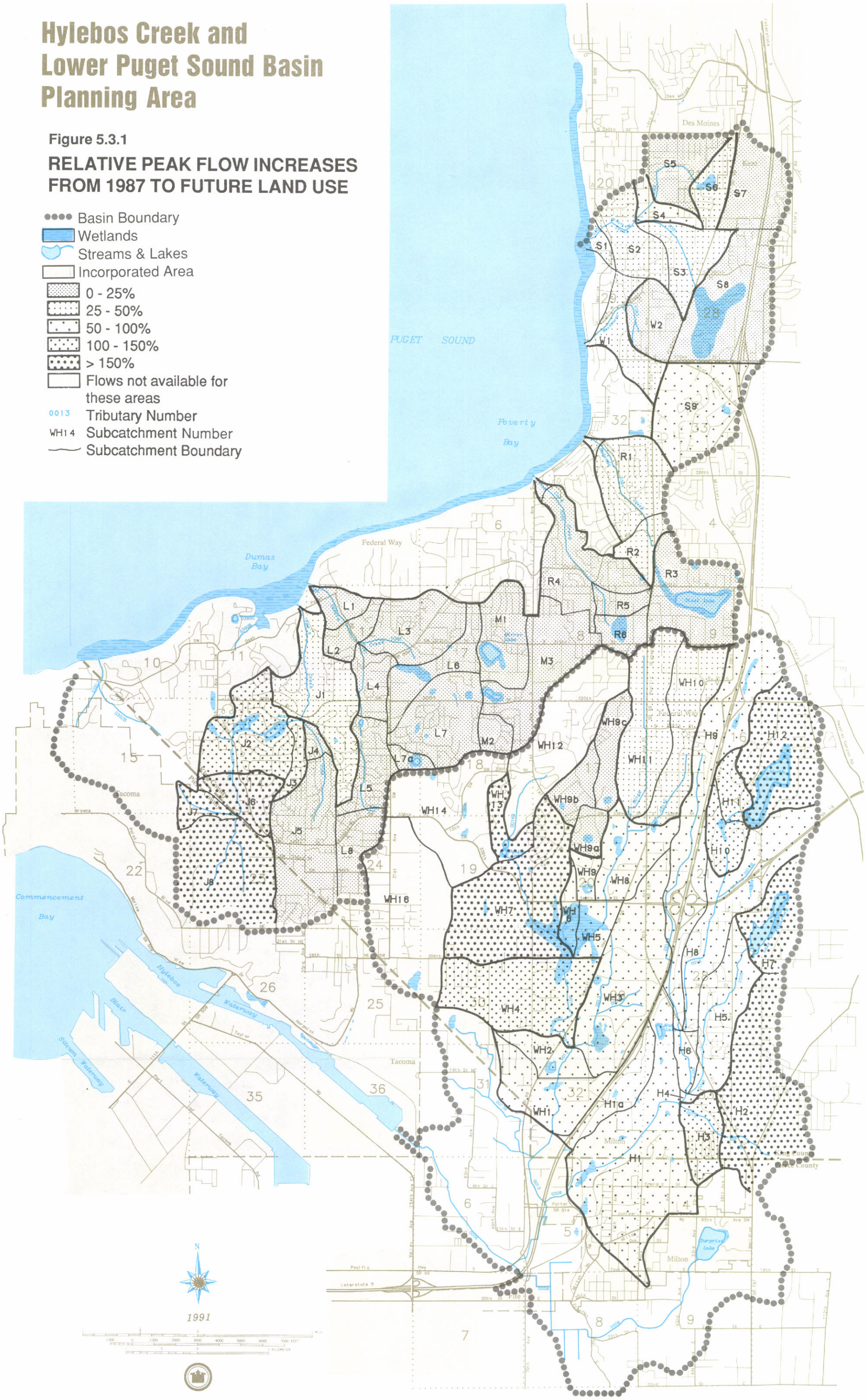
forested conditions. The high flow increase in Lakota Creek (308 percent higher than under forested conditions) is attributable to the nearly built out state of the basin under 1987 land use and the high percentage of outwash soils in the basin. Conversion of forest cover to high-density residential developments on outwash soils has resulted in particularly large flow increases in this sub-basin.

Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 5.3.1

RELATIVE PEAK FLOW INCREASES FROM 1987 TO FUTURE LAND USE

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- 0 - 25%
- 25 - 50%
- 50 - 100%
- 100 - 150%
- > 150%
- Flows not available for these areas
- 0013 Tributary Number
- WH14 Subcatchment Number
- Subcatchment Boundary



5.4 FLOODING

The occurrence and extent of flooding in the Hylebos and Lower Puget Sound streams have been severely affected by urbanization. The types of flooding that may occur in the basins are 1)regional systemic, 2) local systemic, and 3) local nonsystemic. Regional systemic flooding typically occurs in flat broad floodplain areas where a large stream or river is the principal source of the flood waters. The lower portion of Hylebos Creek from the upper end of the Hylebos Waterway to the confluence of the East and West Branches experiences this type of regional flooding. The portion of the West Branch in the vicinity of South 373rd Street also has a broad floodplain area that is susceptible to regional flooding. Regional flooding is generally the type of flooding mapped by the Federal Emergency Management Agency for insurance purposes. The Hylebos Creek and Lower Puget Sound basins within King County are currently mapped as Zone X. Zone X is considered an "area of moderate or minimal hazard from the principal source of flood in in the area" (Federal Emergency Management Agency, 1987). This designation applies to areas that lie outside the mapped 500-year floodplain. In light of current basin plan analyses, the Zone X designation for this portion of Hylebos Creek is obsolete.

New flood analysis of the Pierce County portion of Hylebos Creek is included in the Stormwater Master Plan currently in preparation by James M. Montgomery and Associates for Pierce County Surface Water Management. The final plan is expected to be available in the Fall of 1991.

Significant Current Conditions

The Hylebos Creek basin has stream reaches that are prone to regional and local systemic flooding, whereas the Lower Puget Sound basin is mainly afflicted by numerous nonsystemic drainage problems. The Hylebos Creek basin suffered greater property damage and had more significant flooding problems in the recent flood events than the Lower Puget Sound drainages. In most cases, flooding during the January 1990 storm not only was a result of increased volumes of water but also was caused by large cobbles and woody debris clogging culverts. Overall, areas typically plagued by flooding were once again inundated but to a much greater extent. New locations of flooding occurred in the Twin Lakes area and in the reach between Panther Lake and the West Hylebos Wetland. Since the last major storm event, which occurred in 1986, the upstream tributary areas of these two locations have had large amounts of recent development.

Based on past occurrences and the recent January and November 1990 storm events, several locations as significant problem areas. The areas, located on Figure 5.4.1, are listed below. These problem areas, which are described in detail in the Current and Future Conditions Report (King County, 1990a), are deemed significant because public safety was jeopardized and/or considerable property damage occurred. The numerous locations of ponded water in streets and yards where public safety was not significantly affected or property damage was slight are not enumerated in this report.

1) Tributary 0006 near I-5
2) Tributary 0006 at 5th Avenue
3) Tributary 0013 at S 373rd Street
4) Tributary 0013B at SR 99 near Swindell Road
5) Tributary 0016A at S 363rd Place
6) Tributary 0013 at S 359th Street
7) Tributary 0014 at S 356th Street
8) Tributary 0014C at S 336th Street and SR 99
9) Tributary 0014B at 1st Avenue S
10) Tributary 0014B at SW 336th Street
11) Tributary 0388 (Joes Creek) at Lorene Lake and Jeane Lake
12) Tributary 0389 in Olympic View Park
13) Tributary 0381 in Salt Water State Park
14) Tributary 0381 at S 272nd Street and Star Lake Road
15) Easter Lake near S 312th Street
16) S 320th Street between SR 99 and 23rd Avenue S
17) SW 356th Street near 11th Avenue SW

Other areas of roadway flooding during the January 1990 storm include:

- Tributary 0014 at S 348th Street near 11th Avenue S
- Tributary 0006 at SR 161 near S 370th Street
- Tributary 0016 at SR 161 near S 368th Street
- Tributary 0014C at S 330th Street and 20th Avenue S
- Headwater areas of tributaries 0014A and 0014C near S 317th Street between 20th and 23rd Avenues S
- Tributary 0384 at 4th Place S near Redondo Beach
- Adelaide Beach along 20th Place S (no tributary number)
- Lake Ponce De Leon near SW 324th Street and 26th Avenue SW
- SW 337th Street and 21st Avenue SW (malfunctioning commercial infiltration pond)
- Tributary 0016A southwest of the I-5 and S 348th Street interchange (behind Costco)

Previous efforts toward resolving flooding problems in the basins include capital improvement projects and drainage studies completed by the SWM PM&D and DI Units. Some DI Unit studies are initiated as a result of problems identified during inspections by SWM Facilities Maintenance personnel. The King County Roads and Engineering Division also has several projects in progress that have drainage design components.

Significant Future Conditions

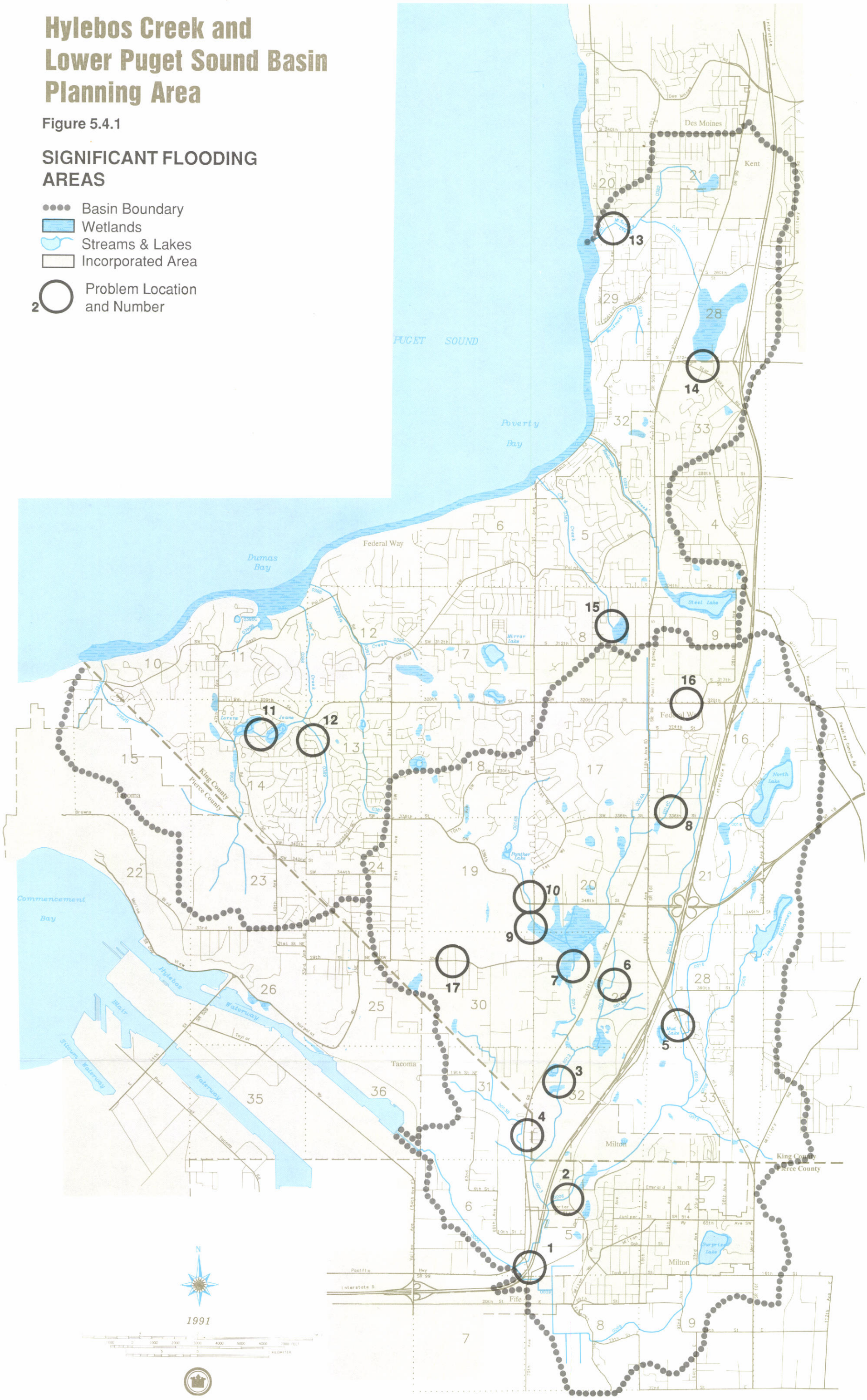
Increased flows generated from more intensive future land use will exacerbate current flooding problems as well as cause flooding in previously flood-free areas. A concomitant of increased peak flows is increased frequency, causing flooding to occur more often. Increased flows and frequencies will result in greater amounts of property damage, more frequent maintenance, and a higher risk to public safety. As demonstrated in the Current and Future Conditions Report (King County, 1990a), some existing culverts do not have adequate capacities for the predicted 1987 stream flows, and even fewer culverts would accommodate future unmitigated flows.

Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 5.4.1

SIGNIFICANT FLOODING AREAS

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Problem Location and Number



During the January and November 1990 storms, outflow from Panther Lake occurred because land-use density in the tributary area has increased and also because of additional tributary area draining to the lake. This observed condition more closely reflects future flow modeling, which predicts a 100-year unmitigated lake outflow of nearly 200 cfs. This predicted increased future outflow from Panther Lake will exacerbate existing flooding in downstream reaches.

Recent land-use changes in the headwaters of Joes Creek caused similar flooding to the Twin Lakes area (subcatchments J6 and J8) during the January 1990 storm. Because the majority of the Lower Puget Sound drainages are substantially built out, the increase in flows under future conditions and the associated damage caused by those flows should be minimal. The exception to this situation is tributary 0388 in the South Lower Puget Sound sub-basin. In this sub-basin, conversion of forest to urban land uses will substantially increase flows to Twin Lakes. If remedial action is not taken, increased flooding of lakeside homes will occur at a greater frequency.

The most dramatic change in flooding conditions will occur in those areas that under current conditions are flood-free but will experience over a two-fold increase in future peak flows. Two areas of concern are the East Branch Hylebos Creek (tributary 0016) downstream of North Lake in subcatchments H8 and H10, and a tributary (0015) of the East Branch within subcatchment H2. In the North Lake area, the two-fold increase reflects relatively small quantities of flow and thus damage potential is limited. For example, the 100-year discharge of subcatchment H10 will increase from 17.4 cfs under 1987 conditions to 31.9 cfs. Farther downstream along tributary 0016, however, subcatchment H8 has a lower percentage increase but a much larger discharge for the same event (70.5 cfs and 117.0 cfs, respectively), mainly because of the conversion of forested areas to urban land uses. Residential development currently under construction along tributary 0016 south of SR 18, and existing residential areas just upstream of the SR 161 culvert crossing, could experience severe flooding if these future flows are not mitigated. Future overtopping of SR 161 at the tributary 0015 culvert crossing is also expected to occur because of greatly increased runoff from subcatchment H2.

5.5 WATER QUALITY

The stream water quality in the Hylebos Creek and Lower Puget Sound basins has been assigned a Class A (Excellent) by the DOE. In general, the most commonly identified beneficial water uses for this class are fish and shellfish migration, spawning, rearing and harvesting; domestic, industrial and agricultural water supply; stock watering; wildlife habitat, primary contact recreation; aesthetic enjoyment, and commerce and navigation. In the early 1980s, several water quality studies focused on the elevated pollutant concentrations due to water quality concerns associated with industrial activities in Hylebos Waterway.

Metro (1988) rated the baseflow water quality as generally good in the Hylebos Creek and Lower Puget Sound basins. Water quality during 1987-1988 appeared sufficient for support of beneficial uses. Recent Metro reports describe surface waters in the basins as "cool, clear, and well oxygenated and had relatively low bacteria levels" during baseflow conditions (Metro, 1988). Bacteria levels at the mouths of seven creeks sampled had relatively low bacteria levels, although nitrogen concentrations were relatively high in three sub-basins.

A supplemental survey of water quality conditions conducted by SWM during the development of this Basin Plan indicated that during storm events, water quality is degraded in most areas of both basins. Figure 5.5.1 highlights the significant surface water quality problems observed during this 1989-1990 storm event monitoring. These problems are identified as significant because sampling results consistently showed pollutant concentrations exceeded state water quality standards, federal guidelines, or technical criteria for the pollutants identified. The most significant problems identified in each sub-basin are listed below:

Sub-Basin	Significant Pollutant Problem
◦ West Hylebos	Metals (Copper, Lead, and Zinc)
◦ East Hylebos	Nutrients (Nitrogen and Phosphorus)
◦ Lower Hylebos	Pollutant loading to Commencement Bay
◦ North Lower Puget	Phosphorus, Copper, fecal bacteria
◦ Central Lower Puget	Total suspended solids
◦ South Lower Puget	Fecal bacteria, total suspended solids, phosphorus

No lake sampling was included in this study. However, Metro data suggest that potential eutrophic conditions exist in Panther Lake, Lake Killarney, Steel Lake, Mirror Lake, and Lorene and Jeane lakes. Therefore, the need for source controls of nutrients such as phosphorus exists in these basins.

Hylebos Creek and Lower Puget Sound Basin Planning Area

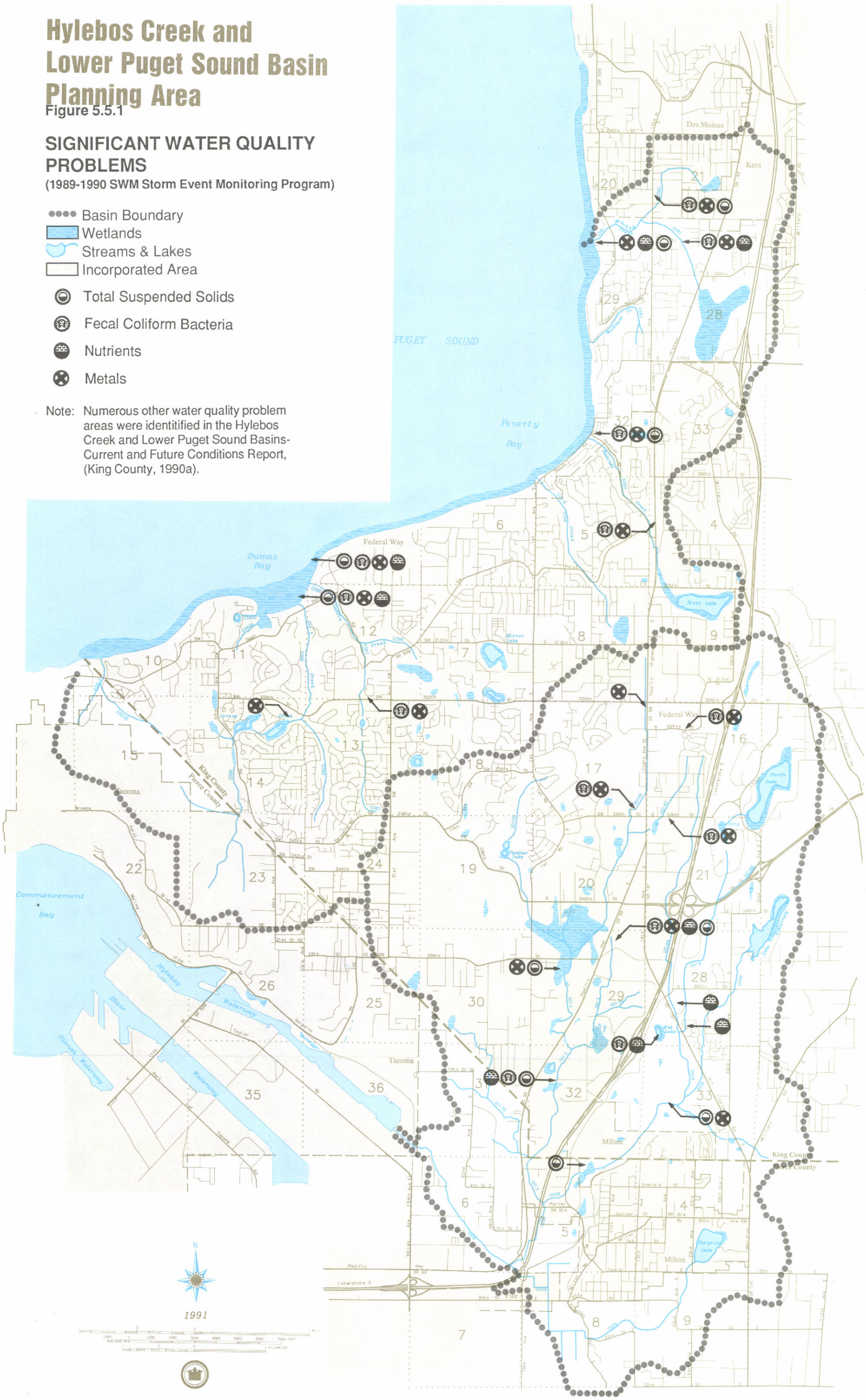
Figure 5.5.1

SIGNIFICANT WATER QUALITY PROBLEMS

(1989-1990 SWM Storm Event Monitoring Program)

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Total Suspended Solids
- Fecal Coliform Bacteria
- Nutrients
- Metals

Note: Numerous other water quality problem areas were identitified in the Hylebos Creek and Lower Puget Sound Basins-Current and Future Conditions Report, (King County, 1990a).



Significant Current Water Quality Problems

Several significant water quality issues were identified from the water quality data and information referenced in the Current and Future Conditions Analysis (King County, 1990a). These issues are noted because they represent the most serious threats to water quality conditions in both basins.

1. Relatively high concentrations of heavy metals (e.g., copper, lead, and zinc) are transported during storm events from road runoff and automobiles to water bodies, particularly in the Hylebos Creek basin. Most notable are the Evergreen Industrial Park, SW 320th Street near tributary 0014B, and below the SeaTac Mall areas.

2. Uncontrolled large sediment loads and their associated contaminants are impacting downstream beneficial uses such as: commerce and navigation activities, stock watering, industrial operations (e.g., cooling water), and fish and wildlife. Notable problem areas include lower reaches of both Cold Creek and Lakota Creek, Regency Woods onsite detention ponds (tributary 0016), and the Evergreen Industrial Park (tributary 0013).

3. Relatively high concentrations of fecal coliforms which exceed contact recreation standards, particularly in the Lower Puget Sound basin, may be originating from sewer line leaks, failing onsite septic systems, animal access to creeks, and pet wastes. These bacteria are a potential threat to human contact with surface waters and affect recreational shellfish harvesting while contributing to the decertification of commercial shellfish beds in Puget Sound.

4. Relatively high concentrations of nutrients were observed in several streams. Potential sources include fertilizers, failing septic systems, decomposing organic matter from leaves and grass clippings, agricultural runoff, urban street refuse, and atmospheric deposition. These nutrients may be contributing to observed algal blooms in lakes and lowered oxygen levels in both lakes and streams. Notable areas include: Enchanted Village Facility (tributary 0016A); Evergreen Industrial Park; the lower reaches of Cold Creek and Lakota Creek; and tributaries 0016 and 0016A above SR 161.

Future Water Quality

There are indications of water quality problems presently in both basins that could be exacerbated in the future. Some baseflow samples showed existing low dissolved oxygen and pH levels. These water quality constituents, when low, can create stress levels for salmonids and may, in combination with high pollutant loads introduced by storm flows, create future limitations for these fish populations. Other potential problems include increased turbidity and sediment loads from construction activity and instream erosion from increased flows; increased concentration of metals, solids, and other constituents from newly urbanized areas; increased fecal coliform levels from failing septic systems, sewer line leaks, or both; and increased runoff from roads, parking lots, and commercial areas. The SWM preliminary sampling program showed that all of these water quality parameters are elevated now. Any future develop-

ment must include mitigation plans for water quality impacts. In this way, the number of beneficial uses of these streams, lakes, and wetlands, can be increased in the future.

5.6 HABITAT

The Hylebos Creek system (Figure 5.6.1) is composed of approximately 28 miles of streams, five named lakes, and over 30 identified wetlands totaling more than 250 acres. The basin also contains a number of other small unnamed ponds and uninventoried wetland areas.

The East Branch Hylebos Creek originates at Lake Killarney and North Lake on the northeast border of the basin and flows south and west to the confluence of West Branch Hylebos Creek in Pierce County. The original headwaters of the West Branch were situated within a complex of wetlands in the vicinity of S 320th Street and within the West Hylebos Wetland, whose present approximate boundaries lie between S 348th Street, S 356th Street, 1st Avenue S, and SR 99. Altogether, there are 18.5 river miles on the mainstem and East Branch and their tributaries and 9.7 miles on the West Branch and its tributaries.

The eight independent Lower Puget Sound drainages (Figure 5.6.1.) together comprise over 18 miles of stream channels, five named lakes, and 30 inventoried wetlands -- including over 250 acres of shallow intertidal and subtidal areas in adjacent waters of Puget Sound.

Historical Information

Hylebos Creek was at one time among the most productive small stream systems in central Puget Sound. The basin supported annual returns of several thousand adult coho (Oncorhynchus kisutch) and chum (O. keta) salmon, plus hundreds of chinook (O. tshawytscha) salmon, steelhead trout (O. mykiss), and cutthroat trout (O. clarkii). Like most Puget Sound lowland streams (Gonor et al., 1988), lower Hylebos Creek consisted of a network of sloughs, beaver ponds, and driftwood dams grading into steeper segments of the stream system flowing through ravines forested with old growth conifers. Large organic debris played an important role in the ecology of the stream system by stabilizing stream channels and forming diverse sequences of riffles and pools used by salmon and trout as spawning and rearing areas. By comparison, fish habitat within present-day Hylebos Creek contains only remnant areas of productive fish and wildlife habitat. Fish populations are small due to the basinwide influences of urbanization on the remaining productive fish habitat within the system.

In the West Branch, historic use by salmonids extended from the mouth up to the West Hylebos Wetland (RM 1.10) and up to the vicinity of South 359th Street on tributary 0013. The East Branch used to provide excellent spawning and rearing habitat for anadromous fish up to approximately RM 7.0 on tributary 0006, RM 0.5 on tributary 0015, and RM 0.4 on tributary 0016, with some cutthroat habitat in upstream headwaters.

A small population of freshwater mussels (Margaritifera faleata) also exists in the West Branch near its confluence with the East Branch. These organisms are important indicators of change in the watershed. Their continued presence indicates some hope for the future.

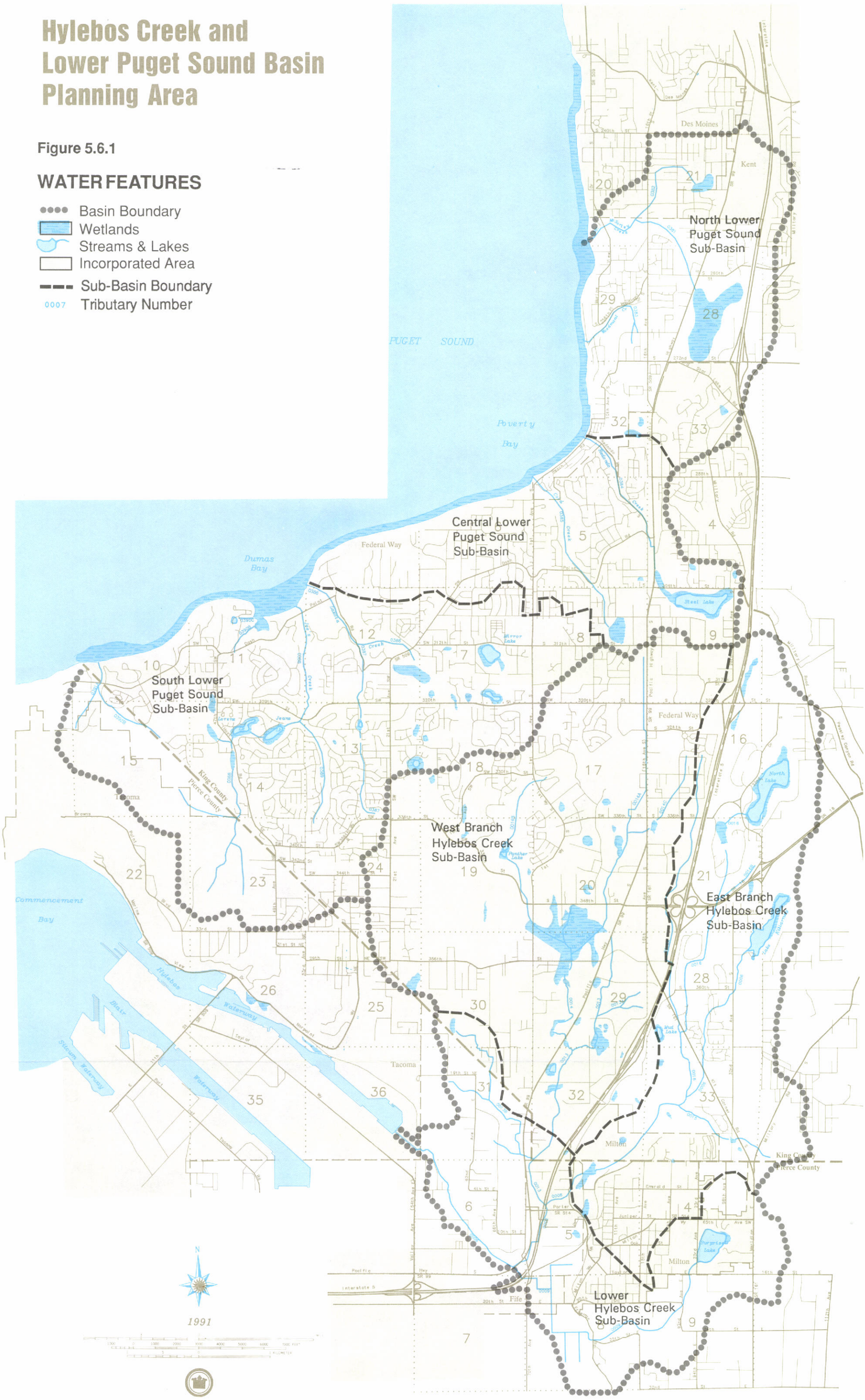
Each of the Lower Puget Sound tributaries is considerably shorter, steeper, and conveys less flow than Hylebos Creek and its main tributaries. As a

Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 5.6.1

WATER FEATURES

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Sub-Basin Boundary
- 0007 Tributary Number



consequence, even in pre-settlement times none of these streams supported large populations of salmonids, although collectively their contribution to local fish abundances and shoreline conditions of Puget Sound was important. Due to past habitat damage caused by filling of headwater wetlands, channel alterations, excessive peak flows and severe erosion, and disruptions to year-around streamflow, only McSorley, Lakota, and Joes Creeks at present support residual fish populations of any significance. All the Lower Puget Sound streams, however, are important for support of local wildlife and because of their potential for adverse impacts on Puget Sound water quality and sensitive estuarine and coastal bluff habitats.

Current Habitat Conditions

At present, fish and wildlife habitats in the Hylebos Creek and Lower Puget Sound basins vary from good to very poor. While some good instream, riparian, and wetland habitats remain, development-related habitat problems are extensive.

Much of the habitat in the headwaters of the Hylebos Creek and Lower Puget Sound systems has been decreased or eliminated by the routing of long stream segments inside culverts, the loss of large channel stabilizing woody material, and by alterations in flow regimes that cause headwater areas to dry up in the summer and during low flow winter periods in dry years. Habitat in the lower mainstem of Hylebos Creek has been harmed by channelization and dredging, and by encroachment into the riparian zone by roads, bridges, and inadequate building setbacks.

Intertidal habitat at the mouth of Hylebos Creek has been extensively impacted by development. Since the 1920s the Waterway has been regularly dredged to accommodate marine vessel traffic, resulting in a loss of 90 percent of the estuarine habitat. The Waterway is also currently planned as part of the ongoing EPA Superfund cleanup of Commencement Bay. Additional intertidal habitat has been lost along the Puget Sound shoreline due to bulkheading of marine shoreline areas and the formation of alluvial tideflats has been disrupted by bank armoring near the mouths of the streams.

At least half of the freshwater wetlands in both basins have been eliminated or significantly altered by filling and removal of native vegetation. Many of the existing wetlands are threatened by radical changes in hydrology and water quality due to adjacent development. Loss of these wetlands would seriously compromise the quality and stability of downstream fish habitats as well as reduce local populations of wildlife.

The areas of good stream habitat for salmonids that still remain in the Hylebos Creek and Lower Puget Sound systems are generally located downstream of the heavy urban development found in Federal Way (Figure 5.6.2). Typically, these areas are situated in ravines, which historically were unbuildable and therefore have retained healthy riparian corridors. Buildings near the stream channels are rare, thus allowing greater opportunities for restoration and enhancement of stream habitat.

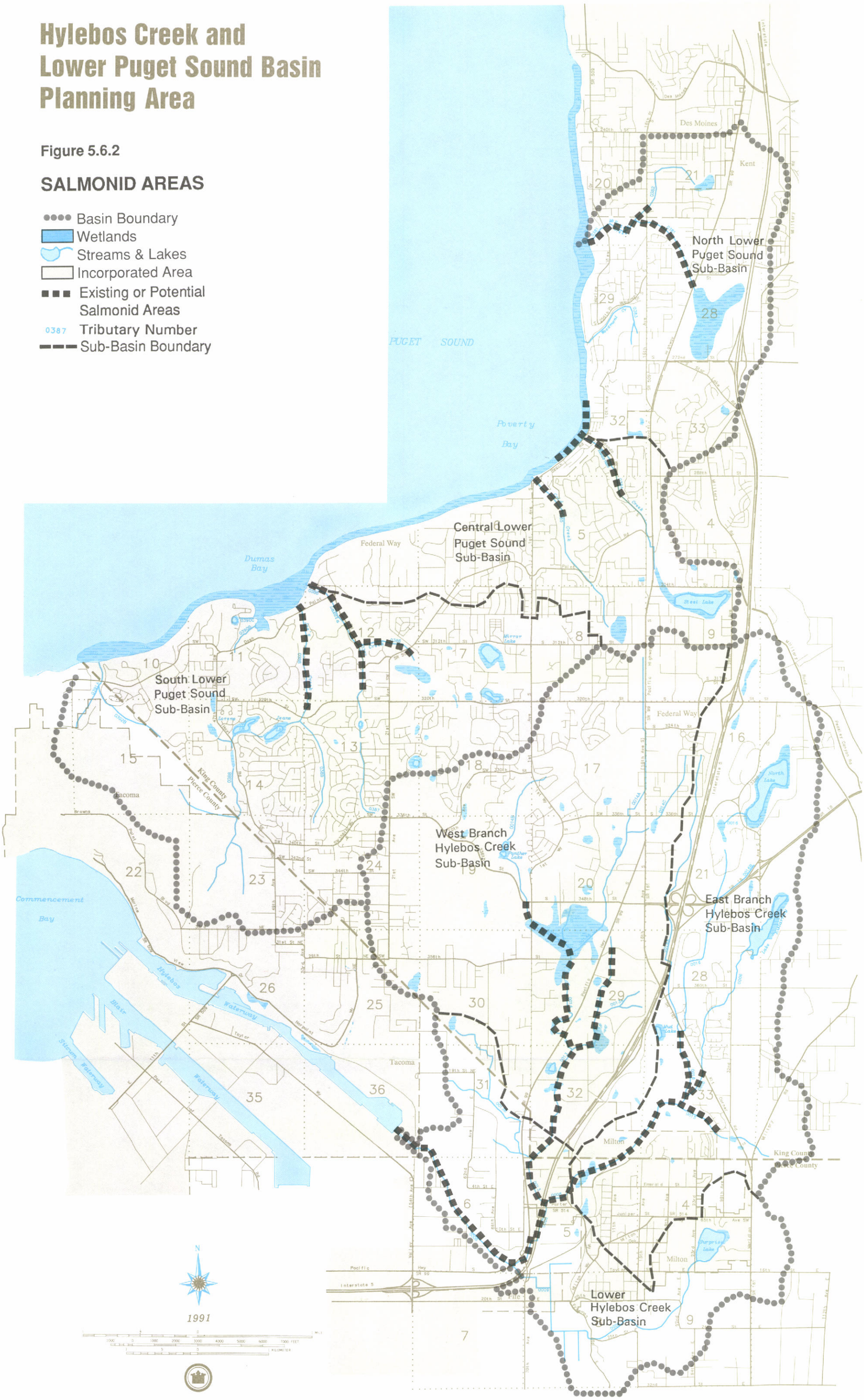
Current habitat conditions are summarized below:

Hylebos Creek and Lower Puget Sound Basin Planning Area

Figure 5.6.2

SALMONID AREAS

- Basin Boundary
- Wetlands
- Streams & Lakes
- Incorporated Area
- Existing or Potential Salmonid Areas
- 0387 Tributary Number
- Sub-Basin Boundary



- Approximately 90 percent of the estuarine habitat formerly associated with lower Hylebos Creek has been eliminated. Estuarine habitats in Dumas Bay are threatened by excessive sedimentation from upstream erosional areas.

- The filling of wetlands has directly reduced the quality and quantity of areas for fish and wildlife breeding, nesting, feeding, and predator escape. Numerous habitats have also been damaged indirectly by loss of wetland functions by impacts of increased peak flows on instream and riparian habitats.

- Elimination of native riparian vegetation to the stream edge has occurred in many segments of the Hylebos and Lower Puget Sound stream systems. Where dense riparian vegetation remains there has been wholesale replacement of conifers by smaller deciduous trees and shrubs in many areas.

- The quality and quantity of instream habitat in many parts of the Hylebos and Lower Puget Sound stream systems has been degraded or eliminated by channelization and removal of large organic debris.

- Damage to habitats from excessive peak flows is widespread in the drainages.

- Reduced groundwater recharge is affecting quantity and quality of aquatic habitat during summer low flows and in winter low flow periods of dry years. Loss of groundwater volumes will ultimately affect the quality and functions of many wetlands in the Hylebos Creek and Lower Puget Sound basins.

- Continued increases in the intensity and magnitude of peak flows will reduce or eliminate remaining instream habitats.

Appendices

Appendix A

Public Comments

INTRODUCTION

This appendix includes comment letters received on the Draft Plan and the Environmental Checklist. The King County SWM Division greatly appreciates all of the thoughtful and constructive comments that were prepared. The revision incorporated in this document have made it a clearer and more useful Plan.

Pierce County
Public Works Department
2401 South 35th Street, Room 150
Tacoma, Washington 98409
(206) 591-7250 • FAX (206) 596-2740

April 8, 1991

Roz Glasser
King County SWM Division
710 - 2nd Ave., Room 730
Seattle, WA 98104

Subject: **Draft** - Hylebos Creek and Lower Puget Sound Basin Plan
Pierce County SWM Comments

Dear Roz:

Enclosed herein, are our comments on the **Draft Hylebos Creek and Lower Puget Sound Basin Plan.** We appreciate the opportunity to comment on your Plan. The comments are as follows:

1) Figure 1.1 - Portion of watershed (as highlighted on attached map) indicates that King County drains into a highly sensitive area of Pierce County currently experiencing severe flooding and property damage with a minimal rainfall event. Strict drainage requirements meeting 100% retention must be implemented to control runoff to this area. If retention is not possible, discharge and detention meeting Chapter3.2.**BW-3** will be required. This area in Pierce County will classify as a "Specific area having special characteristics" as mentioned on page 3-7, last paragraph, under **Discussion of Recommendations.** 1

2) Page 3-6 - **BW-3: Stream Protection Onsite Detention Standard;** We recommend that this discharge and detention standard be encouraged throughout the entire Hylebos Creek Basin to reduce the peak flows into Hylebos Creek and to mitigate significant adverse impacts downstream. We encourage and support your statement under **Discussion of Recommendations,** page 3-7, last paragraph, for enhanced detention standards to be used to reduce peak flows and long-term flow durations to pre-developed levels. 2

If you have any questions, please do not hesitate to contact the undersigned at 596-2725. Thank you for your time and interest in addressing our joint concerns in the Hylebos Creek Basin.

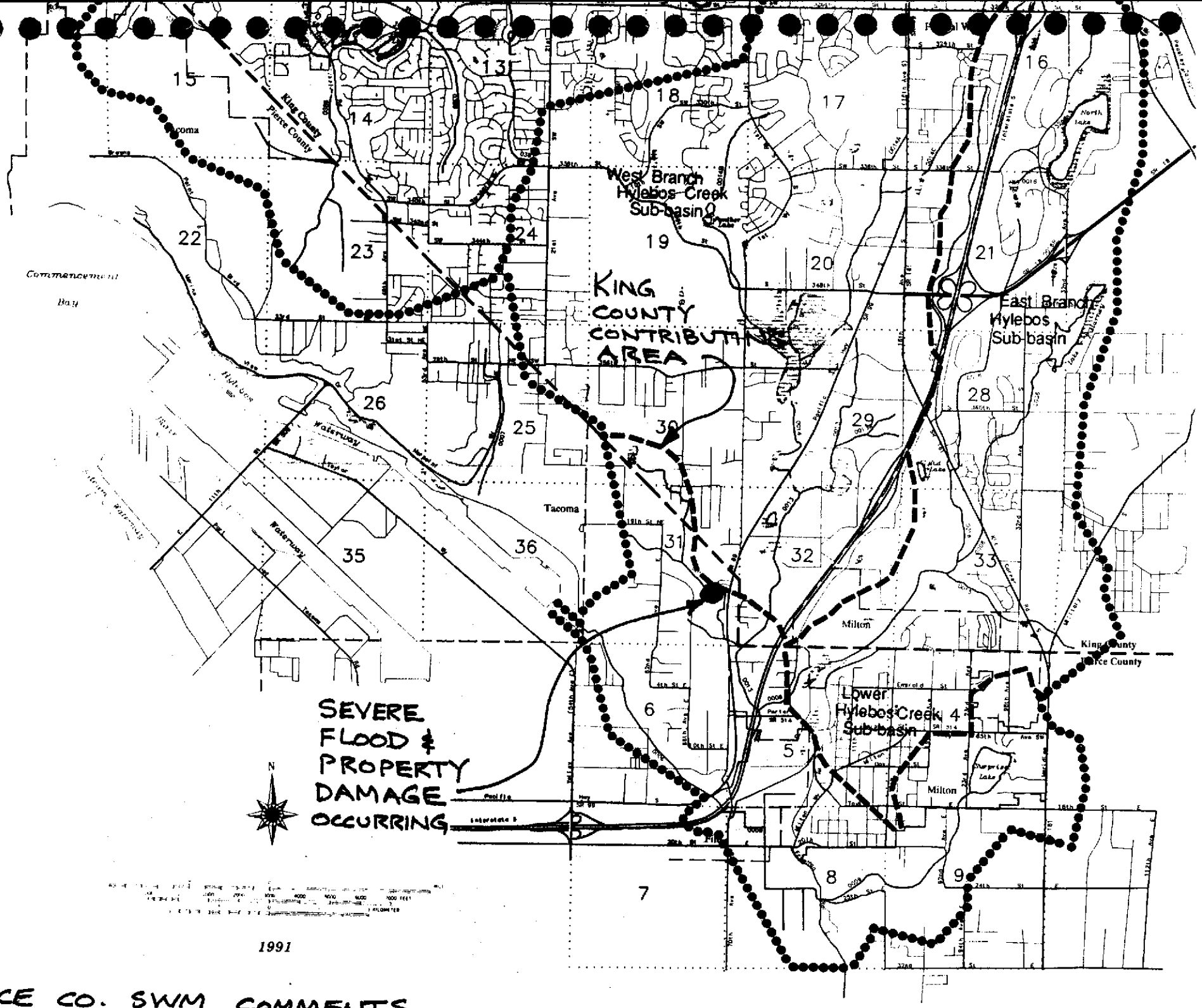
Very truly yours,

John O. Trent, P.E.
Public Works Director

John Cutter, P.E.
Surface Water Management Section

JOT:JRC:ln CORJC\SWM91.008

cc: File



PIERCE CO. SWM COMMENTS

WINDUS, THOMAS, CALMES & WILEY
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April 10, 1991

Ms. Roz Glasser
King County SWM Division
710 2nd Avenue, Room 730
Seattle, Washington 98104

RE: Draft Hylebos Creek and Lower Puget Sound Basin Plan

Dear Ms. Glasser:

As I advised you at the citizen advisory committee meeting held on March 28, 1991, this office represents certain owners of the parcel of property located on the southwest corner of S.W. 336th Street and Pacific Highway South (16th Avenue South) in Federal Way. I would offer the following comments concerning the Draft Hylebos Creek and Lower Puget Sound Basin Plan (draft plan) for your consideration.

3 Table 2.3.2 in the draft plan, as item number 8, describes the referenced project as an enforcement action. It is my belief that the characterization of this project in this manner is inappropriate inasmuch as it is conclusory in nature from both a factual and legal standpoint. I believe that the project reference should be re-phrased in a neutral manner. Given the fact that this cannot be properly termed an enforcement action I believe that it is likely that the estimated cost listed in the proposed plan may be dramatically understated. I would request that these items be revised accordingly.

4 The same comments above apply to the statement contained on page 4-12 in reference to capital improvement number 2, project 2436. I do not believe that there is a factual or legal basis for the statement that the area "was illegally drained". This apparently is simply the opinion of the person who drafted this statement and/or possibly the opinion of King County SWM Division. The inclusion of this type of statement in the proposed plan is inappropriate. Given the foregoing the estimated cost listed on this page likely is misleading. Again, I would request that this reference be modified.

While the property owners recognize that there may be a need and/or a desire on the part of King County or the City of Federal Way to address the problems and satisfy the goals set forth in the plan, projects which effect private property rights will have to be addressed through communication between the property owners and appropriate governmental agencies. We believe that it is inappropriate that these items be included in the plan as currently drafted.

I would ask that you consider revising the above-referenced portions of the proposed plan. I will be willing to consult with you further regarding language which would be neutral and acceptable to the property owners if you desire. Finally, I would ask that you advise me as to the language which is ultimately included in this proposed plan. Thank you for your consideration.

Very truly yours,

WINDUS, THOMAS, CALMES & WILEY

Thomas K. Windus

TKW:le

cc: Mr. Cary M. Roe - City of Federal Way
R.M. Laursen - Safeco Insurance Company of America
William J. Chase
Leonard C. Schaadt

Twin Lakes

Homeowners' Association, Inc.

3420 S.W. 320th, Suite B-2 • Federal Way, WA 98023

Phone: 838-0464

April 6, 1991

Roz Glasser
King County SWM Division
710 Second Ave., Room 703
Seattle, WA 98104

Dear Roz:

With regard to prioritizing work and expenditures for **Draft Hylebos Creek and Lower Puget Sound Basin Plan,** the Twin Lakes Homeowners' Association and the Twin Lakes Golf and Country Club are pleased and generally agree with the direction the plan is taking.

We believe that there are solid reasons why King County and the City of Federal Way should address projects 3330 and 3331 first. These reasons include, but are not limited to:

*Since 1976, Twin Lakes has been actively pursuing a solution, from King County, to the Lake Jeane/Joe's Creek drainage problem. (Help may have been requested longer than others.)

5 *Houses flood due to the inability of Lake Jeane's drain to keep up with the increased run-off caused by upstream development, approved by King County.

*There are over 1378 families, in Twin Lakes, that are affected.

*Constant flooding degrades the water quality affecting fish and wildlife.

*Continuous land erosion occurs with constant flooding.

Due to the continuous, severe flooding to homes on Lake Lorene and Lake Jeane, we sincerely hope that this project will be completed before next fall's heavy rains.

Sincerely,

Jim Schneider, President
Twin Lakes Golf & Country Club

Andy Johnston, President
Twin Lakes Homeowner's Assoc.

cc: Jim Schneider
Andy Johnston
Lake Jeane Committee

Twin Lakes

Homeowners' Association, Inc.

3420 S.W. 320th, Suite B-2 • Federal Way, WA 98023

Phone: 838-0464

April 9, 1991

Roz Glasser
King County SWM Division
710 Second Ave., Room 703
Seattle, WA 98104

Dear Roz:

The Draft Hylebos Creek and Lower Puget Sound Basin Plan clearly illustrates the enormity of problems created by less than thoughtful policies and regulations-not to mention possible inadequate enforcement of those regulations-that have been in force for the past many years. Beginning in 1976 and continuing to the present, the community of Twin Lakes, now numbering 1300 plus single family residences, has attempted to bring to the attention of officials and departments of King County, and now the City of Federal Way, problems concerning surface water and drainage damage. As development of this community progressed, it became apparent that directing storm water runoff into existing streams and lakes would create long term problems and that each additional development would compound the costs to correct.

Regarding the draft recommended Capital Improvement Projects and Studies as applies to project numbers 3330 an 3331, we wish to express our opinion that (1) the projects should receive urgent early remedial action and (2) the proposed fixes ignore the root problem of volume and velocity and will do little toward meeting your goals of reducing flooding, improving aquatic habitat and water quality.

Taking No. (2) above first, please recognize that the volume of water, by your calculations, will only increase and it seems unreasonable to expect that natural drainage areas of Woodridge Ravine; Lakes Lorene and Jeane; and upper and lower Joe's Creek can accept this increase without further degradation due to silting of lakes and the "Duck Pond"; further erosion of Woodridge Ravine; and upper and lower Joe's Creek. Further this continually increasing flow of water washing over roofs, driveways and streets will carry more pollutants creating health hazards for the some 5,000 citizens that live continguous to this open runoff.

6 It is respectfully suggested that the time has come to recognize the surface water problem for what it is and do as other metropolitan areas have done and pipe the excess water underground for proper treatment and discharge before it causes further silting and erosion to the lakes and Joe's Creek.

With regard to priority for these projects, that this community has been experiencing damage, repeated residential flooding, inconvenience and expense from this problem for years and since 1976 has requested help from appropriate governmental agencies, is reason enough that early relief is deserved.

It must be noted here that nothing of substance came from King County to ease the problems pointed out by these requests. (Copies of letter and replies enclosed.) Additionally, with each heavy rain, further serious damage is done to private property, fish and wildlife habitat and in that a great many people live very close to the runoff areas, dangers from fast flowing volumes of water and pollution in that water creates hazards that are real and of concern to the population living in the immediate vicinity. The plan requires, but omits, specific comments about the progressive sedimentation of Lake Lorene and Lake Jeane, caused by inadequate monitoring and control of developments by King County of water runoff and erosion during land clearing, street building and individual residential construction and sequelae.

7 Responsibility for existing silt removal from the two lakes, essentially through King County's malfeassance, needs to be addressed and not ignored.

In summary, unless priority is given to a proper correction of these problems, the lakes will fill with silt and disappear adversely affecting property values, the streams will continue to erode becoming unsafe and not able to support fish and wildlife and health hazards will increase.

We anticipate a response to these comments.

Sincerely,

Jim Schneider, President
Twin Lakes Golf & Country Club

Andy Johnston, President
Twin Lakes Homeowner's Assoc.

cc: Tim Hill, King County Executive
Mayor Debra Ertel, City of Federal Way
Cary Roe, Director of SWM Division, City of Federal Way
Jim Schneider
Andy Johnston
Lake Jeane Committee

JOSEPH R. BLUM
Director

STATE OF WASHINGTON

DEPARTMENT OF FISHERIES

115 General Administration Building • Olympia, Washington 98504 • (206) 753-6600 • (SCAN) 234-6600

April 11, 1991

King County Surface
Water Management Division
ATTENTION: Roz Glasser
710 Second Avenue, Room 730
Seattle, Washington 98104

SUBJECT: Draft Hylebos Creek and Lower Puget Sound Basin Plan

Dear Ms. Glasser:

This plan covering the entire Hylebos drainage basin and many independent tributaries to Puget Sound is well written. When the various aspects of the plan are completed, the streams involved will suffer less erosion and have improved water quality. This will have a positive impact on fishery resources dependent on them for survival.

8 Unfortunately, even being optimistic it will take five (5), ten (10), or more years to accomplish these goals. With this in mind, one of the proposals outlined in the plan will have a devastating impact on the salmon resources in the west branch of Hylebos Creek. This is the continued dredging in the vicinity of South 373rd. We feel the impacts of dredging under the bridge after every storm are unacceptable. We have indicated in past Hydraulic Project Approvals for this work that an alternative solution for flood protection must be found. The salmon resources cannot wait five (5), ten (10), or more years for a stable spawning area. A temporary gravel trap could be developed in the area which would allow the removal of gravel without the destruction of spawning areas or inhibiting upstream migration.

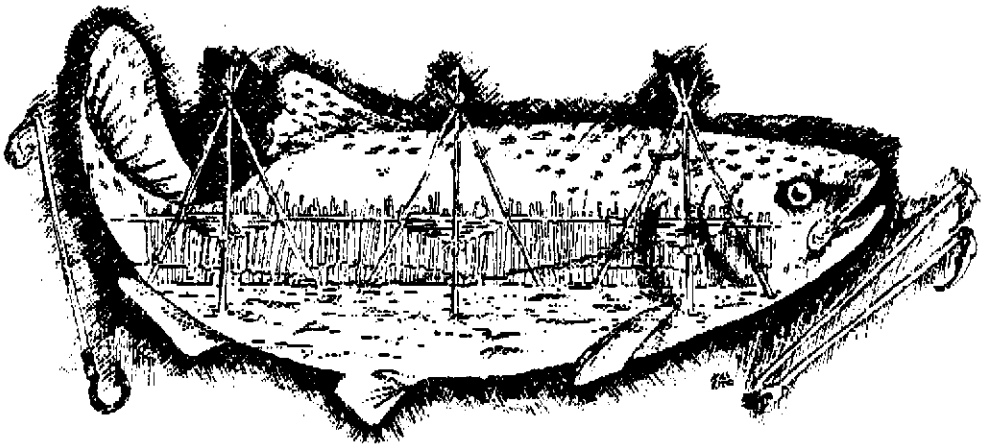
We would also like to recommend that some controls be placed on the one (1) unit per five (5) acre zoning. If the numbers of animals are not controlled and/or the stream not fenced, this zoning will not have the positive benefits hoped for.

9 Thank you for the opportunity to review this basin plan. If you have any questions concerning our comments, please contact me at 753-2980.

Sincerely,

Joseph L. Robel
Regional Habitat Manager
Habitat Management Division

JLR:jkd



MUCKLESHOOT INDIAN TRIBE
FISHERIES DEPARTMENT

39015 172ND AVENUE S.E. - AUBURN, WASHINGTON 98002 - (206) 939-3311

April 12, 1991

Roz Glasser
King County SWM Division
710 Second AV Room 730
Seattle WA 98104

RE: Comments on Draft Hylebos Creek and Lower Puget Sound Basin Plan

The following comments are presented on behalf of the Muckleshoot Indian Tribe with reference to the standing of the Tribe in relation to the Basin Plan.

As a sovereign government holding both property interests protected by treaty and federally reserved water rights, the Tribe has a fully vested stake in the future of the Hylebos Creek and Lower Puget Sound Basins. The Muckleshoot Indian Tribe is a federally recognized Indian Tribe and the successor in interest to the various bands of Indians who were parties to the Treaty of Point Elliott (12 Stat. 927) and the Treaty of Medicine Creek (10 Stat. 1132) and holds federally guaranteed treaty rights to fisheries in the area covered by this Basin Plan. [United States v. Washington, 384 F. Supp. 212 (W. D. Wash. 1974), aff'd 520 F. 2d 676 (9th Cir. 1975), cert denied 423 U. S. 1086 (1976).] These rights are directly affected by the policies and recommendations of the Basin Plan.

The Tribe must assign to King County, as lead agency, the liability for impacts to fish and shellfish resources from past and future development.

For the sake of brevity, these comments address only those aspects of the plan to which the Tribe is offering revisions and do not specifically address aspects with which the Tribe concurs. Lack of comment is not intended to imply concurrence with all remaining portions of the Plan.

1. Plan Approach and Content

Although it may be appropriate and necessary to devise an approach such as the designation of Regionally and Locally Significant Resource Areas in order to focus efforts on salvaging remaining relatively-undegraded resources, it isn't appropriate to stop at a "minimum level of protection for the remainder of the system." This actually undermines the Plan's professed goal of treating watersheds as integrated systems. The rest of the system won't just remain "on hold" but will continue to deteriorate without some additional measures aimed at its restoration.

10 The idea that the higher priority areas will "form the basis for the recovery of habitat in lower priority areas in the future" will work only if such recovery is initiated now. Otherwise, the Plan is simply rationalizing additional degradation by allowing fragmentation of the system in the name of prioritization. At the very least, the Plan needs to define "minimum level of protection" and to set in motion a process that will lead to recovery, in addition to the studies and monitoring that it now proposes. Ways in which this can be accomplished are included in the comments below relating to specific sections of the Plan.

2. Plan Criteria

Rather than identifying Significant Resource Areas and stopping at that, the Plan should also identify at least one other tier of Resource Areas - Secondary Resource Areas, for example - which would include localized fragments of valuable
11 habitat. Rather than writing-off degraded and fragmented areas, the Plan should initiate a system for restoration, however long-range and incremental. Criteria for Secondary Resource Areas would identify areas with localized valuable habitat, with good potential for restoration, with particular importance to the system if restored, etc.

The Criteria for Significant Problems fail to define these problems within the context of an integrated, functional watershed system. The long-range goal of protecting resources
12 and achieving a stable system requires drawing a distinction, in the case of flooding, between excess flooding due to alterations to the watershed and baseline seasonal flooding associated with the system's natural floodplains.

The Criteria for Significant Problems in relation to threats to Resource Areas also need further definition. It should be
13 clear that threats to fish and wildlife passage to and from an

Area, as well as many activities upstream from an Area, also must be considered as threats to the Resource Area.

The Criteria for Flow Reduction Solutions should include frequency and duration as well as magnitude, in order to adequately address resource protection as well as flood protection. The conclusion that "some increase in flow rate" is consistent with maintaining "fair" conditions for aquatic habitat
14 is unfounded. The Plan can't make such a conclusion without also setting out the standards on which it is based. Here and in the sections covering both the entire Basin and the various Sub-Basins, the Plan discusses "improvements" without providing any evidence that these really protect environment and habitat as opposed to just lowering peak flows.

Instead of Flow Reduction, the Plan should address Flow Maintenance, meaning that it would address both excessive peak flows and unnatural low flows. The Conditions Report did not
15 appear to cover species such as steelhead and cutthroat whose life stages are critically related to low flow conditions (intermittent flows, resulting loss of habitat, low dissolved oxygen, high temperatures, and increased concentration of pollutants).

3. Coordination with Pending Plans and Codes

The Plan should acknowledge and incorporate all other applicable plans and statutes including SEPA, the Sensitive Areas Ordinance, Shorelines Management Act, the Growth Management Act, the Nonpoint Rule, Groundwater Protection Act, Magnuson Fish Conservation Act, Fish and Wildlife Protection Act, Clean Water Act, Endangered Species Act, and Water Resources Planning Act.
16

For example, the Plan fails to refer to the County/State wetland and stormwater research program which recommends baseline water quality and hydrologic studies and recommends against hydrologic variability that will impact wetland function. The latter would preclude use of wetlands for more than minimal storage of stormwater.

Also, the Plan does not adequately address its relationship to liability associated with the Superfund clean-up and Natural
17 Resource Damage Assessment processes underway in the Hylebos Waterway and Commencement Bay. Both the NRDA and the CERCLA processes require source controls for hazardous substances in order to prevent chronic impacts to marine life.

The EPA Stormwater NPDES permitting program will soon require limits on oil, grease, and other urban pollutants to surface waters. For this reason, the Basin Plan should include modeling of pollutant loading, calibrated to existing conditions in wetlands, groundwater, and surface water. This should be used
18 to describe current conditions and to predict water quality limitations on activities within the Basin. Examples of such a

process include the Gross Land Area Policy being developed by Pierce County and the Waste Load Allocation Study underway in the Puyallup Basin.

4. Basinwide Recommendations

19 These should include a recommendation for evaluating proposed development projects against existing conditions that are too costly or unfeasible to remedy (for example, those discussed in the Sub-Basin Recommendations Chapter, Pages 4-47, 48, and 49). Projects which exacerbate these conditions or reproduce them should not be permitted.

5. Sensitive Area Protection

20 The Recommendations for Buffers should also state the objectives which the various buffers are intended to accomplish. The Plan should also include recommendations for buffers to prevent soil compaction in aquifer recharge zones.

21 The prohibition on modification or relocation of Class 2 streams should also include Class 3 streams. Just because their function is intermittent doesn't mean it isn't crucial. The proposed conditions for permitted relocation or modification of Class 3 streams create an expensive, cumbersome, and probably not enforceable situation. If the state of the art for mitigation design doesn't assure adequate protection, then no relocation or modification should be allowed.

22 There should be some provision for prohibiting debris dumping and small-scale in-stream modifications by individuals.

23 The Recommendations relating to Impact Mitigation need to be further defined and to be weighted toward no impact as opposed to elaborate mitigation. Further definition is needed of why and when mitigation elsewhere than on the project site would be allowed. In addition to wetlands and streams, headwaters areas should be recognized for special protection. The Plan should recommend Critical Areas designation under the Growth Management Act.

6. Management of Nonpoint Sources of Water Pollution

24 The level of protection needed in this planning area requires more than the BMP programs that are proposed. In addition to recommending implementation of BMP for commercial and industrial land uses, the Plan needs to address further requirements which will be needed in order to comply with the pending Stormwater NPDES program and needs to conduct an analysis of the feasibility of meeting and maintaining water quality standards.

25 The Plan should also address removal of litter from public and private property. Litter can be a significant source of pollution if it accumulates and is flushed into the surface water

system.

7. Code Compliance

26 Stopping work until code violations are corrected should be included in the recommendations for penalties.

8. Tax Incentives

This section should be redesignated as Tax Code Revisions or some similar designation in order to get away from the connotation of the "tax break". Although recommendations in this arena are necessary, they need to be designed carefully so as not
27 to make resource protection appear too expensive for the tax base to handle. Revisions should, for example, include a determination of the value to the landowner of taking conservation measures - such as reduced risk of flooding, lower maintenance costs, reduced tax liability for future CIPs.

In addition to pursuing conservation easements, the Plan might also pursue "conservation liens" and recommend that
28 properties which escaped installation of necessary protective measures at the time of initial development be retrofitted to some extent at the time of sale.

9. Capital Improvements/S 373rd ST Channel Maintenance

Since usable habitat is planned for upstream, plans for
29 dredging must specify how it will be done so as not to interfere with passage to and from that habitat.

10. North Lower Puget Sound Sub-Basin/Reduced Onsite Detention

30 Direct discharge to Puget Sound cannot be described as an acceptable alternative.

11. Central Lower Puget Sound

The recommendations, or lack of them, in this section illustrate a recurring fallacy in this Basin Plan: that flushing discharge into Puget Sound is an "acceptable alternative" after "appropriate treatment". What treatment? Where? When? For how long? In addition, the Plan cannot simply dismiss the need to manage water quantity by writing-off stream channels that have
31 already been severely impacted and are surrounded by build-out. For example, the landslides on Redondo Way during the 1990-91 rainy season tend to confirm that "uncontrolled upland drainage" (Conditions Report, Page 4-31) needs to be controlled, not just flushed away. In this respect, the Plan also fails to address the effects of reduced groundwater recharge on stream flows and wetland functions.

12. Overall

The Plan's recommendations for channel stabilization need to

be pursued, but their success is highly problematic on the scale and under the conditions of this planning area. They can in no way be treated as alternatives to source controls.

The Plan writes-off streams which the Conditions Report describes as having been collectively significant and glosses over the problem of how other streams will accommodate long-term increased flows. In many respects, the Plan throws up its hands at problems while professing to improve conditions and protect resources.

The Tribe opposes instream retention/detention/sedimentation facilities and the use of natural surface waterways as conduits for run-off from urban development. The modifications and
32 maintenance associated with these and the impacts on water quality and stream flow cause adverse effects to fishery resources as a result of lost and damaged habitat, increased predation on juvenile fish, and interference with fish life cycles.

By discarding those CIP's and source controls that it labels as "too costly", the Plan ends up masking the true cost of the damage that has been done. This approach also appears to preempt the policymaking prerogative of the King County Council by dismissing rather than presenting alternatives. The various "excessive" costs and "unfeasible" measures identified in the Plan should be compiled and used as a standard against which to evaluate the true cost of alternatives which would obviate the necessity of such costly retrofits in the future.

Thank you for your attention to these comments. Please direct any questions to me at the above address.

Sincerely,

Genevieve

Genevieve Pisarski
Watershed Management Specialist

C: Stanley Moses
Chair, Fisheries Committee
Will Sandoval
Director, Fisheries Department
Don Finney
Morgan Bradley

CITY OF FEDERAL WAY
33530 1ST WAY SOUTH • FEDERAL WAY, WASHINGTON 98003

RECEIVED
APR 16 1991
KING COUNTY
SURFACE WATER MANAGEMENT DIVISION

Roz
Jim
Dave
Joanna

RECEIVED
APR 15 1991
KING COUNTY
PUBLIC WORKS DIRECTOR

Paul Tanaka, Director
King County Building and Land Development Division
3600 136th Place Southeast
Bellevue, WA 98006
ATTN: SEPA Center

April 11, 1991

RE: DRAFT HYLEBOS CREEK AND LOWER PUGET SOUND BASIN PLAN DETERMINATION OF NON-SIGNIFICANCE

Dear Mr. Tanaka:

Thank you for the opportunity to review and comment on the above referenced determination of non-significance. We have been working closely with Roz Glasser and the King County Surface Water Management Division on this project since our incorporation.

Overall, the draft plan provides an excellent technical analysis of conditions and opportunities within these sensitive drainage basins. In addition, the plan provides a comprehensive menu of recommended policies and implementation strategies for the City to consider in preparing our comprehensive surface water management plan.

For purposes of transmitting the draft plan to participating cities for consideration, we concur that the non-project phased SEPA analysis provided in the environmental checklist and the determination of non-significance is adequate. Information contained in this environmental checklist and the draft plan will be carefully considered as we undertake preparation of the City's comprehensive surface water management plan.

Policies and recommendations contained in the draft basin plan will be evaluated for consistency with the City's existing policy and regulatory framework, and the philosophy and strategy for surface water management within the City. In addition to a policy framework, the City's plan will contain: recommended construction design standards; a financing/funding strategy; a five year capital improvement plan; and, a maintenance and administrative element. Subsequent phased SEPA review will be conducted by the City, using information contained in the County's determination of non-significance, prior to adoption of a comprehensive surface water management plan.

Again, thank you for the opportunity to comment on this environmental determination. If you have any questions, please give me a call at 661-4108.

Sincerely,

Greg Fewins
Senior Planner

c: Ken Nyberg, Assistant City Manager/Director of Community Development
Philip Keightley, Public Works Director
Cary Roe, Surface Water Manager
Roz Glasser, King County Surface Water Management Division

d4:basinpln.wp

ADMINISTRATION
1000 Laurel Street
Milton, Washington 98354
Telephone (206) 922-8733

April 12, 1991

Ms. Roz Glasser
King County SWM Division
710 Second Ave, Room 730
Seattle, WA 98404

Dear Roz:

The City of Milton has reviewed the Draft Hylebos Creek and Lower Puget Sound Basin Plans dated February, 1991. We find the document to be comprehensive and accurate in detail to our knowledge.

We believe implementation of the recommended capital improvement projects will not only improve habitat, but will also significantly reduce the storm water flows from King County that currently cause flooding within the City of Milton.

34 Our only concern is the uncertainty of the cost to the City of Milton for the project number 2447 and 2448, which are indicated as participation projects with King County. I understand this will be addressed in a subsequent phase.

I congratulate you, your staff and the Citizen Advising Committee on producing this fine document.

Sincerely,
CITY OF MILTON

Leonard E. Sanderson,
Mayor

cc: "out"

vdb

Seattle
Solid Waste Utility
Division of Seattle Engineering Department

Gary Zarker, Director of Engineering
Diana Gale, Director, Solid Waste Utility

April 12, 1991

Roz Glasser, Project Manager
King County SWM Division
710 Second Avenue, Room 730
Seattle, Washington 98104

RE: Draft Hylebos Creek and Lower Puget Sound Basin Plan.

Dear Ms. Glasser:

We have reviewed the report referenced above and have several comments. First, I would like to compliment you on the thoroughness of the report and excellent graphics. It is clear that a great deal of effort has gone into this project.

Our specific comments are listed below:

35 Page 4-33, 1st paragraph ("Further Studies"). It is not clear in this paragraph whether you are discussing the confluence of the discharge from the Midway Landfill detention pond with tributary 0382, or the confluence of tributaries 0381 and 0382. If the latter, please note that the discharge point from the Midway Landfill surface water detention pond is located approximately 300 feet east of the intersection of S. 250th Street and 16th Avenue S., which is about 1,200 feet upstream of the confluence of tributaries 0381 and 0382.

36 Page 4-33, 2nd paragraph. One of the recommendations of this report is that the City of Seattle and Washington State Parks Department should evaluate the performance of the Midway detention pond using continuous hydrologic modeling.

First, you should understand the constraints established for the design and operation of this detention pond. In order to obtain a permit from the Washington Department of Fisheries for discharge from the pond, we had to meet their requirements. Since the landfill and surrounding area tributary to it were not part of the McSorley Creek watershed, Fisheries would not allow an increase in stream flows at the point of our discharge for 2-year, 25-year, and 100-year storms based on existing conditions.

Consequently, our consultants conducted a study of stream flows in tributary 0382. They also identified a 38-acre area that was tributary to McSorley Creek (a portion of Highway 99 and adjacent

property, designated as "Subbasin D" in the resulting report) that could be routed into the detention pond. The pond was then designed so that the rate of flow from the pond would not exceed the uncontrolled rate of flow from Subbasin D which was historically tributary to the creek. This was obviously not an easy task and resulted in the large capacity of the pond. As you have recognized, it also requires significant storage even during high frequency storms. This is what was required of us by the regulatory agencies; it was included in the design report for the project and has been constructed according to these requirements. The design report is referenced in the consent decree entered into with the Department of Ecology and filed with the King County Superior Court. As a result, this mandated requirement is legally binding.

The model used for this study was HYDRA, version 3.59. While this is an event based hydrologic model rather than a continuous hydrologic model, it does provide a reasonably accurate picture of flow conditions in the creek. For more information, please see the Midway Landfill Surface Water Management Plan (June 1987).

36 (cont.) The City of Seattle does not believe that additional modeling is necessary at this time. However, we do concur that the pond should be monitored for performance and operation once normal operations begin. As a result, we plan to install a recording flow level recorder to monitor rates of discharge from the pond. In addition, we also hope to install a recording rain gauge so that flows can be better correlated with storm events.

Discussions with your office indicate that your main concern is that the capacity of the pond is "used up" by smaller storms and thus is not available during larger storm events. Apparently, modeling conducted by the County shows that the pond fills up due to the relatively low rate of discharge during the smaller storm events. Thus, when larger storms occur, the pond rapidly fills and discharges at the 25 or 100-year flow rates at a time when using that capacity and a lower flow rate could possibly help mitigate downstream flooding.

If performance monitoring does in fact indicate that the flow control structure for the pond could be restructured to allow a higher rate of discharge during smaller storms, the City would be willing to work with the County to implement this change, provided that King County could get the agreement of the Departments of Fisheries and Ecology.

37 Page 5-7, Figure 5.1.3. This figure shows that for the purposes of forecasting future flows in the watershed, the Midway Landfill site was labeled as "Commercial/Impervious." This land use classification would result in substantially higher runoff values for the site than would actually occur. The drainage characteristics of the cover system presently being constructed on the site (a clay/HDPE liner covered with one foot of sand, one foot of topsoil, and planted with grass), would be closer to that identified for the existing (1987) condition; that is "Rural/Undeveloped Land." Given the fact that the cover system is designed to maximize total surface water drainage (not rate of flow) from the site, it might be more accurate to use a classification of "Medium/Low Density Single Family" in your modeling. However, the landfill cover system does not behave like 55 acres of impervious surface.

We have appreciated the opportunity to meet with you and to comment on this report at its various stages. Please call me at 684-7687 if you have any questions.

Yours very truly,

Lin Robinson

Lin Robinson, M.S,
Midway Program Manager

LAR/

cc: Harris Martin, Seattle Solid Waste Utility
Cathy Orsi, Seattle Solid Waste Utility
Rick Hermes, Parametrix
Midway Files

JAN TVETEN
Director

STATE OF WASHINGTON

WASHINGTON STATE PARKS AND RECREATION COMMISSION

7150 Cleanwater Lane, KY-11 • Olympia, Washington 98504-5711 • (206) 753-5755

April 12, 1991

Re: 35-965-65 Draft Hylebos Creek and Lower Puget Sound Basin Plan - West Hylebos, Dash Point, and Saltwater State Parks

Roz Glasser, Project Manager
King County Surface Water Management Division
730 Dexter Horton Building
710 2nd Ave
Seattle WA 98104

Dear Ms. Glasser:

The staff of the Washington State Parks and Recreation Commission has reviewed the above noted plan and wishes to make the following comments.

The draft plan is very comprehensive, showing a thorough evaluation of conditions and recommendations within the Hylebos Creek and Lower Puget Sound Basins. We concur with the significant problem locations and recommended capital improvement projects which have been identified for the Hylebos wetlands and lower McSorley Creek. The plan, if implemented would greatly protect and enhance the natural values of West Hylebos State Park and Saltwater State Park. However, we are concerned about increased flooding impacts in Dash Point State Park, which is in the basin but was not addressed.

The following are some concerns and suggestions which may be of help in preparing the final plan.

Specific Comments:

38 1. The plan does not address issues related to tributaries 0391A and 0392B which flow through Dash Point State Park. Flooding within the park has escalated in recent years with increased urbanization in the basin. The November 1990 flooding caused severe damage within the park as well as damage to residential property outside the park. We are concerned that flooding problems will increase in the future if proper measures are not taken to reduce flows. These tributaries meet the requirements for Category A of Significant Problems as defined in the plan. The final plan should address problems and solutions for tributaries 0391A and 0392B.

39 2. Project 3321, Midway Landfill detention pond retrofit study should also include representatives from King County and WDOE in the evaluation process. Representatives from those organizations have participated in past Midway Landfill detention pond flood related activities and would be an integral part of a retrofit study.

40 3. Project 3322, Lower McSorley Creek Sediment Control and Habitat Improvements is currently being requested for legislative funding by State Parks. The project, as proposed by State Parks, is based on an independent consultant's recommendation to replace all five drainage structures within the park, and conduct fisheries enhancement in the creek. It is not certain at this point if funding will be approved, so it would be beneficial if the project is kept in the plan; however, if funding is approved we will notify you.

41 Additionally, our consultant assessed exiting and future flows within McSorley Creek. The basin plan shows the peak flows with current conditions for a 100 yr event at 199 cfs in McSorley Creek. This is much lower than those presented by our consultant. Our study found peak flows in McSorley Creek to be 367.8 cfs with existing conditions during a 100 yr/24 hr event, 419 cfs for existing conditions during a 100 yr/24 hr event with the Midway Landfill pond releasing at an undetained peak flow, and 462.9 cfs for a projected future condition during a 100 yr/24 hr event with the Midway Landfill pond releasing at an undetained peak flow. Consequently, we are designing the park's drainage structures to be sized to handle these flows. If you would like to review our study please contact me.

42 4. Figure 5.1.2 shows future land use of the basin as extremely more developed than it is today. This greatly concerns us about the future of all three state parks in the basin. We recommend the county and local jurisdictions be responsive to drainage needs and ensure developed areas to comply with strict drainage regulations. If this is not performed then all three state parks will be greatly degraded, losing their ecological, social, and economical value to the region.

43 5. Project 2451 is shown in the wrong location on figure 2.3.2. It is shown on SW 336th St and should be shown on SW 356th St.

44 6. The project description in Table 2.3.2 for Project 3322, "Place instream habitat structures" was shown in the preliminary draft plan and deleted from draft plan. It should be replaced in the final.

Overall, we were impressed with the draft plan. The information presented will be useful in future protection of West Hylebos and Saltwater State Parks. If implemented, the plan will reduce many of the concerns we have had for proper management of all three of our State Parks in the basin, provided the plan addresses the issues and solutions surrounding Dash Point State Park. We appreciate the opportunity to provide these comments and look forward to continue working with your staff during the preparation of the basin plan.

If you have any questions or concerns regarding these comments please call me at 753-5769.

Sincerely,

Mike Ramsey, Asst. Chief,
Environmental Coordination

cc: David W. Heiser, E.P., Chief, Environmental Coordination
Kris Kauffman, P.E., Chief, Engineering and Construction
Bill Phillips, P.E., Asst. Chief, Engineering and Construction
Randy Person, Asst. Chief, Site Planning and Acquisition
Don Simmons, Region 5 Supervisor
Bruce Bartling, Park Manager, Saltwater State Park
Bob Togstad, Park Manager, Dash Point State Park

King County
Offfice of Open Space
Parks, Planning, and
Resources Department
1621 Smith Tower
506 Second Avenue
Seattle, Washington 98104
(206) 296-7800

April 12, 1991

To: Roz Glasser, Division of Surface Water Management

Fr: David Tiemann, Open Space Planner

Re: Draft Hylebos Creek and Lower Puget Sound Basin Plan

There are two recommendations in the Draft Hylebos/Lower Puget Sound Basin plan that directly impact the Office of Open Space.

Recommendation BW-39: Current Use Taxation.

45 This recommendation proposes that lands in stream and wetland buffers within RSRAs and LSRAs be eligible for Current Use Taxation. This proposal would require amending the King County's existing Current Use Taxation Ordinance, but is an eligible current use taxation category under state enabling legislation. To the extent that there would be open space public benefits associated with this type of current use taxation, the Parks Division, through the Office of Open Space, would most likely be asked to review the application. Depending on the amount of applications received, this could require significant additional staff resources.

Recommendation BW 41: Conservation Easements and Land Trusts

46 This recommendation notes that the King County Open Space Program is a caretaker agency for conservation easements. In fact, the Office of Open Space, a section of the Parks Division, is authorized only to acquire, not hold properties funded through 1989 Open Space Bond Act. The Parks Division is, however, a caretaker agency. Further discussion with Parks is necessary to determine any cases where it would be an appropriate caretaker agency for this purpose.

cc: Lois Schwennesen, Director, Parks, Planning & Resources
ATTN: Barbara Wright, Manager, Parks Division
Jim Geenfield, Administrator Designee, Open Space

Pierce County
Department of Planning and Land Services
2401 South 35th Street
Tacoma, Washington 98409-7460
(206) 591-7200 • FAX (206) 591-3131

DEBORA A. HYDE
Director

April 12, 1991

Ms. Roz Glasser
King County SWM Division
710 Second Ave., Room 730
Seattle, WA 98104

RE: Hylebos Creek and Lower Puget Sound Basin Plan

Dear Ms. Glasser:

I would like to begin by stating that I think that your staff and Committee have produced an extremely comprehensive and well thought out plan.

My comments are on organization and clarity rather than content.

47 1) It would be helpful if the affected entities for each category of recommendations were cited. This would include a listing of organizations that may be asked, or have already agreed, to aid in implementation. For example, the Conservation District may be involved in implementing the recommendation to fence livestock from streams, either by providing information or administering programs. Entities that provide funding sources for these types of organizations need to know if there will be an increase in the demand for their services. Agencies that will be given responsibility for enforcement should also be specified.

48 2) The discussions of recommendations should precede the affected entities explanations. The discussions emphasize the importance and purpose of implementing the recommendations. The logical progression would be to assign these tasks to the different entities after their importance has been established.

Thank you for the opportunity to comment on the plan.

Sincerely,

BARBARA ANN BAKER
Assistant Planner

cc: Sue Comis, Principal Planner

KING COUNTY CONSERVATION DISTRICT

935 Powell Ave. S.W. • Renton, WA 98055
Phone (206) 226-4867

April 15, 1991

Roy Glasser, Project Manager
Hylebos Creek Basin Plan
King County Surface Water Management
710 Second Ave., Rm. 730
Seattle, WA. 98104

Dear Mr. Glasser:

We have reviewed your draft of the Hylebos Creek and Lower Puget Sound Basin Plan. The Conservation District has done some work in these basins with farmers both large and small as well as construction erosion control work. The areas included in yourstudy do not have a large quantity of agriculture type activity, but there are some hobby farms now. The Conservation District has a hobby farm specialist who works with landowners to provide planning assistance that will provide better pastures and also improve water quality. Our existing project for small farms is small so we have of necessity prioritized the county into high priority areas to target for outreach projects. The subject area is not in our highest priority areas, but we will work with owners who seek our assistance.

49

Because the subject areas are highly developed, water quality improvement is extremely important to Puget Sound and to the lower reaches of accessible fish bearing streams. All work done in the areas has to put water quality improvement on an equal level with flood mitigation measures, which can often be done simultaneously.

If there are any special areas where we can be of further assistance, give me a call.

Sincerely,

Jack Davis

Jack Davis
District Manager

CONSERVATION • DEVELOPMENT • SELF-GOVERNMENT

Washington State
Department of Transportation
District 1
15325 S.E. 30th Place
Bellevue, Washington 98007-6538
(206) 562-4000

Duane Berentson
Secretary of Transportation

April 18, 1991

Ms. Roz Glasser
King County SWM Division
710 Second Avenue, Room 730
Seattle, WA 98104

Hylebos and Lower Puget
Sound Basin Plan Comments

Dear Ms. Glasser:

We have reviewed the Hylebos Creek and Lower Puget Sound Basin Plan Draft. The following concerns were noted in our January 25, 1991, response on the preliminary draft, and we feel that comment is still warranted:

Page 3-10, BW-7 Stream Crossings

50 BW-7 still discourages the use of culverts and disallows all but arch culverts. Fill heights are limited for arch culverts, and they provide less allowance for channel degradation. We feel that the blanket prescription proposed for stream crossings under BW 7 does not address the variation in site conditions. Culvert design parameters are being included in the Stormwater Management Manual for the Puget Sound Basin. Consistency between the plans would be desirable.

Page 3-14, BW-8 Clearing

51 BW-8 still mentions a permit requirement for grading activities in excess of 100 cubic yards. This limit appears excessively low particularly if applied without some consideration of area involved.

Page 3-14, BW-9 Seasonal Clearing

52 BW-9 imposes rigid time and activity requirements. This would be better as a performance specification.

Page 3-35, BW-20 Ditch Cleaning

53 BW-20 recommends a ditch cleaning regime that WSDOT has neither the staff nor equipment to provide. We still feel that the "Ditch Master" is poorly suited for this area and that a performance requirement is more appropriate, i.e. smooth cut ditches with a minimum of loose or disturbed materials remaining in ditches.

The following items are in addition to those we commented on in the preliminary draft.

54 A common map base featuring aerial photographic centers is recommended to facilitate management and field mapping.

Page 3-34, BW-18 Highway Runoff Control

55 The Department of Ecology (Ecology) is in the process of adopting WAC 173-270 Puget Sound Water Quality Runoff Program to comply with the Puget Sound Water Quality Authority (PSWQA) 1991 Puget Sound Water Quality Management Plan. The Washington State Department of Transportation (WSDOT) will adopt and implement a highway runoff program complying with that rule and the management plan.

The Hylebos plan should be consistent with the regulations for the entire Puget Sound basin. It should also recognize the implementation time-tables for the entire Puget Sound basin plan.

Page 3-25, BW-16 Basin Revegetation "Desired vegetation should reflect climax states in sizes and species distribution."

56 The 150 to 300 year requirement for climax size Douglas Fir and Western Red Cedar may exceed the life of the plan. Channel hardening projects should be incorporated in the steeper areas to provide the stabilization required for climax conditions to develop.

57 The proposal to revegetate the basin conflicts with land development and ownership goals. Purchase of sites with highly permeable soils for green belts, parks, recharge basins, and channel hardening sites could be considered.

Page 3-34, BW-19 "Collection and Disposal of Residuals..... Kent ..... Auburn decant station."

58 Timely disposal of liquids collected during cleaning of catch basins will require convenient access to decant facilities. Provisions should be discussed for decanting off collected liquids from solids in those locations where decant stations are not economically accessible.

Page 3-42, BW-29 Short Term Highway Runoff Monitoring: Each type of best management practice (BMP) will be monitored to quantify its effectiveness; and determine if modifications are needed.

59 Pollutant concentrations in highway runoff vary from storm to storm. It is more effective to "monitor upstream and downstream of BMPs" than to monitor "before and after BMP implementation" as requested in the draft plan.

60 Page 4-4, Plate 4.02 depicts a mature mixed species forest stand without the urbanization typical of the Hylebos basin.

Page 4-10, WH-2 Coalescent plate oil/water separators.

61 These are efficient in situations with relatively large amounts of oil and small amounts of water. They are not cost effective in situations with relatively small amounts of oil and large amounts of water. Manufacturer's data indicates oil/grease concentrations in coalescent plate effluent are typically higher than concentrations in untreated highway runoff. To say whether or not they would be effective in removing oil from SeaTac Mall runoff, or truck wash water, would require testing.

Thank you for the opportunity of participating in the plan development.

Sincerely,

R.D. AYE, P.E.
Development Engineer

RDA:cj

Federal Way Water & Sewer

P.O. Box 4249 • 31627 - 1st Avenue South • Federal Way, Washington 98063
Seattle: 941-1516 • Tacoma: 927-2922 • Engineering: 941-2288 • Fax: 839-9310

April 12, 1991

Roz Glasser
King County SWM Division
710 Second Avenue, Room 730
Seattle, Washington 98104

Subject: Hylebos Creek and Lower Puget Sound Basin Plan

Dear Ms. Glasser:

In general, we believe the Hylebos Creek and Lower Puget Sound Basin Plan is a positive step forward to improve the stormwater management in the area. The surface water management (SWM) group has made a solid effort to include the concerns of the District. I have divided my comments, and sometimes questions, into general and specific categories in the contents of the document.

General:

62 1. Water quality is our major concern and is mentioned throughout the document, but the methods for cleanup and potential impacts should be better explained and emphasized.

63 2. Potential future Federal stormwater permitting requirements are not discussed. Should they be?

64 3. What internal controls within the King County development approval process will SWM have to assure that the program will be implemented. This is not discussed under Basin Plan Recommendations.

65 4. The plan does not discuss fully the potential of stormwater as a resource and combining for win-win projects with parks, water recharge and stormwater control for certain areas of the basins.

66 5. More emphasis should be placed on the use of berms and swales for quality control and groundwater recharge. This could be incorporated into the zoning control and development of site sections of the report.

Specific:

67 1. Page 2-11, Par. 6 - What structures (houses?) are you referring to? Also, we have stocked the Lakota Creek with salmon and made the lower reaches a salmon spawning stream.

Donald L.P. Miller
Commissioner

Leonard A. Thompson
Commissioner

Beverly J. Tweddle
Commissioner

68 2. Page 2-13, Par. 1 - Again, what about groundwater as a resource and the protection of groundwater as additional objectives?

69 3. Pages 2-21/22, Items 8B,9B,15B - We highly support erosion control on Lakota Creek because of its potential problems concerning the salmon spawning reaches downstream and our sedimentation basin.

70 4. Page 2-27, Items 27,28,29 - We need to discuss how these costs were developed for relocation of the sewer line. Any planned project should take into account how this cost would be reduced in the community interest.

71 5. Page 3-1, Par. 1 & 2 - We support these statements.

72 6. Page 3-10, BW-7 - Even though the environmental issues are utmost, consideration needs to be given for pipeline crossings under the right conditions that cannot practically be made in other locations and in the overall public interest. (1-a-2) We agree with the use of bottomless pipe arches for stream channels. (1-b-1) To jack and bore under streams is very expensive and should be only used as a last resort. (3) We agree that existing stream crossings should be evaluated but do not agree with the use of all BW-7 as stated above.

73 7. Page 3-25, Par. 1 - Agree with statement.

74 8. Page 3-30, Par. 1 - Does leaking sanitary sewage facilities mean septic tanks?

75 9. Page 3-42, BW-30 - These are the type of programs the District is interested in doing even though there has been no indication of a District-wide problem. When a problem does become known to us, we correct it. So far we have had greater problems with leakage into our pipes, not out. We have not seen information that indicates sewer line leakage as a major problem.

76 10. Page 3-51 - Coordination with other agencies is not mentioned.

77 11. Page 4-46/47/48 - Same as Specific item numbers 4 and 5.

78 12. Page 5-33, Par. 4 - We have no indication of sewer line leaks but, conversely, have problems with water leaking in, not out of pipelines.

79 13. Page 5-39 - The Lakota Creek habitat improvements and stream stocking program is something positive on how things can be improved in the area.

Thank you for allowing us to comment on this report.

Sincerely,

S. Wieneke

Steve Wieneke
Director of Engineering

STW/krb

COMMENTARY ON
DRAFT HYLEBOS CREEK and
LOWER PUGET SOUND BASIN PLAN
February 1991

by:
Fay Conroy
22 March 19

The Department of Ecology (Ecology) is in the process of adopting WAC 173-270 *Puget Sound Highway Runoff Program* to comply with the Puget Sound Water Quality Authority (PSWQA) *1991 Puget Sound Water Quality Management Plan*. The Washington State Department of Transportation (WSDOT) will adopt and implement a highway runoff program complying with that rule and the management plan.

80 The Hylebos Plan should not include details that may conflict with the regulation for the entire Puget Sound basin. Local plans should recognize that scheduling priorities must be set for the entire Puget Sound basin; and not assume that their priorities will control the implementation time-table.

81 <u>page 3-35, BW-20 Maintenance of Roadside Ditches, item 2</u>: Pollutants in runoff directed through grassed swales will be absorbed by, or adsorbed on, the vegetation. Composting and recycling vegetation harvested from these swales will re-release the pollutants. Harvested vegetation should be analysed and legally disposed of so that entrapped pollutants are permanently removed from the environment.

<u>page 3-42, BW-29 Short Term Highway Runoff Monitoring</u>: Each type of best management practice (BMP) will be monitored to quantify its effectiveness; and determine if modifications are needed.

82 Pollutant concentrations in highway runoff vary from storm to storm. It is more effective to "monitor upstream and downstream of BMPs" than to monitor "before and after BMP implementation" as requested in the draft plan.

83 <u>page 4-10</u>: Coalescent plate oil/water separators are efficient in situations with relatively large amounts of oil and small amounts

of water. They are not cost effective in situations with relatively small amounts of oil and large amounts of water.

Manufacturer's data indicates oil/grease concentrations in coalescent plate effluent are typically higher than concentrations in untreated highway runoff. To say whether or not they would be effective removing oil from SeaTac Mall runoff, or truck wash water, would require testing.

Hylebos

Puyallup Tribe of Indians

May 8, 1991

Roz Glasser
King County SWM Division
710 Second Ave., Room 730
Seattle, WA 98104

RE: Hylebos Creek and Lower Puget Sound Basin Plan

Dear Ms. Glasser:

Thank you for the opportunity to comment on the basin plan. The Puyallup Tribe would like to compliment you and your staff on a fine document. The overall report is thorough, well organized and provides excellent graphic orientation.

The Puyallup Tribe Fisheries Division views the plan as a positive step toward improving the hydrology and water quality within the basin. From a fisheries resource protection and enhancement standpoint, the recommendations outlined in chapter 3 will go a long way toward reestablishing a healthy stream environment.

Specific comments and concerns of the Puyallup Tribe are identified below.

84 Page 1-5: Code enforcement and Penalties as they apply to BW-8, BW-9 and BW-10 is essential to a healthy stream environment. Significant damage to a drainage often occurs during construction phase. Developers and contractors need to realize the impact of their actions and understand that repeat violations will not be tolerated.

85 Page 3-32, BW-17 #2: A brief section discussing the impact of surface mining operations within the plan area and upon respective drainage basins would be appropriate here. We realize the bulk of these operations are located within Pierce county, nevertheless their impacts to Hylebos Creek are significant. A review of erosion and sedimentation BMPs for this specific land use needs to be addressed. One possibility for operation BMPs would include a wet season moratorium from say October 1st through March 31st. Also, details for site reclamation and mitigation would prevent the prolonged erosion and sediment input observed during idle periods and/or following closure.

86 Page 3-34, BW-18 #2: Current Interstate 5 HOV lane construction will result in increased runoff. Where will this additional flow be directed? We are all well versed in the problems resulting from the overwhelmed channel capacity in the East Fork from the original I-5 construction and drainage rerouting. We cannot afford to repeat this mistake and duplicate this situation in an alternative reach or exacerbate current conditions.

2002 East 28th Street • Tacoma, Washington 98404 • 206/597-6200

87 Page 3-35, BW-20: The Tribe whole-heartedly endorses these recommendations and related discussion on page 3-37. This practice will complement the use and benefits of bioswale filtration on water quality and ground water recharge.

88 Page 3-41, BW-26: Monitoring programs should be activated prior to implementation of major basin wide and sub-basin recommendations. Routine sampling taken at established stations would provide a baseline standard to compare over time and provide a tool for measuring the effectiveness of sub-basin specific improvement projects. Without an established means of quantifying current conditions, future evaluations are subjective and speculative.

89 Page 4-13, CIP 2441: Dredging the channel at this point protects the bridge but does not address the stream channel north of 373rd within the Mace property. Current channel morphology inhibits both adult and juvenile fish migration within this corridor. The braided configuration which has formed from gravel deposition during high flows has been observed to strand outmigrating fry, impede adult passage and enhance bird predation. Efforts are needed to consolidate the stream into a single channel. It is possible that completion of CIPs 2433 and 2435, 36 and 37 will negate long term maintenance of this reach. However, an interim solution is crucial to fisheries survival.

Flooding

90 Page 5-24: Cumulative impacts of highway construction is not discussed. The ballast requirements in the construction of large roads can have dramatic influence on the natural drainage within an area. Such structures can, in the case of Interstate 5, create a dam, altering the established hydrology.

91 During periods of heavy rain, flooding is especially pronounced east of 70th Avenue East in tributary 0006, identified as problem location number 1. The extent of recent development within the Hylebos basin has brought to our attention a major change in the drainage pattern which has until recently gone unnoticed. Groundwater seepage and wetlands detention once extended out across the valley floor and is now constricted by the freeway which magnifies the problem of increased runoff.

The Tribe appreciated the opportunity to work with King County and discuss plan issues throughout the development of this document. Please call me at 593-0254 if you have any questions.

Sincerely,

Russ Ladley
Biologist

SUNFIRE PROJECT
Environmental Education
&
Regulatory Enforcement

1610 Main St.
Milton, WA 98354

Derek Sherrod
(206) 926-0234

05/24/91

Roz Glasser
King County SWM Div.
710 Second Ave., Rm 730
Seattle, WA 98104

Roz:

Its been a while since we talked and I do realize that I am late for the comment period, but I feel I have a situation that never the less should be addressed.

As you may know, I have for the last eight years now been studying the East Hylebos and the life it supports in written and photo form and I feel that I know the East Hylebos pretty well...last year alone took nearly 2200 hours.

The concern is this; You are planning according to the latest Hylebos Basin Draft Project No. 2445 to stabalize the channel and address the migration of the knick-points of which there are three.

If you intend to remove the knickpoints or make themin such a way that migrating Salmon may bypass them let me caution you on this matter.

You must remember that the upper portion of the East Hylebos is a seasonal stream and is dry from late May to November.

By removing the lowermost knickpoint which is the blockage which prevents the salmon from proceding farther up stream you will surely encourage migration
92 and spawning but have sentenced the hatched fry to certain death as when the upper East dries up it does it very quickly, usually within two days.
The remaining pools may take another week to dry up which is where 20000 or more fry are stranded every year only to die from lack of water.

I suggest one of three solutions:
1. Place a barrier to prevent fish migration where the upper East and lower East maintain a yearly flow.
2. Have a fish rescue team to go in and move stranded fry to safety.
3. Place a barrier to prevent spawners from migrating too far upstream.

Thanks for your interest.

Sincerely
Derek C Sherrod

BARGHAUSEN CONSULTING ENGINEERS, INC.

"Land Planning, Survey, and Design Specialists"

April 11, 1991
FAXED 296-0192

Ms. Roz Glasser
King County
Surface Water Management
730 Dexter Horton Building
710 Second Avenue
Seattle, WA 98104

Re: Draft Hylebos Creek and Lower Puget Sound Basin Plan

Dear Roz:

In accordance with our field inspection today with Mr. Gino Lucchetti near the southerly-most tip of the portion of the Hylebos Creek which is covered in your study (at the King/Pierce County line), I am requesting one minor change to your proposed zoning designation map which substantially impacts a 24-acre parcel nearly ready for construction.

The 24-acre parcel in question is located entirely within Pierce County. The north boundary line of this property is the King/Pierce County line pursuant to the attached map. This project will include the construction of 224 townhouse/apartment units on approximately 24.7 acres (a density of 9.1 dwelling units per acre). This project has already received a Mitigated Declaration of Non-Significance which was finalized several months ago by Pierce County. The final building permit will be issued within the next several weeks.

In order that your proposed zoning map is consistent with this development, I am requesting a minor line shift for that portion of the plan covering Pierce County as noted. This line shift would be more consistent with actual field topography. If this preliminary line were not shifted, it would conflict with the existing development as it would be constructed.

I have already given Gino a copy of all of the engineering design plans, including grading and storm drainage (which will incorporate 100 percent retention of storm drainage on the site up to the 100-year storm), as well as a copy of the landscape/Hylebos buffer plan, which are currently being finalized through Pierce County.

It is our intent to limit human intrusion into the Hylebos Creek/wetland area to minimize disturbance to the Creek. This will be accomplished by retaining a 5-foot to 10-foot vertical buffer for the buildings, as well as an average 65-foot horizontal buffer. Dense vegetation will be planted within this 65-foot horizontal buffer along with a "hog fence" which will not be visible but will limit the intrusion of pets and humans into the Hylebos Creek area.

We are currently proposing to dedicate that portion of the property (approximately 10 to 12 acres) located south of the Hylebos Creek, and including some or all of the Hylebos wetlands, to the City of Milton. They would either leave the area undeveloped or develop a walking park through this portion of the site.

Home Office: 18215 72nd Avenue South • Kent Washington 98032 • (206) 251-6222 • Fax (206) 251-8782

California Office: 4612 Roseville Road, Suite #103 • North Highlands, California 95660 • (916) 348-3057 • Fax (916) 348-0953

93 Please revise your 1-unit/5-acre designation in accordance with the attached modified map. I believe that this map more closely follows the existing contours and will also be consistent with the proposed development which will be constructed on the site. As you can see from our plans and our site inspection, we are taking every possible measure to protect the Hylebos Creek by planting Evergreen and deciduous trees between the building and the Hylebos Creek and wetland areas. I believe this small modification to your plan will make the development consistent with the objective of your proposed study. If you have any further questions please contact me.

Respectfully,

Dana B. Mower, P.E.
Vice President

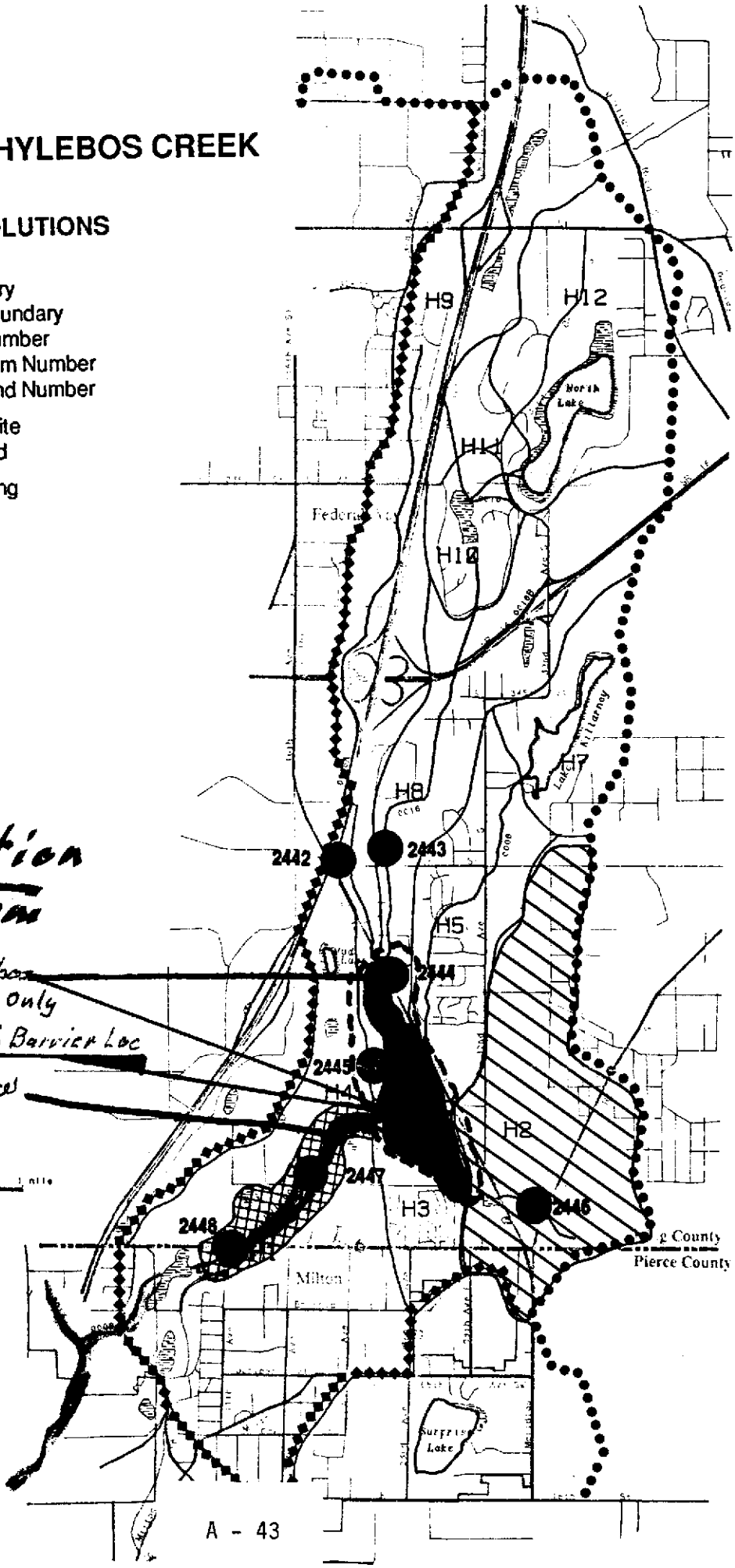
DBM/sg
C609.04
enc: As Noted
cc: Mr. Dick Butko
Mr. Gino Lucchetti, King County Surface Water Management
Mr. Tom Barghausen, Barghausen Consulting Engineers, Inc.

Figure 4.2.3

EAST BRANCH HYLEBOS CREEK SUB-BASIN

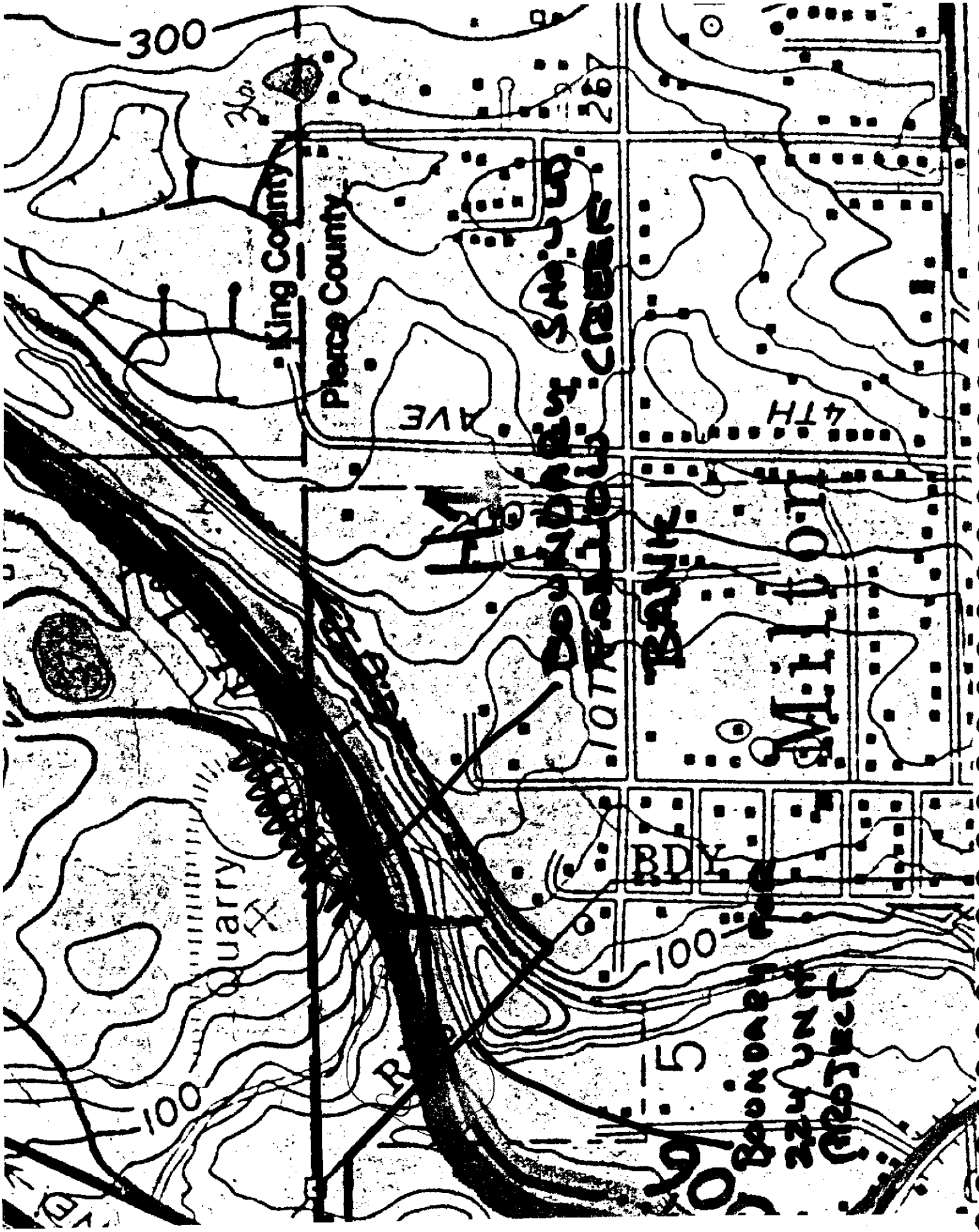
RECOMMENDED SOLUTIONS

- Basin Boundary
- Sub-Basin Boundary
- Sub-Catchment Boundary
- H9 Sub-Catchment Number
- 0015 Streams and Stream Number
- 2431 Project Location and Number
- Supplemental Onsite Detention Standard
- 1 Unit/5 Acre Zoning



The Solution
The Problem

Upper East Hylebos
Seasonal Flow Only
Recommended Fish Barrier Loc
Year around flow


300
King County
Pierce County
AVE
4TH
BDY
100
quarry
100

Responses to Public Comments

Pierce County Public Works Department

1. The area described is outside of the study area of the Basin Plan. The areas where the more strict detention standard, BW-3, is recommended were determined from detailed analysis of the hydrology in those areas. The King County SWM Division will support a more strict detention standard in the area in question if a detailed analysis determines that such a standard is warranted.

2. Comment noted.

Windus, Thomas, Calmes & Wiley

3. A Notice and Order was issued in 1987 to all three property owners alleging the draining of the wetland. When a Notice and Order is issued, it is referred to as a code enforcement action. Please refer to King County Code Title Number 23 for further information. The King County SWM Division continues to support the Plan language as written.

4. Please see Section 4.1 for revisions responding to your comment.

Twin Lakes Homeowners Association

5. Comment noted.

6. Cross-basin transfer of storm water is not an acceptable alternative due to the associated environmental impacts and high costs. The King County SWM Division continues to support the Plan Language as written.

7. Sub-basin recommendation, SL-1, applies supplemental on-site detention to areas upstream of Twin Lakes. Also, basinwide recommendations BW-8, BW-9, and BW-10, address soil and vegetation retention and steep slope protection.

It is recognized that silt deposition has been associated with upstream development. Its presence, however, is not equivalent in significance to the other basin problems that are addressed in the Plan. Please also refer to Section 2.4, which discusses the "Criteria for Significant Problems." Furthermore, removal of the silt without modifying the lake outlet configuration does not provide increased flood storage. The alternative, to reconfigure the outlet to lower water levels of the lakes, would require a significant amount of dredging at a substantial cost and impact to existing lakeside uses.

Washington State Department of Fisheries

8. On April 25,1991, Basin Planning Program staff members conducted a field investigation of the reach in question. It was determined that a temporary sediment trap would have unmitigatable adverse impacts on an existing wetland and riparian areas without commensurate downstream benefits. Furthermore, this stream reach currently has a high potential for enhancement of the aquatic habitat. Please refer to Project 2433 for a description of the enhancement. In the interim, the City of Federal Way also began to implement the Plan recommendation for Panther Lake. The project is planned to be implemented in 1993. The King County SWM Division continues to support the Plan language as written.

9. Recommendation BW-6, Livestock Access Control, responds to your concern about managing the access of farm animals to streams. This recommendation requires measures such as fencing of livestock from stream and wetland buffers with the provision for watering points. Strict regulation of animal densities is both difficult to determine and to effectively enforce due to individual site conditions. BW-17.5, BMP Programs for Control of Nonpoint Source Pollution from agricultural activities, will also help control water quality effects from these uses via individual farm management water quality plans developed through the Conservation District. These plans provide direction for pasture management, fencing, and animal densities. The King County SWM Division continues to support the Plan language as written.

Muckleshoot Indian Tribe

10. a) At a minimum, the Plan recommends a higher level of protection than has ever existed in the planning area. If implemented, these measures will be more stringent than any other requirements in the region. Unfortunately, the high level of existing development in the planning area precludes many restoration options for much of the system. Restoration is being pursued wherever possible and where natural ecosystem functions can reasonably be expected to recover. (Please also refer to response 32.)

    b) Please refer to Section 2.1 for revisions responding to your comment.

11. Fragmented and degraded habitats, including many streams and wetlands that are not specifically in a RSRA or LSRA, are unfortunately the rule rather than the exception within the planning area. Protection for these habitats is provided by a variety of basinwide recommendations ranging from buffer requirements and impact avoidance to storm flow attenuation. These recommendations are far more stringent than past standards and as such are not considered a "writing-off" of these habitats. Recommended criteria suggested for "Secondary Resource Areas" are similar to those for LSRA designation. As a result, the King County SWM Division continues to support the Plan language as written.

12. The Significant Problems list was developed based on a prioritization of problems, the criteria for which embody the spirit of the recommendation of the Muckleshoot Tribe. The prioritization of problems and subsequent solutions for the Plan recognized the distinction between natural versus human-exacerbated problems such as increased erosion and flooding due to upstream developments. By comparison, the Plan also views the sub-basins as integrated units. This is demonstrated, in part, by a ranking of solutions to address upstream problems first. A major concern of problem and solution identification was the protection of natural functions and processes in RSRAs and LSRAs. Where possible and where County jurisdiction prevailed, corridors for safe migration of anadromous fish into these areas were evaluated and were provided.

13. Please refer to response 12.

14. Please refer to Section 2.4, Plan Criteria, and Section 3.2, Control of Volume and Timing of Runoff From Developing Sites, for revisions responding to your comment.

15. Base flows in creeks are maintained by exfiltration from the groundwater and shallower saturated areas adjacent to the creek. Urbanization reduces recharge to groundwater because of impervious surfaces and soil compaction. This results in a reduction in base flow to creeks. The basinwide recommendation BW-21 (stormwater infiltration) and sub-basin recommendation WHL-25 (enhanced area-specific infiltration) address the problem of reduced base flow to some extent by promoting practices that recharge the groundwater table. Because it is not feasible to infiltrate all precipitation that formerly recharged the groundwater prior to development, reduction of base flows will generally accompany development wherever it occurs. Therefore, the King County SWM Division continues to support the Plan language as written.

16. The primary purpose of Section 2.5, "Coordination With Pending Plans and Codes," is to identify local documents that are currently being prepared in which Basin Plan recommendations could be incorporated as part of the adoption process. This practice is an efficient mechanism to implement the Plan recommendations and will minimize the need for separate time-consuming and duplicative approval processes. Therefore, this section is not intended to be inclusive of all existing federal, state, or local plans or regulations. Hence, no mention is made of these plans or statutes. These plans and statutes, however, were taken into consideration as part of the environmental analysis during Plan development, and they will be evaluated further during the implementation phase of each project. The King County Shoreline Master Program and other plans and codes are currently being updated to fulfill the requirements of the Growth Management Act. These amendments should therefore be included in the list. Please refer to Section 2.5 for these revisions.

17. Consultation with U.S. EPA has indicated King County is not potentially liable with regards to the Hylebos Waterway and Commencement Bay Superfund Cleanup Projects and Natural Resource Damage Assessment process.

18. The National Pollutant Discharge Elimination System (NPDES) will require permit application requirements for stormwater discharges associated within five general areas: 1) industrial activity; 2) discharges from a municipal separate storm sewer system serving a population of 250,000 or more; 3) discharges from municipal separate storm sewer systems serving a population of 100,000 or more, but less than 250,000; 4) counties with unincorporated urbanized areas greater than 250,000; and 5) counties with unincorporated urbanized areas greater than 100,000 but less than 250,000. The City of Federal Way does not fall into one of these five categories at this time, although certain industrial activities (e.g., Evergreen Industrial Park) will be required to obtain a permit. Unincorporated King County will be required to obtain a permit.

    Existing water quality conditions were documented in the Hylebos Creek and Lower Puget Sound Basins-Current and Future Conditions Report. The database used for this analysis was extremely limited. Therefore, modeling of these data to provide annual estimates of pollutant loadings was not feasible. Water quality monitoring programs that are needed to further identify and isolate problem areas, and monitor trends in the long term are listed in recommendations BW-26 through BW-31.

19. The Plan recommends no net loss of aquatic habitats (BW-11) and identifies as a first priority, preventing the need for mitigation by avoiding project impacts (BW-12). When mitigation is necessary, recommendation BW-12 identifies an order preference of actions that should be taken. Please refer to BW-12 for revisions to emphasize this point.

20. Please refer to the "Discussion of Recommendations" in Section 3.3 which describes the functions of buffers in protecting streams and wetlands from impacts due to the encroachment of development and human intrusion.

21. The primary purpose of BW-7.2, "Limitations on Stream Crossings and Stream Modifications or Relocations," is to eliminate impacts to salmonids and their habitat from these activities. In the planning area, the bulk of Class 3 stream reaches is well upstream of this anadramous zone. As a safeguard, however, a provision was included requiring an environmental analysis for stream modifications or relocations for Class 3 streams. This would require the proponent to show that the proposed alternative would have the least environmental impact on the stream. It is anticipated that, as a result, downstream affects on anadramous areas would be negligable. The King County SWM Division continues to support the Plan language as written.

22. a) Existing codes in all entities in the basins currently have provisions which prohibit dumping in surface waters. Due to limitations in enforcement staff and the lack of public awareness, these codes have not been effective. For this reason, the recommendation in BW-37, Public Involvement and Education, is included in the Plan. This recommendation will increase public awarness about the role of individual citizens in improving, or degrading, their environment. Please see this Section for revisions responding to your comment.

    b) Recommendation BW-7, "Limitations On Stream Crossings and Stream Modifications or Relocations," does not exempt activities based on whether projects are small- or large-scale.

The King County SWM Division continues to support the Plan language as written for both comments a and b.

23. Critical areas designations are to be established by local governments as outlined in the Growth Management Bill #2929. The Basin Plan should be of great use to local entities in identifying and establishing those designations. Please also refer to response 19.

24. As stated earlier in response 18, the City of Federal Way will not fall under the NPDES permit requirements until the municipality has reached a population of 100,000. Parts of the basins that are located in unincorporated King County will be included in the County's permit process. Until a more comprehensive data base is established and final rules are approved, it is not appropriate to conduct an analysis of the feasibility for meeting and maintaining water quality standards.

25. Please refer to recommendation BW-37, "Education and Public Involvement," for revisions responding to your comment. The King County SWM Division believes public involvement and education programs are where the emphasis is needed to address removal of litter from public and private property.

26. Section 3.7, "Code Compliance," is intended to include recommendations for penalties that are not included in current enforcement codes. Issuance of stop work orders until code violations are corrected is a code provision which all entities currently have available to them.

27. Protection of resources is expensive. However, prevention has been shown to be more cost-effective than corrective actions. One of the major purposes of the basin plan is to predict future problems and identify ways to prevent them. Section 3.7, Tax Incentives, is not intended to imply that resource protection is too expensive for the tax base, but rather that a variety of tools, in addition to the public initiatives such as the Sensitive Areas Ordinance and the Open Space Acquisition Program, are needed to protect these areas. The recommendations in Section 3.7 therefore are additional tools which the private sector should consider in their decisions about converting undeveloped land to urban uses. Utilizing these tools is considered an important approach to protecting resource areas and meeting private financial goals. Please also refer to Section 3.7 for revisions responding to your comment.

28. Properties that developed without the benefit of current stormwater requirements are "grandfathered" to the requirements in place at the time original construction permits were obtained. Therefore, a conservation lien that requires upgrading a stormwater system in the absence of a request for new permit would be unenforceable. However, as new construction permits are issued for redeveloping (expansion or remodel) these uses, it is the general policy of entities in the basins to also require that stormwater systems are upgraded to current standards, to the extent possible.

29. Please refer to Section 4.1 for revisions responding to your comment.

30. Direct discharge of stormwater to Puget Sound (recommendations NS-1, CS-1, and SL-2) following water-quality treatment as specified in the 1990 King County Surface Water Design Manual achieves equivalent removal of pollutants and more effective control of water quantity than any other alternative recommended in the Plan or in any other existing ordinance. The loss of groundwater recharge is not affected by this recommendation. Whether the runoff from impervious surfaces is piped to Puget Sound or discharged into a surface stream, that water is lost to the groundwater system (please see response 15). Basinwide recommendation BW-21 ("Stormwater Infiltration") and sub-basin recommendation WHL-5 ("Enhanced Area-Specific Infiltration") address this problem to some extent. Loss of recharge, however, is one environmental impact of urban development that cannot be wholly mitigated. These direct-discharge recommendations do not affect this fact, either for better or for worse. Therefore, the King County SWM Division continues to support the Plan language as written.

31. The cost of rehabilitating severely degraded stream channels and the extreme improbability that they could ever become fully functional biologic and hydrologic systems suggests that an uncritical, full-scale effort for each of these systems is futile and counterproductive to the basin plan objective of genuine stream restoration. Those channels whose setting and intrinsic complexity suggest that rehabilitation is possible are recommended for substantial efforts (Projects 2433, 2448, 3322, 3326, 3327, 3328, 3329, and 3331). Please also refer to response 30. Therefore, the King County SWM Division continues to support the Plan language as written.

32. Stream-channel restoration is nowhere considered an alternative that excludes feasible source control. However, where a catchment area is totally built-out and sites are unavailable for detention, the Plan seeks to acknowledge physical reality and proceed as effectively as possible. In some cases, the technical staff judged that full restoration was in fact impossible. This conclusion was not reached on any of the major tributaries of the two basins, where the intrinsic complexity of those streams and their drainage basins suggested that restoration of historic function was feasible. The true cost of past damage, although not quantified with a dollar figure, is clearly stated on page 1.1 of the Plan and repeated throughout the document. Source controls and regulations to avoid future degradation comprise the largest single section of the Plan (Section 3); the King County SWM Division believes these recommendations represent as strong and effective set of protection measures as can be realistically developed.

<u>City of Federal Way</u>

33. Comment noted.

<u>City of Milton</u>

34. The impression stated in your letter is correct. The methods for cost sharing the Plan implementation will be discussed with each entity in the development of implementation agreements.

City of Seattle Solid Waste Utility

35. Thank you for the clarification. Please refer to Section 4.3 for revisions responding to your comment.

36. Project 3321 recommends a study to examine the performance of the Midway Landfill detention pond using a continuous hydrologic model and modifying the outlet structure to improve flow reduction downstream. The Basin Plan also recommends monitoring of stage height in the pond to assess its performance and calibrate the continuous model. Modeling of the Midway Landfill using the Basin Planning model, HSPF, indicates that the Midway Landfill detention pond does not reduce flows to the design level. The pond was designed using a single event hydrologic computer model. Detention ponds designed using single event methods are susceptible to overtopping because water is present in the ponds prior to the beginning of a large storm event. Single event models, by definition, use only a single event for design and cannot correctly account for sequential storms. The hydrologic model used in the Plan provides a more accurate representation of runoff than the single event model used to design the Midway Landfill detention pond. The HSPF model is more accurate because it computes runoff continuously in time, uses actual precipitation and evaporation rates as input, and is calibrated with two years of flow data from the McSorley Creek drainage.

    Both components of the Plan recommendation, flow monitoring and continuous hydrologic modeling, are needed to assess the performance of the detention pond. The flow monitoring will be used to calibrate the continuous model. With a calibrated model, a long series of simulated flows (20 years or more) may be routed through the pond and used to compute the probability of occurrence of a specific flow in the existing pond. Without the hydrologic model, it is difficult to assess the probability of occurrence of the gaged flows. If the results of this analysis show that the pond is not performing as designed, then the model could be used to determine a more optimal outlet configuration. Therefore, the King County SWM Division continues to support the plan language as written.

37. The area occupied by the Midway Landfill on Figure 5.1.2 is shown as commercial land use based on the zoning in that area but does not reflect the land use input to the hydrologic model in the landfill area. The land use and subcatchments in the vicinity of the Midway Landfill that were used in the hydrologic model were obtained from the Midway Landfill Closure Plan Draft Environmental Impact Statement, Technical Appendices (August, 1985). The runoff parameters for the Landfill cap were assumed to be grass cover on till soil. The runoff characteristics of grass covering glacial till, which is a dense clay and gravel matrix, would be similar to the Landfill cap which is composed of grass covering sand and an impervious liner. The land cover of the Midway Landfill area was therefore modeled correctly, although Figure 5.1.2 does not reflect this. Because of printing costs, Figure 5.1.2 cannot be changed.

48. The "Affected Entities" Section is placed immediately following the basin-wide recommendations because these recommendations are primarily addressed to entities for consideration as changes in their existing regulations and programs. Since reviewers of the Plan in the entities are primarily concerned with how the recommendations apply to their jurisdiction, the "Affected Entities" Section precedes the "Discussion of Recommendations." Therefore, the King County SWM Division continues to support the Plan language as written.

King County Conservation District

49. Comment noted.

Washington State Department of Transportation

50. The stream crossing design alternatives are listed in decreasing order of preference so that there is flexibility to design to a variety of site conditions. This approach to minimizing impacts due to stream crossings is consistent with the King County Sensitive Areas Ordinance and current practices by the Washington Department of Fisheries. The King County SWM Division continues to support the Plan language as written.

51. The permit requirement for grading volumes of 100 cubic yards or more (BW-8.1) is the threshold adopted in the King County Sensitive Areas Ordinance. This ordinance exempts grading in publicly-owned road rights-of-way and clearing and grading by a public agency for routine road maintenance. For specific language in this code, refer to Section 100 of the King County Sensitive Areas Ordinance 9614. Also, Section 70 of this ordinance provides for a variance to the requirements if circumstances warrant. The Plan recommendation responds to the cumulative impact of small volumes of materials which are being graded or used for fill throughout the basins without adequate controls. Erosion from these sources is adding to the excessive instream sediment loads from development-related activities. Therefore, the King County SWM Division continues to support the Plan language as written.

52. The recommendation to establish seasonal clearing and grading limits is viewed as a primary measure to control the volume of sediment entering surface waters from development-related activity. The Hylebos Creek and Lower Puget Sound Current and Future Conditions Report (King County, 1990a) documents that severe erosion and sedimentation problems are pervasive in the basins. These conditions are reflected in significant concentrations of solids found in water quality samples taken throughout the planning area, including tributary areas with, and without, erosion hazard areas. Visual observations also verify numerous locations with excessive sediment deposition and cementing of spawning and rearing gravels due to soil erosion in both basins. Development-related sediment sources are a major contributor to this problem. Furthermore, research conducted by the King County Conservation District has found that although best management practices to control onsite erosion have been a permit requirement for many years, these practices have generally not been followed to the extent necessary to avoid damage to stream systems. It is anticipated that when development-induced

erosion is controlled to a greater extent through this regulation, aquatic habitat in both basins can improve dramatically.

On the basis of these findings, there is ample evidence that this recommendation should be applied as a uniform standard throughout the basins, rather than as a performance standard which could be implemented on a case-by-case basis. Therefore, the King County SWM Division continues to support the Plan language as written.

53. Within Chapter 173-270 WAC (Puget Sound Highway Runoff Program) a new section (WAC 173-270-030, Best Management Practices) is being proposed. Within this section, it states, "The highway runoff manual shall include, but not be limited to: a) BMPs for control of erosion and sedimentation including standards for operation and maintenance; b) Hydrologic analysis procedures; c) Design, operation, and maintenance standards for retention and/or detention facilities and conveyance systems that shall emphasize systems which maximize water quality benefits as well as water quantity control, such as inclusion of biofiltration techniques where practicable; d) BMPs for the control of pests; e) BMPs for selection and use of deicing chemicals; and f) BMPs for waste disposal from highway runoff system maintenance."

    This new section emphasizes the need for BMPs to control pollution through the use of biofiltration techniques and operation and maintenance activities. The Hylebos Basin Plan recognizes the importance of these items and has recommended a "Ditch Master" or other comparable horizontal auger. The Highway Runoff Program will require minimum standards that WSDOT will need to meet. This will require additional staff and appropriate equipment to implement BMPs which will maximize water quality benefits. King County SWM Division staff believes the "Ditch Master" is well-suited for these basins. In addition, performance requirements utilizing smooth cut ditches with a minimum of loose or disturbed materials remaining in ditches, as WSDOT has suggested, will not be a preferred BMP.

54. The base maps for the Basin Plan were not generated by interpreting aerial photographic centers. However, this is a process that the King County SWM Division is considering for use in other Basin Planning endeavors.

55. The Basin Plan does not assume the priorities in these basins would control the implementation timetable of the Puget Sound Highway Runoff Program. However, the proposed new section WAC 173-270-060(3)(b) states "WSDOT shall develop a priority rating and ranking system and submit it to Ecology for concurrence." In a comment letter (March 21, 1991) to Mr. Gary Kruger [Washington State Department of Ecology (DOE)] regarding these proposed WACs, King County expressed concerns with regards to this issue and recommended that local jurisdictions should be consulted in the development of the prioritization criteria.

56. Recommendation BW-16 is proposed primarily to revegetate developed areas, in part to restore natural soil permeability and provide sites for future recruitment of large woody debris (LWD) into stream channels. The revegetation program will supplement the flow-control capital improvement projects. These flow controls, coupled with the LWD project, will stabilize streambeds and streambanks, thereby avoiding the need for channel hardening.

57. Consideration of local park and recreation planning needs was included in Plan development to encourage coordinated use of sites for both park and stormwater facilities. For example, capital improvement projects as well as LSRAs and RSRAs in the Plan have been incorporated into the City of Federal Way Draft Park and Recreation Plan to the extent possible. As a result some of these areas may be acquired by the City.

    Section 3.10, Tax Incentives, is also intended to identify ways that land owners can preserve sensitive areas in exchange for federal and local tax concessions.

58. The Washington State Department of Ecology (DOE) has established an interim disposal policy for Vactor/Eductor trucks. DOE is currently working on a final disposal plan. Metro is facilitating the introduction of decant liquids into their sanitary sewer system. The following four options are presented as a tool to be used with best professional judgement:

    a. Use of an unregulated fill on property owned or leased by you in compliance with RCW 70.95.240 and any local laws;

    b. Disposal at a demolition landfill (e.g., Coal Creek, (Newcastle), or Mt. Olivet);

    c. Disposal at a lined landfill (e.g., Cedar Hills); or

    d. Disposal by a licensed storage, treatment, and disposal facility.

    NOTE: Coal Creek landfill should be used when cleaning basins in residential and commercial areas.

    Cedar Hills landfill should be used when cleaning basins in industrial areas.

59. Agree. However, to determine the effectiveness of a BMP on the system, a sampling program must include monitoring prior to BMP implementation.

60. Comment noted.

61. It is recognized that the coalescent plate oil/water separators have limitations in high flow conditions. However, these separators are currently considered to be the best available technology. It is anticipated that as new technology becomes available, the current limitation will be overcome. In situations where high stormwater volumes are anticipated, the recommendation does not preclude the use of additional control options such as oil-absorbent pillows in all storm drains, oil booms in detention ponds, or placing separators downstream of retention ponds. All of these methods, however, require regular maintenance to avoid excessive build-up of residue on collection surfaces.

    The following general guidelines, for oil/water separation devices were obtained from the Metro 1990 report, "Oil and Water Don't Mix: The Application of Oil-Water Separation Technologies in Stormwater Quality Management." These guidelines are suggested to maximize the effectiveness of oil/water separators:

a) Consideration should be given to the cost-benefit relationship of stormwater treated versus construction costs (the 6-month, 24-hour storm would be cost effective as the water quality design storm standard);
b) Coalescing plate oil/water separators should be used in places where relatively high oil and grease concentrations are expected;
c) Separators should be designed with a turn-down elbow inside the first chamber at the inflow pipe and a sample-T at the outflow pipe;
d) A floating or rope oil skimming device which removes oil from the oil collection chamber of the separator and drains to a waste-oil tank offers a combination of practicality, reasonable cost and effectiveness; and
e) it is good practice, where design parameters allow, to install a flow controlling structure upstream of an oil-water separator which regulates the amount of water getting into the separator.

Federal Way Sewer and Water District

62. It is not within the scope of the Basin Plan to describe in detail the methods for water quality cleanup. There are many references in the water quality portion of the Plan that stress the need for additional identification of water quality problem areas and isolation of potential pollutant sources.

63. NPDES permit requirements for the City of Federal Way were discussed in response 18.

64. The capital improvement projects in the approved Plan will be placed on the SWM capital improvements list. As noted in BW-43, implementation of King County projects will be started at least within one year of approval of the Plan, provided the SWM Strategic Plan is adopted. Adopted basinwide recommendation will be implemented both within King County, and within the various entities involved, through interlocal agreements among the entities. As proposed, the Stream Steward (BW-38) would be responsible for coordinating Plan implementation both within the County and with other entities. An annual progress report (BW-32) will also be prepared to describe progress in Plan implementation among all entities in the basins.

65. See response 57.

66. The 1990 King County Design Manual, which has been adopted by most local entities in the planning area, currently requires the use of biofiltration swales as part of onsite stormwater control facilities. Recommendations BW-21 and WHL-5 are proposed as additional measures to promote groundwater recharge and apply specifically to the planning area. It is unnecessary to include standards in the Plan that are already being implemented. Therefore the SWM Division continues to support the Plan language as written.

67. The structures referred to in Section 2.2, which summarizes erosion conditions in Lakota Creek, are SR-509 and the Federal Way Sewer and Water District Sewage Treatment Plant. Please refer to Section 2.2 for revisions responding to your comment.

68. Please refer to Section 2.3 for revisions responding to your comment.

69. Comment noted.

70. Project costs are feasibility level estimates that are based on prices for common construction items used in typical King County SWM Division projects. Project costs will be refined in the development of preliminary engineering design and specifications. Project cost reduction, cost sharing, and opportunity projects will be addressed as part of the Implementation Package and Interlocal Agreements for the participating entities.

71. Comment noted.

72. The recommendations in BW-7 outline an order of preference of methods for stream crossings in order to minimize the impact of such activities. The cost of implementing these methods needs to be assessed in terms of the concomitant short- and long-term cost to the public resource. The recommendation does not limit the use of a less expensive alternative, but the proof of infeasibility must lie with the proponent. In this respect, agencies and individuals must anticipate impacts and costs of their actions and plan accordingly. We feel this is important to the long-term maintenance of stream systems. Therefore, the King County SWM Division continues to support the Plan language as written.

73. Comment noted.

74. Leaking sanitary sewage facilities, referred to in Section 3.5, include onsite sewage disposal systems and possibly sanitary sewer lines.

75. The District's sewer lines may not be the cause of high fecal coliform contamination; however, in areas where there are no onsite septic systems and there are high fecal levels, these lines should be suspect and should be inspected by video camera in order to eliminate this source as the cause of the problem.

76. Please refer to Section 3.11 for revisions responding to your comment.

77. Please refer to response 70.

78. Please refer response 75.

79. Comment noted.

<u>Washington State Department of Ecology</u>

80. Please refer to response 55.

81. Agree. The new section WAC 173-270-030, Best Management Practices, proposed within the Highway Runoff Program Manual should contain the following: (f) BMPs for waste disposal from highway runoff system maintenance.

82. Please refer to response 59.

83. Please refer to response 61.

Puyallup Tribe of Indians

84. Comment noted.

85. The impact of surface mining activities were not specifically evaluated in the Plan. You are correct however that although there are no surface mines in the King County portion of the Plan area, impacts from these uses, where they occur in the system, are likely significant, at least locally.

In general, site layout is probably more effective than seasonal grading restrictions in managing erosion and sedimentation because most of these sites are typically uncovered regardless of whether or not active mining is occurring. Specific BMPs for surface mining activities have not been developed in this state (or at least are not listed in the WSDOE Draft Stormwater Manual). Nevertheless, general source control and stormwater treatment BMPs should be used for related activities and facilities in surface mines as follows:

a. Fueling Stations;
b. Vehicle equipment washing and steam cleaning;
c. Loading and unloading liquid materials;
d. Liquid storage in above-ground tanks;
e. Container storage of liquids or dangerous wastes;
f. Outside storage of raw materials, by-products or finished products;
g. Outside manufacturing activities; and
h. Parking areas.

BMPs should also include:

a. Emergency spill cleanup plans;
b. Vegetation management/Integrated Best Management;
c. Frequent maintenance of storm drains; and
d. Implementation of stringent soil erosion and sedimentation plans.

In addition to these controls, all other regulatory requirements will need to be followed including compliance with a National Pollution Discharge Eliminations System Permit (NPDES). This permit requires regular sampling of the point source discharges for several water quality parameters, including pH and solids.

86. The runoff from Interstate 5 in the vicinity of the HOV lane construction discharges to tributary 0016a. Comment noted.

87. Comment noted.

88. The primary purpose of BW-36, Regional Monitoring, is only to evaluate how well the capital improvement projects and onsite detention standards are improving conditions downstream. Therefore, it is appropriate to begin regional monitoring after these measures have been implemented. Other moni-

toring recommendations (BW-28, BW-29, BW-30, and BW-31) mentioned in the water quality monitoring program will be the main sources of information on water quality trends for the entire planning area prior to, during, and following Plan implementation.

89. Interim solutions, including construction of a temporary sediment trap and/or natural enhancement of sediment detention capabilities in the alluvial flood plain between SR 99 and the Mace property, have been evaluated as possible ways to temporarily reduce sedimentation upstream of 373rd Street until upstream projects can be implemented. It was determined that these alternatives were infeasible due to high costs, questionable effectiveness, time constraints in permitting and construction, and significant long term effects on an existing forested wetland and stream reach with high potential for fish habitat restoration. (Please also refer to response 8.) The King County SWM Division is supporting the construction of these projects as soon as possible. Therefore, the King County SWM Division continues to support the Plan language as written.

90. Highways effect stream flows in two ways. Both types of effects were considered in the Basin Plan analyses. First, through the introduction of impervious surfaces, highways increase peak flow runoff. Second, if the conduit that conveys a creek through a highway berm is undersized, a restriction is formed that creates a defacto dam.

    Runoff from the impervious surfaces of roads and highways was considered in both the current and future land use analyses. Thus, the downstream cumulative affects on basin hydrology of these surfaces along with other impervious surfaces associated with urbanization was considered.

    Locations where culverts are undersized for current or projected future flows and caused flooding were noted as flooding problems (see significant flooding problem number 5, Figure 5.4.1, for example). Therefore, the King County SWM Division continues to support the Plan language as written.

91. Comment noted.

<u>Sunfire Project</u>

92. Several species of salmon and trout, such as coho and cutthroat, will commonly utilize stream reaches that are prone to desiccation during summer low flow periods. Since it occurs quite frequently even under natural conditions, populations of these fish are presumably somewhat adapted to this culling process. However, human induced changes in stream conditions, such as increased width to depth ratios, loss of pools, and reduced summer baseflow discharges may exacerbate the stranding phenomena beyond natural levels.

    Some of the effects of stream desiccation may be offset by the behavior of newly emergent fry. These fry generally drift downstream from the spawning areas until a certain size is reached and territories and social hierarchies are formed. Because of its widespread and at least nominal success, the population level benefits of spawning and early rearing in these ephemeral environments appear to offset, under natural conditions,

the obvious deleterious effects on individual fish. Perhaps its historical, and therefore evolutionary, value is in ensuring wide distribution of offspring and therefore better utilization of space and food by the species.

Given this behavioral trait, it is not clear that the three solutions are appropriate long-term strategies for managing populations in the systems. For example, if a barrier is placed to limit fish distribution above the knickpoint(s), is there a potential affect on the natural selection process for the population? Also, would a fish rescue team simply be transplanting fish into reaches of stream in which territories and hierarchies are already naturally established and where carrying capacities may be set? If so, a false sense of accomplishment is attained.

Project 2445 is not intended as a fish passage project and the negative and/or positive aspects of providing fish passage as noted above, should be considered when it is implemented. Assistance in such implementation concerns and in conducting activities such as transplanting fish is provided for in the Plan through activities to be planned and coordinated by the Stream Steward. Therefore, the King County SWM Division continues to support the plan as written.

<u>Barghausen Consulting Engineers, Inc.</u>

93. Within the basin planning process, RSRA designations signify environmental features that are unique on a regional level, and as such, require special protection, particularly from the impacts of high density development. The proposed change in the boundary of the East Branch Hylebos Creek RSRA would be contrary to this intent and its provisions for resource protection. The topography of the site is very sensitive to development impacts, which are not expected to be avoidable in this area. The King County SWM Division, therefore, continues to support the boundary of this RSRA as defined in the Plan.

APPENDIX B: STREAM AND WETLAND DEFINITIONS

Stream Definitions

"Streams" are those areas where surface waters produce a defined channel or bed. A defined channel or bed is an area which demonstrates clear evidence of the passage of water and includes but is not limited to bedrock channels, gravel beds, sand and silt beds and defined-channel swales. The channel or bed need not contain water year-round. This definition is not meant to include irrigation ditches, canals, storm or surface water runoff devices or other entirely artificial watercourses unless they are used by salmonids or used to convey streams naturally occurring prior to construction in such watercourse. Streams are further categorized as follows:

A. Class 1 streams. "Class 1 streams" means those streams inventoried as "Shorelines of the State" under King County's Shoreline Master Program, K.C.C. Title 25, pursuant to RCW Chapter 90.58.

B. Class 2 streams. "Class 2 streams" means those streams smaller than Class 1 streams that flow year around during years of normal rainfall or those that are used by salmonids.

C. Class 3 streams. "Class 3 streams" means those streams that are intermittent or ephemeral during years of normal rainfall and are not used by salmonids.

Wetland Definitions

"Wetlands are those areas that are inundated or saturated by ground or surface 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. (Army Corps of Engineers Regulation 33 CFR [323.2(c)] 328.3 (1988). Where the vegetation has been removed or substantially altered, a wetland shall be determined by the presence or evidence of hydric or organic soil, as well as other documentation of the previous existence of wetland vegetation such as aerial photographs.

A. Class 1 wetlands. "Class 1 wetlands" means wetlands assigned the Unique/Outstanding #1 rating in the King County Wetlands Inventory, 1983; or which meet any of the following criteria:

1. The presence of species listed by the federal government or state as endangered, or threatened, or the presence of critical or outstanding actual habitat for those species;
2. Wetlands having 40% to 60% permanent open water in dispersed patches with two or more classes of vegetation;
3. Wetlands equal to or greater than ten acres in size and having three or more wetland classes, one of which is open water; or
4. The presence of plant associations of infrequent occurrence.

B. Class 2 wetlands. "Class 2 wetlands" means wetlands assigned the Significant #2 rating in the King County Wetlands Inventory, 1983; or any wetlands which meet any of the following criteria:

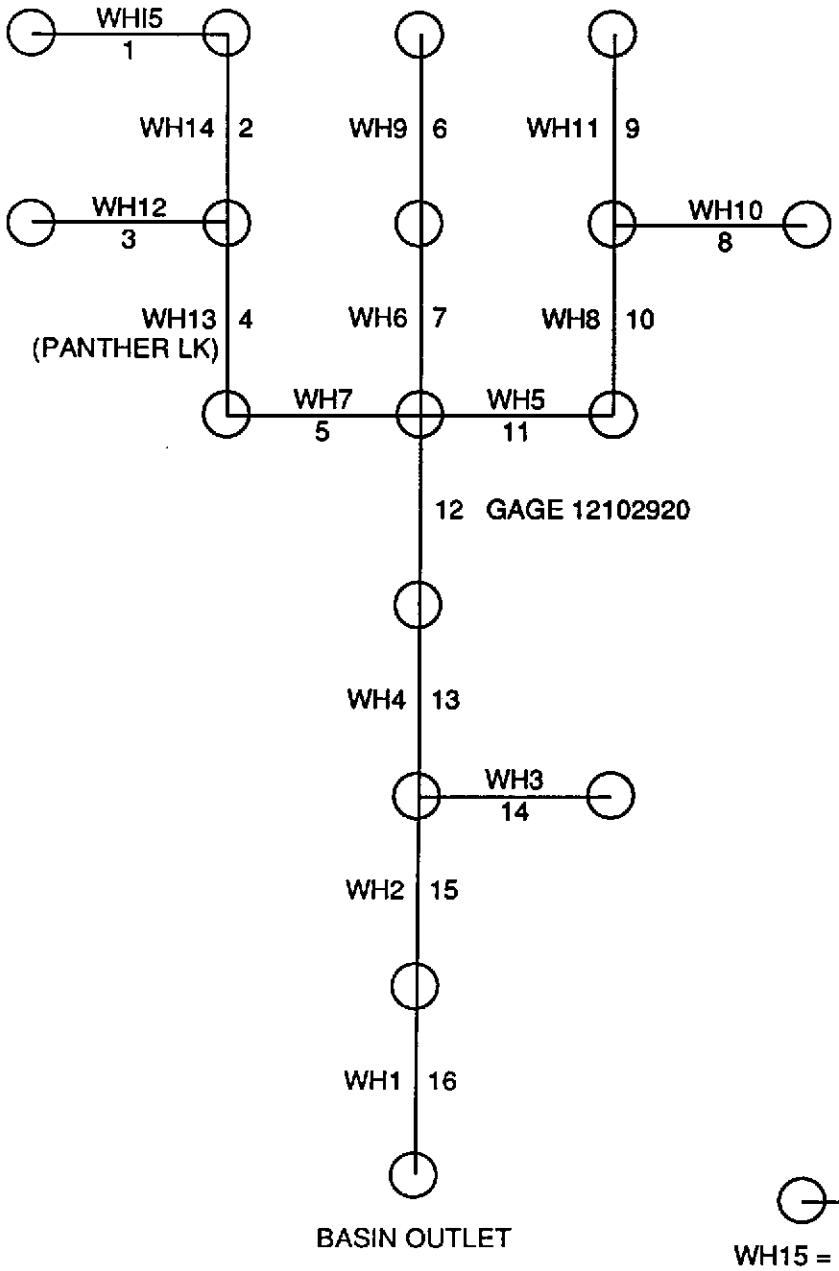
1. Wetlands greater than one acre in size;
2. Wetlands equal to or less than one acre in size and having three or more wetland classes;
3. Wetlands equal to or less than one acre that have a forested wetland class;
4. The presence of heron rookeries or raptor nesting trees.

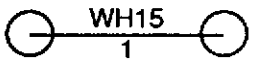
C. Class 3 wetland. "Class 3 wetland" means wetlands assigned the Lesser Concern #3 rating in the King county Wetlands Inventory, 1983, or uninventoried wetlands that are equal to or less than one acre in size and that have two or fewer wetland classes.

For the purposes of this section, the U. S. Fish and Wildlife Service's Classification of Wetlands and Deepwater Habitats of the United States, FWS/OBS-79/31 (Cowardin et al, 1979) contains the descriptions of wetland classes and subclasses.

APPENDIX C: MODELED HSPF FLOW FREQUENCIES AND DURATIONS BY SUBCATCHMENT

WEST BRANCH HYLEBOS CREEK NETWORK

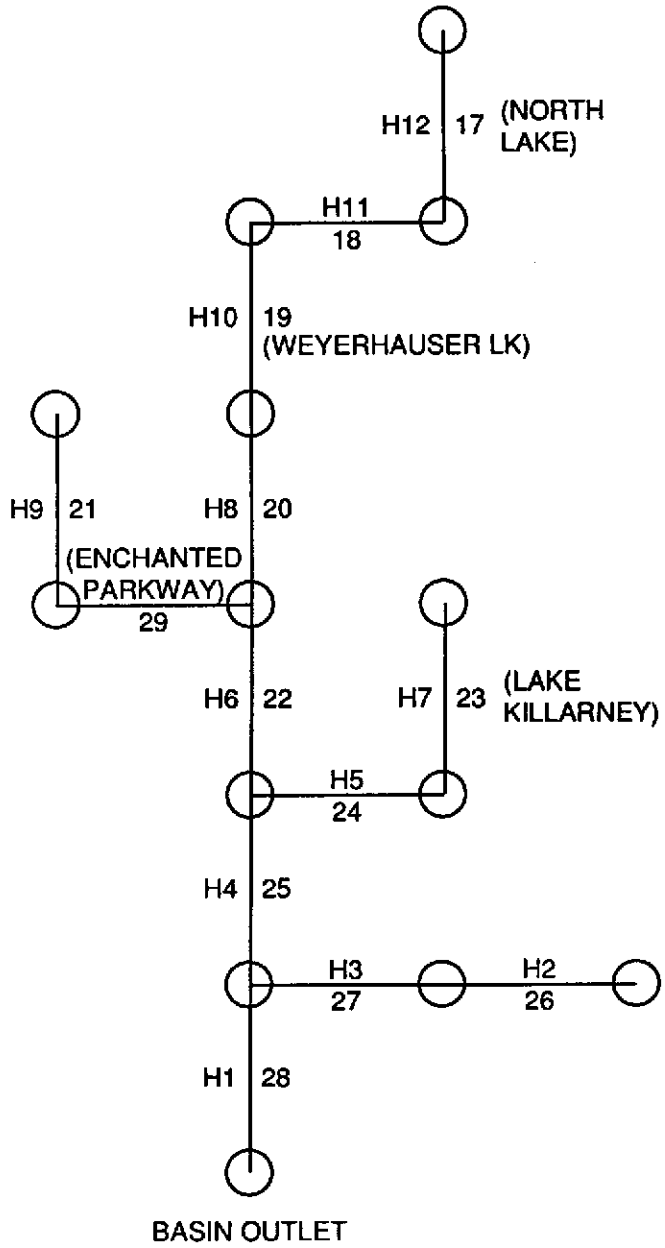


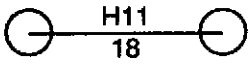


WH15 = SUBCATCHMENT
1 = REACH NUMBER

NOTE: ALL MODELED FLOWS ARE COMPUTED AT DOWNSTREAM END OF REACH

EAST BRANCH HYLEBOS CREEK NETWORK

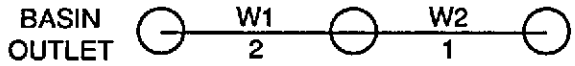




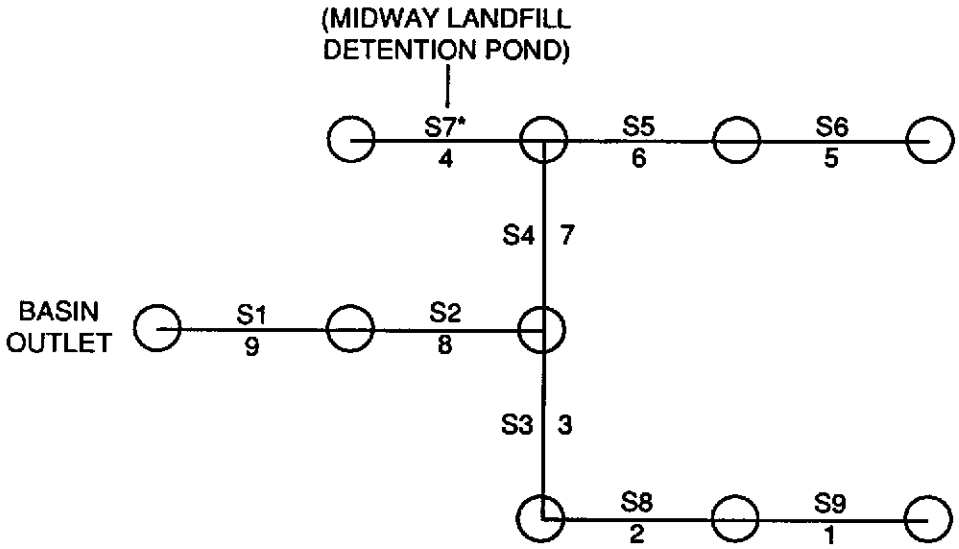
H11 = SUBCATCHMENT
18 = REACH NUMBER

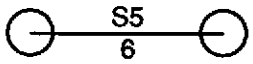
NOTE: ALL MODELED FLOWS ARE COMPUTED AT DOWNSTREAM END OF REACH

WOODMONT CREEK NETWORK



MCSORLEY CREEK NETWORK



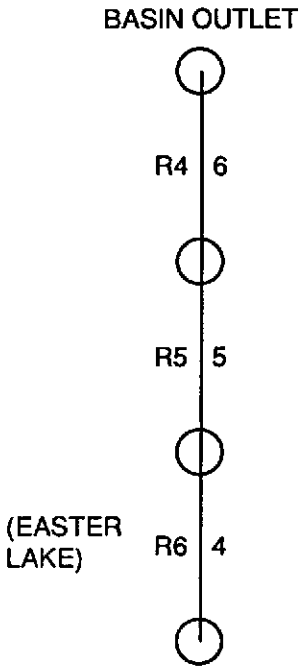


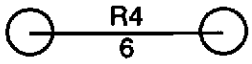
S5 = SUBCATCHMENT
6 = REACH NUMBER

NOTE: ALL MODELED FLOWS ARE COMPUTED AT DOWNSTREAM END OF REACH

* SUBCATCHMENT S7, THE MIDWAY LANDFILL CAP, IS CONNECTED IN THE FUTURE MODEL SCENARIOS ONLY.

COLD CREEK NETWORK)

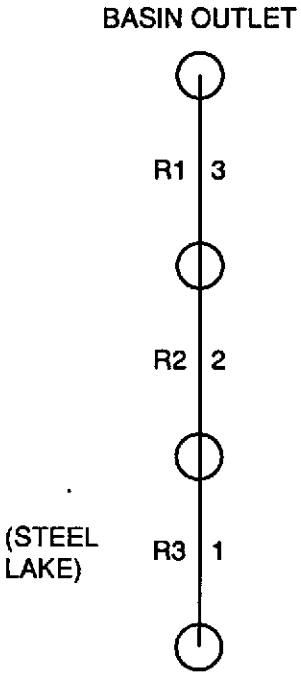




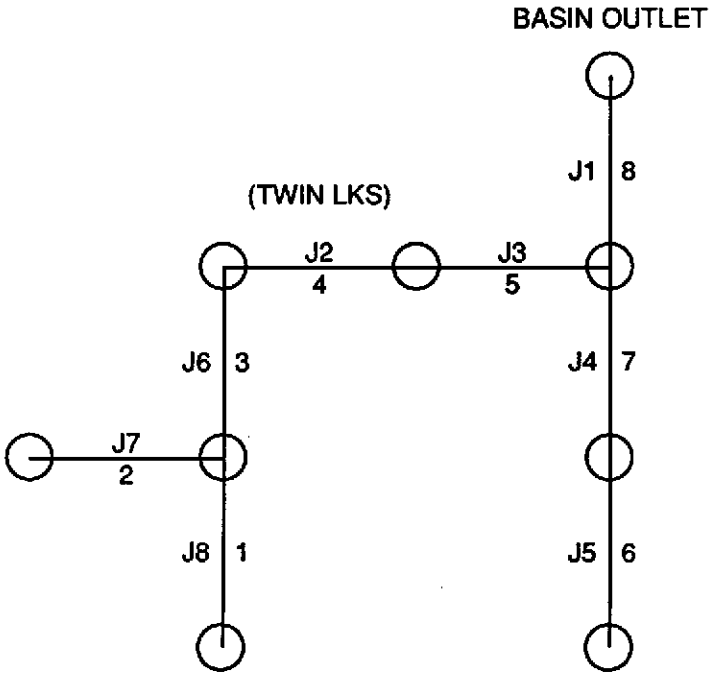
R4 = SUBCATCHMENT
6 = REACH NUMBER

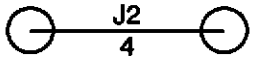
NOTE: ALL MODELED FLOWS ARE COMPUTED AT DOWNSTREAM END OF REACH

REDONDO CREEK NETWORK



JOES CREEK NETWORK

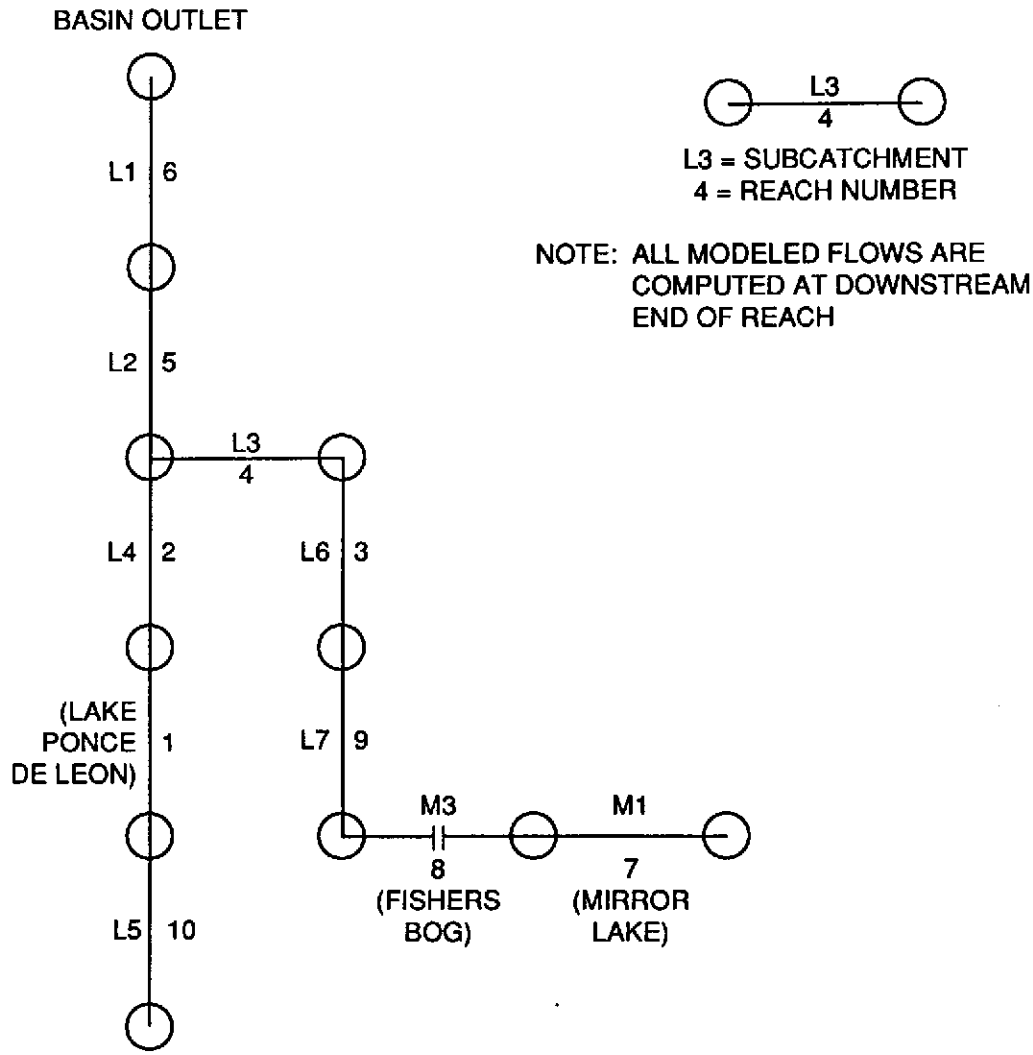




J2 = SUBCATCHMENT
4 = REACH NUMBER

NOTE: ALL MODELED FLOWS ARE COMPUTED AT DOWNSTREAM END OF REACH

LAKOTA CREEK NETWORK



M3 DISCHARGES TO L7
DURING LARGE EVENTS
ONLY.

APPENDIX D: MODELED HSPF FLOW FREQUENCIES UNDER VARIOUS LAND USE SCENARIOS

12-Apr-91

Scenario: Hylebos and Lower Puget Sound Basins
FOREST= Pre-developed Land Use
1987= 1987 Land Use
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SOL= Future land use with regional cips and on-site detention
SOLA= Future land use with regional cips and on-site detention sized with 7-day storms on till pre-forest areas.

Sub-Basin	Scenario	Peak Annual Flow Frequency (CFS) 1.01-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr	Mean of 2-100 Yr Flows
H KITT	1987	23.1	40.5	46.8	50.0	53.2	55.2	56.9	60.1	50.4
H1	1987	52.0	119.0	163.0	193.0	231.0	260.0	290.0	361.0	209.3
H10	1987	2.1	4.7	7.1	9.0	11.9	14.5	17.4	25.8	10.8
H11	1987	2.3	6.5	9.3	11.1	13.5	15.3	17.2	21.5	12.1
H12	1987	0.8	1.9	3.0	4.0	5.6	7.1	8.9	14.7	5.1
H1+WH1	1987	111.0	236.0	318.0	374.0	446.0	500.0	556.0	692.0	405.0
H2	1987	4.8	11.9	16.7	19.9	24.0	27.2	30.4	38.1	21.7
H3	1987	9.2	22.2	29.8	34.5	40.2	44.3	48.2	57.1	36.5
H4	1987	43.4	87.3	111.0	125.0	142.0	153.0	165.0	190.0	130.6
H5	1987	8.1	17.1	22.8	26.6	31.4	35.0	38.7	47.4	28.6
H6	1987	35.6	71.2	89.0	99.4	111.0	120.0	127.0	144.0	102.9
H7	1987	0.7	3.7	5.4	6.3	7.2	7.7	8.2	9.0	6.4
H8	1987	13.6	31.3	42.1	49.1	57.8	64.2	70.5	85.2	52.5
H9	1987	23.6	44.4	56.5	64.2	73.8	80.8	87.7	104.0	67.9
J1	1987	45.8	93.8	119.0	134.0	151.0	163.0	175.0	200.0	139.3
J2	1987	6.4	11.9	16.3	19.7	24.4	28.3	32.5	44.0	22.2
J3	1987	8.5	17.0	22.5	26.2	31.0	34.5	38.2	47.0	28.2
J4	1987	27.6	56.5	70.6	78.8	88.1	94.5	100.0	113.0	81.4
J5	1987	27.1	55.9	70.3	78.6	88.1	94.6	101.0	114.0	81.4
J6	1987	6.7	13.3	18.1	21.6	26.3	30.1	34.1	44.4	23.9
J7	1987	0.03	0.04	0.07	0.10	0.18	0.28	0.44	1.25	0.2
J8	1987	3.4	7.5	11.2	14.3	19.0	23.1	27.8	41.7	17.1
L PONCE	1987	7.2	17.0	23.1	27.2	32.3	36.0	39.8	48.6	29.2
L1	1987	30.8	57.7	72.1	81.0	91.6	99.2	106.0	123.0	84.6
L2	1987	30.8	57.8	72.5	81.5	92.4	100.0	108.0	125.0	85.4
L3	1987	18.1	33.0	40.8	45.5	51.2	55.2	59.1	67.7	47.5
L4	1987	11.1	23.2	30.4	35.1	40.9	45.2	49.4	59.4	37.4
L5	1987	12.7	24.2	30.3	34.1	38.7	41.9	45.0	52.0	35.7
L6	1987	4.1	9.6	11.2	11.9	12.5	12.7	13.0	13.3	11.8
L7	1987	17.4	33.0	42.4	48.6	56.2	61.9	67.6	81.1	51.6
M1	1987	0.4	0.7	1.0	1.2	1.4	1.6	1.8	2.3	1.3
M3	1987	CLOSED BASIN								ERR
R1	1987	29.0	60.1	77.1	87.4	99.8	109.0	117.0	136.0	91.7
R2	1987	9.4	21.6	28.4	32.7	37.7	41.3	44.8	52.5	34.4
R3	1987	0.2	2.1	4.5	6.3	8.9	11.0	13.1	18.3	7.6
R4	1987	17.2	37.6	48.0	54.0	60.9	65.6	70.0	79.3	56.0
R5	1987	10.5	19.7	24.3	27.0	30.1	32.2	34.2	38.4	27.9
R6	1987	2.1	4.3	5.9	7.2	8.9	10.3	11.8	15.7	8.1
S1	1987	51.3	107.0	136.0	153.0	173.0	186.0	199.0	228.0	159.0
S2	1987	50.2	107.0	137.0	154.0	174.0	187.0	200.0	228.0	159.8
S3	1987	18.9	41.1	53.2	60.5	69.2	75.3	81.1	94.0	63.4
S4	1987	22.4	47.2	60.5	68.5	78.0	84.7	91.1	105.0	71.7
S5	1987	17.4	36.9	47.5	54.0	61.7	67.2	72.5	84.2	56.6

12-Apr-91 MODELED FLOW FREQUENCIES UNDER VARIOUS LAND USE SCENARIOS

Hylebos and Lower Puget Sound Basins

Scenario:
FOREST= Pre-developed Land Use
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SOLA= Future land use with regional cips and on-site detention sized with 7-day storms on till pre-forest areas.

Sub-Basin	Scen-ario	Peak Annual Flow Frequency (CFS) 1.01-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr	Mean of 2-100 Yr Flows
S6	1987	2.3	4.8	6.6	7.9	9.7	11.1	12.5	16.3	8.7
S7	1987	CLOSED BASIN								ERR
S8	1987	10.7	23.8	32.0	37.4	44.3	49.4	54.6	66.8	40.3
S9	1987	17.7	33.0	40.9	45.7	51.4	55.3	59.1	67.6	47.6
W1	1987	24.0	47.7	60.9	69.1	78.9	86.0	92.8	108.0	72.6
W2	1987	14.0	27.4	34.8	39.3	44.7	48.6	52.4	60.8	41.2
WH UW	1987	38.8	71.5	93.5	109.0	129.0	145.0	161.0	201.0	118.2
WH1	1987	62.9	121.0	161.0	189.0	227.0	257.0	287.0	365.0	207.0
WH10	1987	22.6	39.0	47.0	51.6	57.0	60.7	64.1	71.6	53.2
WH11	1987	48.1	76.7	93.2	104.0	117.0	127.0	137.0	160.0	109.2
WH13	1987	CLOSED BASIN								ERR
WH2	1987	60.6	115.0	154.0	181.0	217.0	245.0	275.0	351.0	197.8
WH3	1987	27.5	48.5	59.5	66.2	74.2	79.9	85.3	97.5	68.9
WH4	1987	42.7	79.0	106.0	125.0	151.0	172.0	194.0	251.0	137.8
WH5	1987	33.7	61.6	80.1	92.8	109.0	122.0	135.0	168.0	100.1
WH6	1987	1.6	3.1	4.1	4.7	5.5	6.1	6.7	8.2	5.0
WH7	1987	4.6	8.3	11.6	14.2	18.0	21.3	25.0	35.5	16.4
WH8	1987	44.7	83.9	108.0	123.0	143.0	158.0	172.0	208.0	131.3
WH9	1987	0.9	1.5	2.1	2.6	3.3	3.9	4.5	6.4	3.0
H KITT	SOL	15.8	29.3	38.7	45.2	53.9	60.8	67.9	85.8	49.3
H1	SOL	62.7	132.0	184.0	222.0	276.0	319.0	365.0	486.0	249.7
H10	SOL	3.7	9.7	14.0	17.0	21.0	24.1	27.4	35.5	18.9
H11	SOL	3.4	8.3	12.1	15.0	19.1	22.4	25.9	35.4	17.1
H12	SOL	1.2	5.7	8.0	9.1	10.2	10.9	11.4	12.3	9.2
H1+WH1	SOL	134.0	257.0	357.0	432.0	539.0	627.0	723.0	984.0	489.2
H2	SOL	8.3	16.7	23.6	28.9	36.5	42.9	49.9	69.2	33.1
H3	SOL	10.3	20.5	27.5	32.5	39.0	44.2	49.5	63.0	35.5
H4	SOL	42.8	85.0	116.0	138.0	167.0	191.0	216.0	280.0	152.2
H5	SOL	9.6	20.6	28.1	33.4	40.3	45.7	51.2	65.1	36.6
H6	SOL	33.7	64.8	87.8	104.0	127.0	146.0	165.0	215.0	115.8
H7	SOL	1.1	5.1	7.2	8.3	9.4	10.1	10.6	11.5	8.5
H8	SOL	19.6	37.6	50.3	59.4	71.5	81.1	91.1	117.0	65.2
H9	SOL	29.7	52.1	65.6	74.6	85.9	94.3	103.0	123.0	79.3
J1	SOL	44.7	94.6	124.0	143.0	166.0	183.0	200.0	238.0	151.8
J2	SOL	7.3	12.7	13.7	13.9	14.1	14.1	14.1	14.2	13.8
J3	SOL	9.1	17.4	20.9	22.7	24.7	25.9	27.0	29.2	23.1
J4	SOL	26.1	55.7	69.4	76.9	85.2	90.6	95.5	105.0	78.9
J5	SOL	25.2	55.5	69.3	76.9	85.1	90.4	95.2	105.0	78.7
J6	SOL	10.7	18.0	23.2	27.0	32.0	36.0	40.3	51.1	29.4
J7	SOL	0.8	1.1	1.3	1.5	1.7	1.9	2.1	2.6	1.6
J8	SOL	6.2	11.0	15.0	18.1	22.6	26.3	30.4	41.8	20.6
L PONCE	SOL	6.3	16.3	22.4	26.2	31.0	34.4	37.8	45.5	28.0
L1	SOL	37.3	62.8	76.9	85.8	96.6	104.0	112.0	130.0	89.7

12-Apr-91 MODELED FLOW FREQUENCIES UNDER VARIOUS LAND USE SCENARIOS

Hylebos and Lower Puget Sound Basins

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Sub-Basin	Scen-ario	Peak Annual Flow Frequency (CFS) 1.01-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr	Mean of 2-100 Yr Flows
L2	SOL	36.5	62.2	76.3	85.2	96.0	104.0	112.0	129.0	89.3
L3	SOL	19.0	31.1	39.2	44.8	52.1	57.7	63.6	78.1	48.1
L4	SOL	10.7	22.9	30.0	34.6	40.3	44.5	48.6	58.1	36.8
L5	SOL	11.7	23.2	29.4	33.1	37.5	40.6	43.6	50.2	34.6
L6	SOL	4.4	7.8	11.9	15.8	22.3	28.6	36.4	62.7	20.5
L7	SOL	16.3	32.3	41.9	48.0	55.7	61.3	66.9	80.0	51.0
M1	SOL	0.4	0.8	1.0	1.2	1.5	1.7	1.9	2.4	1.3
M3	SOL	CLOSED BASIN								ERR
R1	SOL	30.0	61.1	77.7	87.8	99.8	108.0	116.0	134.0	91.7
R2	SOL	9.6	22.0	28.9	33.1	38.1	41.7	45.1	52.6	34.8
R3	SOL	0.6	6.0	8.0	8.6	9.0	9.1	9.2	9.2	8.3
R4	SOL	14.6	38.6	51.0	58.1	66.1	71.5	76.4	86.4	60.3
R5	SOL	9.7	19.7	25.5	29.1	33.6	36.9	40.1	47.5	30.8
R6	SOL	1.5	5.4	8.9	11.6	15.5	18.7	22.3	31.9	13.7
S1	SOL	56.6	121.0	156.0	178.0	203.0	222.0	239.0	279.0	186.5
S2	SOL	55.6	121.0	157.0	179.0	206.0	225.0	243.0	284.0	188.5
S3	SOL	22.6	42.9	55.8	64.4	75.6	84.0	92.6	113.0	69.2
S4	SOL	24.9	57.9	75.8	86.5	99.0	108.0	116.0	134.0	90.5
S5	SOL	15.6	35.4	45.2	50.9	57.2	61.4	65.3	73.4	52.6
S6	SOL	2.6	4.9	6.8	8.3	10.3	12.0	13.8	18.9	9.4
S7	SOL	8.7	15.0	21.2	26.3	34.1	41.0	48.9	72.2	31.1
S8	SOL	11.9	24.0	32.2	37.8	45.3	51.1	57.0	71.9	41.2
S9	SOL	20.2	33.8	42.5	48.4	55.9	61.7	67.6	81.9	51.7
W1	SOL	22.3	47.4	60.4	68.1	77.0	83.2	89.0	102.0	70.9
W2	SOL	13.0	27.2	34.3	38.5	43.4	46.7	49.8	56.5	40.0
WH UW	SOL	45.8	78.0	106.0	129.0	161.0	189.0	220.0	306.0	147.2
WH1	SOL	71.9	129.0	178.0	216.0	271.0	317.0	369.0	511.0	246.7
WH10	SOL	25.6	40.9	49.2	54.5	60.9	65.5	70.1	80.5	56.9
WH11	SOL	52.9	79.5	96.7	108.0	124.0	135.0	147.0	176.0	115.0
WH13	SOL	18.7	31.4	39.1	44.2	50.6	55.5	60.3	71.9	46.9
WH2	SOL	70.1	124.0	170.0	207.0	261.0	307.0	358.0	502.0	237.8
WH3	SOL	35.2	52.6	63.9	71.6	81.4	89.0	96.7	116.0	75.9
WH4	SOL	50.2	86.9	121.0	147.0	188.0	222.0	261.0	374.0	171.0
WH5	SOL	30.3	51.1	70.4	86.0	109.0	129.0	152.0	217.0	99.6
WH6	SOL	2.1	3.4	4.7	5.7	7.1	8.3	9.7	13.6	6.5
WH7	SOL	16.7	30.3	38.8	44.4	51.6	57.0	62.5	75.7	47.4
WH8	SOL	33.3	54.6	75.0	91.6	117.0	138.0	163.0	235.0	106.5
WH9	SOL	1.0	1.9	3.0	3.9	5.4	6.8	8.5	14.1	4.9
H KITT	FOREST	4.9	16.2	25.5	32.4	42.0	49.7	57.8	79.0	37.3
H1	FOREST	25.2	58.2	85.8	107.0	138.0	164.0	192.0	270.0	124.2
H10	FOREST	1.7	4.2	6.3	7.9	10.2	12.1	14.3	20.2	9.2
H11	FOREST	1.1	3.9	6.2	7.8	9.9	11.6	13.4	17.7	8.8
H12	FOREST	0.6	2.1	3.4	4.6	6.3	7.8	9.5	14.6	5.6

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Sub-Basin	Scen-ario	Peak Annual Flow Frequency (CFS) 1.01-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr	Mean of 2-100 Yr Flows
H1+WH1	FOREST	47.7	113.0	165.0	204.0	260.0	306.0	356.0	489.0	234.0
H2	FOREST	3.1	6.7	9.6	11.8	14.9	17.3	20.0	27.3	13.4
H3	FOREST	4.2	10.3	15.0	18.5	23.2	27.0	31.1	41.7	20.9
H4	FOREST	13.6	40.0	60.9	76.4	97.7	115.0	133.0	180.0	87.2
H5	FOREST	3.1	8.8	12.7	15.4	18.8	21.4	24.1	30.5	16.9
H6	FOREST	10.3	32.2	49.7	62.8	80.8	95.2	111.0	150.0	72.0
H7	FOREST	0.6	3.2	4.5	5.2	5.8	6.2	6.4	6.9	5.2
H8	FOREST	4.9	15.2	23.2	29.1	37.1	43.5	50.2	67.4	33.1
H9	FOREST	4.9	16.4	26.4	34.1	45.0	54.0	63.9	90.2	40.0
J1	FOREST	8.7	24.1	35.6	44.0	55.4	64.5	74.0	98.2	49.6
J2	FOREST	3.2	6.7	9.2	11.0	13.5	15.4	17.5	22.7	12.2
J3	FOREST	3.6	7.5	10.3	12.3	15.0	17.1	19.4	25.1	13.6
J4	FOREST	3.7	14.5	23.6	30.4	39.6	47.0	54.7	74.5	35.0
J5	FOREST	3.8	14.9	24.2	31.1	40.7	48.4	56.4	77.1	36.0
J6	FOREST	1.1	2.7	4.4	6.0	8.4	10.6	13.2	21.4	7.5
J7	FOREST	0.031	0.041	0.068	0.103	0.183	0.283	0.441	1.250	0.2
J8	FOREST	0.4	1.3	2.4	3.6	5.6	7.7	10.4	20.1	5.2
L PONCE	FOREST	1.4	3.5	5.3	6.6	8.6	10.2	12.0	17.0	7.7
L1	FOREST	4.9	9.9	14.3	17.8	22.9	27.2	32.1	45.9	20.7
L2	FOREST	4.6	9.7	14.0	17.5	22.5	26.7	31.4	44.6	20.3
L3	FOREST	1.8	5.4	8.5	10.8	14.1	16.8	19.7	27.5	12.5
L4	FOREST	1.8	4.0	5.8	7.2	9.3	11.0	12.8	18.0	8.4
L5	FOREST	1.4	3.5	5.3	6.6	8.6	10.2	12.0	17.0	7.7
L6	FOREST	0.9	3.2	5.3	7.0	9.6	11.8	14.2	21.0	8.5
L7	FOREST	2.3	6.2	9.6	12.3	16.2	19.6	23.3	33.6	14.5
M1	FOREST	0.2	0.4	0.6	0.7	0.8	0.9	1.0	1.3	0.8
M3	FOREST	CLOSED BASIN								ERR
R1	FOREST	2.8	8.9	15.9	22.2	32.6	42.5	54.5	93.0	29.4
R2	FOREST	1.7	4.3	7.0	9.3	13.0	16.4	20.3	32.5	11.7
R3	FOREST	0.2	0.5	1.1	2.1	5.0	9.4	17.6	75.1	5.9
R4	FOREST	2.6	8.8	14.3	18.7	24.9	30.0	35.7	50.9	22.1
R5	FOREST	1.2	4.0	6.5	8.4	11.4	13.8	16.6	24.2	10.1
R6	FOREST	0.7	1.4	1.9	2.3	2.9	3.4	3.9	5.2	2.6
S1	FOREST	12.1	35.3	51.8	63.3	78.3	89.7	101.0	130.0	69.9
S2	FOREST	11.5	34.6	51.1	62.5	77.3	88.7	100.0	128.0	69.0
S3	FOREST	5.8	17.2	24.4	29.0	34.7	38.7	42.7	51.7	31.1
S4	FOREST	4.6	13.7	21.0	26.5	34.1	40.3	46.9	64.2	30.4
S5	FOREST	3.5	10.6	16.5	20.8	26.9	31.8	37.1	51.0	24.0
S6	FOREST	0.9	1.8	2.6	3.1	3.9	4.6	5.3	7.2	3.6
S7	FOREST	CLOSED BASIN								ERR
S8	FOREST	4.5	12.9	18.2	21.6	25.7	28.7	31.6	38.2	23.1
S9	FOREST	4.3	10.0	14.2	17.2	21.3	24.5	27.9	36.6	19.2
W1	FOREST	4.2	14.1	21.9	27.7	35.5	41.7	48.3	64.9	31.5

12-Apr-91 MODELED FLOW FREQUENCIES UNDER VARIOUS LAND USE SCENARIOS

Hylebos and Lower Puget Sound Basins

Scenario:
FOREST= Pre-developed Land Use
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FH= Future Land Use Without Detention (Worst Case Scenario)
SOL= Future land use with regional cips and on-site detention
SOLA= Future land use with regional cips and on-site detention sized with 7-day storms on till pre-forest areas.

Sub-Basin	Scen-ario	Peak Annual Flow Frequency (CFS) 1.01-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr	Mean of 2-100 Yr Flows
W2	FOREST	2.2	6.9	11.0	14.1	18.5	22.1	26.1	36.8	16.5
WH UW	FOREST	9.8	25.2	36.4	44.4	55.2	63.6	72.4	94.7	49.5
WH1	FOREST	23.1	55.1	80.1	98.8	125.0	146.0	168.0	228.0	112.2
WH10	FOREST	3.1	9.4	13.8	16.9	20.8	23.8	26.8	34.0	18.6
WH11	FOREST	3.6	13.9	23.5	31.2	42.4	51.8	62.3	90.8	37.5
WH13	FOREST	CLOSED BASIN								ERR
WH2	FOREST	21.0	51.0	74.5	92.1	117.0	137.0	158.0	215.0	104.9
WH3	FOREST	5.1	18.1	28.8	36.9	48.1	57.1	66.7	91.6	42.6
WH4	FOREST	12.1	31.0	45.0	55.1	68.6	79.2	90.4	119.0	61.6
WH5	FOREST	6.0	17.3	25.3	30.9	38.2	43.7	49.4	63.3	34.1
WH6	FOREST	0.5	1.9	2.9	3.5	4.3	4.8	5.4	6.6	3.8
WH7	FOREST	3.6	6.8	9.4	11.4	14.4	16.8	19.5	27.0	13.0
WH8	FOREST	7.0	18.6	28.5	36.1	47.0	56.1	66.2	93.4	42.1
WH9	FOREST	0.3	0.8	1.1	1.3	1.6	1.8	2.1	2.7	1.4
H KITT	FH	38.5	57.5	73.3	85.2	102.0	116.0	131.0	171.0	94.2
H1	FH	136.0	259.0	329.0	375.0	430.0	471.0	511.0	604.0	395.8
H10	FH	5.4	13.3	18.3	21.6	25.7	28.8	31.9	39.1	23.3
H11	FH	9.0	17.4	21.5	23.9	26.7	28.6	30.3	34.1	24.7
H12	FH	1.1	6.2	9.0	10.5	11.9	12.8	13.4	14.6	10.6
H1+WH1	FH	239.0	479.0	617.0	705.0	814.0	892.0	970.0	1150.0	746.2
H2	FH	17.3	35.5	46.2	53.1	61.6	67.9	74.0	88.4	56.4
H3	FH	25.7	55.4	70.7	79.8	90.3	97.6	104.0	119.0	83.0
H4	FH	91.2	153.0	192.0	218.0	252.0	277.0	303.0	366.0	232.5
H5	FH	13.5	29.9	38.2	43.0	48.5	52.2	55.6	62.9	44.6
H6	FH	78.3	124.0	156.0	177.0	205.0	227.0	249.0	305.0	189.7
H7	FH	1.1	6.4	8.9	10.0	10.9	11.4	11.7	12.2	9.9
H8	FH	32.3	64.3	80.6	90.3	102.0	110.0	117.0	133.0	94.0
H9	FH	46.9	81.0	98.1	108.0	120.0	128.0	136.0	153.0	111.9
J1	FH	54.8	115.0	147.0	167.0	190.0	206.0	222.0	256.0	174.5
J2	FH	10.6	25.5	37.3	46.1	58.4	68.4	79.3	108.0	52.5
J3	FH	12.2	28.2	40.6	49.8	62.7	73.1	84.3	114.0	56.4
J4	FH	32.1	65.5	81.3	90.2	100.0	107.0	113.0	126.0	92.8
J5	FH	31.1	65.3	81.4	90.6	101.0	107.0	114.0	126.0	93.2
J6	FH	29.1	45.7	58.3	67.6	80.2	90.4	101.0	130.0	73.9
J7	FH	3.4	5.3	6.8	8.0	9.8	11.2	12.8	17.1	9.0
J8	FH	17.8	28.2	36.4	42.4	50.8	57.7	65.1	84.6	46.8
L PONCE	FH	6.6	16.9	23.1	27.1	31.9	35.5	38.9	46.7	28.9
L1	FH	40.0	71.3	88.0	98.2	110.0	119.0	128.0	146.0	102.4
L2	FH	37.3	68.0	84.6	94.9	107.0	116.0	124.0	144.0	99.1
L3	FH	20.8	38.0	47.0	52.5	58.9	63.5	67.9	77.6	54.6
L4	FH	12.0	24.8	32.4	37.2	43.1	47.5	51.7	61.6	39.5
L5	FH	12.2	23.9	30.2	34.0	38.6	41.8	45.0	51.9	35.6
L6	FH	7.7	9.8	12.6	15.0	18.7	22.1	26.1	38.0	17.4

2-Apr-91 MODELED FLOW FREQUENCIES UNDER VARIOUS LAND USE SCENARIOS

Hylebos and Lower Puget Sound Basins

cenario:
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SOLA= Future land use with regional cips and on-site detention sized with 7-day storms on till pre-forest areas.

ub-asin	Scen-ario	Peak Annual Flow Frequency (CFS) 1.01-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr	Mean of 2-100 Yr Flows
L7	FH	18.1	35.6	46.0	52.7	60.9	67.0	73.0	87.1	55.9
M1	FH	0.4	0.9	1.1	1.3	1.6	1.8	2.0	2.5	1.5
M3	FH	CLOSED BASIN								ERR
R1	FH	40.2	79.8	102.0	116.0	132.0	144.0	156.0	183.0	121.6
R2	FH	14.2	27.7	35.7	40.9	47.3	52.0	56.6	67.5	43.4
R3	FH	0.6	6.4	8.5	9.2	9.5	9.7	9.7	9.8	8.8
R4	FH	16.5	40.6	52.6	59.3	66.9	71.8	76.4	85.6	61.3
R5	FH	11.8	21.4	26.2	29.1	32.5	34.8	37.0	41.8	30.2
R6	FH	2.2	4.9	6.8	8.1	9.8	11.1	12.5	15.8	8.9
S1	FH	84.9	163.0	199.0	220.0	243.0	258.0	273.0	303.0	226.0
S2	FH	81.9	162.0	200.0	222.0	246.0	263.0	278.0	311.0	228.5
S3	FH	30.7	59.3	73.6	82.1	91.8	98.6	105.0	119.0	85.1
S4	FH	44.6	82.3	101.0	111.0	124.0	132.0	140.0	157.0	115.1
S5	FH	20.6	46.0	59.0	66.6	75.4	81.5	87.1	99.2	69.3
S6	FH	3.1	6.3	8.8	10.6	13.2	15.3	17.5	23.4	12.0
S7	FH	20.2	23.5	25.6	27.0	28.7	30.0	31.3	34.2	27.7
S8	FH	15.1	31.5	40.7	46.4	53.4	58.3	63.2	74.2	48.9
S9	FH	28.1	51.1	64.4	72.9	83.4	91.2	98.8	117.0	77.0
W1	FH	32.3	66.7	84.6	95.3	108.0	117.0	125.0	143.0	99.4
W2	FH	18.0	35.6	44.2	49.2	54.8	58.6	62.2	69.7	50.8
WH UW	FH	75.5	155.0	212.0	252.0	306.0	348.0	393.0	506.0	277.7
WH1	FH	121.0	235.0	311.0	363.0	431.0	484.0	538.0	671.0	393.7
WH10	FH	35.4	55.9	66.3	72.5	79.9	85.1	90.1	101.0	75.0
WH11	FH	69.1	103.0	126.0	141.0	161.0	177.0	193.0	232.0	150.2
WH13	FH	20.7	77.9	114.0	136.0	162.0	180.0	197.0	233.0	144.5
WH2	FH	117.0	233.0	309.0	360.0	427.0	477.0	529.0	655.0	389.2
WH3	FH	54.1	88.8	106.0	117.0	130.0	138.0	147.0	166.0	121.1
WH4	FH	85.3	172.0	234.0	280.0	341.0	389.0	441.0	573.0	309.5
WH5	FH	53.9	98.5	125.0	143.0	164.0	180.0	197.0	235.0	151.3
WH6	FH	2.6	4.3	5.8	7.0	8.7	10.1	11.7	16.2	7.9
WH7	FH	21.4	72.8	106.0	127.0	153.0	171.0	189.0	228.0	136.5
WH8	FH	78.6	141.0	172.0	191.0	214.0	229.0	244.0	277.0	198.5
WH9	FH	1.2	2.6	4.0	5.0	6.7	8.1	9.7	14.3	6.0
WH UW	SOLA	42.7	72.9	95.9	113.0	136.0	155.0	174.0	227.0	124.5
WH1	SOLA	68.0	123.0	161.0	187.0	222.0	249.0	277.0	348.0	203.2
WH10	SOLA	25.3	40.3	47.9	52.4	57.7	61.4	65.0	72.9	54.1
WH11	SOLA	52.8	78.7	96.0	108.0	123.0	135.0	147.0	177.0	114.6
WH13	SOLA	14.7	26.1	32.6	36.7	41.7	45.4	49.0	57.4	38.6
WH2	SOLA	66.5	118.0	154.0	179.0	213.0	240.0	267.0	338.0	195.2
WH3	SOLA	34.0	51.5	60.3	65.6	71.8	76.2	80.4	89.7	67.6
WH4	SOLA	46.8	80.8	108.0	128.0	156.0	180.0	205.0	272.0	143.0
WH5	SOLA	29.6	49.4	64.5	75.6	90.8	103.0	116.0	151.0	83.2
WH6	SOLA	2.0	3.4	4.4	5.1	6.0	6.8	7.6	9.7	5.5

12-Apr-91 MODELED FLOW FREQUENCIES UNDER VARIOUS LAND USE SCENARIOS

Hylebos and Lower Puget Sound Basins

Scenario:
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SOL= Future land use with regional cips and on-site detention
SOLA= Future land use with regional cips and on-site detention sized with 7-day storms on till pre-forest areas.

Sub-Basin	Scen-ario	Peak Annual Flow Frequency (CFS) 1.01-Yr	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr	Mean of 2-100 Yr Flows
WH7	SOLA	14.4	26.7	33.7	38.3	43.9	48.0	52.1	61.7	40.5
WH8	SOLA	32.8	53.0	68.5	79.9	95.7	109.0	122.0	158.0	88.0
WH9	SOLA	1.0	1.9	2.7	3.4	4.5	5.4	6.5	9.8	4.1
H KITT	SOLA	15.4	28.6	36.6	41.9	48.7	53.7	58.8	71.0	44.7
H1	SOLA	60.4	127.0	169.0	196.0	231.0	257.0	283.0	345.0	210.5
H10	SOLA	3.5	9.3	12.8	15.0	17.6	19.5	21.4	25.6	15.9
H11	SOLA	3.3	7.9	10.6	12.4	14.6	16.2	17.8	21.4	13.2
H12	SOLA	1.2	5.5	7.5	8.3	9.2	9.6	9.9	10.4	8.3
H1+WH1	SOLA	128.0	248.0	325.0	377.0	445.0	497.0	549.0	678.0	406.8
H2	SOLA	7.9	15.9	21.0	24.3	28.6	31.7	34.9	42.6	26.1
H3	SOLA	9.7	20.0	25.4	28.7	32.6	35.3	37.9	43.7	30.0
H4	SOLA	41.5	82.9	107.0	123.0	143.0	158.0	172.0	206.0	131.0
H5	SOLA	9.4	20.1	26.4	30.5	35.4	39.0	42.5	50.5	32.3
H6	SOLA	32.7	63.1	81.3	93.2	108.0	119.0	130.0	156.0	99.1
H7	SOLA	1.0	5.0	6.7	7.6	8.3	8.7	9.0	9.5	7.5
H8	SOLA	19.0	37.0	47.0	53.3	60.9	66.4	71.7	83.9	56.1
H9	SOLA	29.2	51.1	62.4	69.2	77.3	83.0	88.5	101.0	71.9

Regional Capital Improvement Projects Simulated Include the :
Following Projects:

West Hylebos: 2430, 2435, 2436, and 2437.
East Hylebos: 2443, 2444.
Joes Creek: 3330. (By-pass with driving range detention).
Lakota Creek: Enhanced Detention at Wetland 9
Cold Creek: 3325.
McSorley: Assumes Midway Landfill Detention Pond in place.

On-site Detention: SOLA: 2-10+30% in all basins according to 1989 release of King County drainage manual.
No on-site detention assumed in area tributary to Panther Lake
SOLB: 2-10+30% in all basins according to 1989 release of King County drainage manual, but with 7-day storms.

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