EPA 910/9-89-006

Puget Sound Estuary Program

EVERETT HARBOR ACTION PROGRAM: 1989 ACTION PLAN

March 1989

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EVERETT HARBOR ACTION PROGRAM: 1989 ACTION PLAN

For

U.S. Environmental Protection Agency
Region 10 - Office of Puget Sound
Seattle, Washington 98101

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GLOSSARY AND LIST OF ABBREVIATIONS

AGENCY AND PROGRAM NAMES

CAC	Citizens Advisory Committee
COE	U.S. Army Corps of Engineers
Ecology	Washington Department of Ecology
EHAT	Everett Harbor Action Team
EPA	U.S. Environmental Protection Agency
IAWG	Interagency Work Group
NPDES	National Pollutant Discharge Elimination System (EPA/Ecology)
PSDDA	Puget Sound Dredged Disposal Analysis Program
PSEP	Puget Sound Estuary Program (EPA/Ecology/PSWQA), including urban bay action programs such as the Everett Harbor Action Program
PSWQA	Puget Sound Water Quality Authority
RCRA	Resource Conservation and Recovery Act
Superfund	EPA and Ecology programs under the Comprehensive Environmental Response, Compensation and Liability Act to clean up hazardous waste sites or other areas of toxic contamination

CHEMICAL NAMES

HPAH	High molecular weight polycyclic aromatic hydrocarbons
LPAH	Low molecular weight polycyclic aromatic hydrocarbons
PAH	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls

POLLUTANT SOURCE NAMES

CSO	Combined sewer overflow. A discharge of raw sewage diluted with stormwater, which occurs whenever the hydraulic capacity of a combined sewer line is exceeded.

OTHER TERMS

AET	Apparent effects threshold. Chemical concentrations in sediments above which a particular adverse biological effect is expected to be statistically significant ($P<0.05$) relative to appropriate reference conditions.
Amphipod	A small organism that superficially resembles a shrimp and lives on the sea bottom. Amphipods are used in laboratory bioassays to test the toxicity of sediments.
Benthic	Pertaining to the bottom of a body of water
Bioaccumulation	The accumulation of a substance in tissues of an organism. Bioaccumulation of toxic substances may lead to disease or other health problems.
Bioassay	A laboratory test used to evaluate the toxicity of a material (commonly sediments or wastewater) by measuring behavioral or physiological responses (including death) of organisms.
Community	A group of interacting species populations found within a defined area.
Diversity	The number of species in a community, or a mathematical index of the variety of species that also accounts for the relative abundance of each species.
Infauna	Animals living within the bottom sediments.
Invertebrates	Animals without backbones.
Lesion	An abnormal structural change in the body due to injury or disease (e.g., a liver tumor in fish).
Loading	Quantity of a substance that enters a body of water during a specified time interval (e.g., pounds per year).
Nonpoint Source	A nonspecific source of pollutants, often from a large area (e.g., stormwater drainage).
Sediment	Material that settles to the bottom of a body of water or that collects on the bottom of pipes such as sewers and storm drains.
Toxic Contamination	Presence of toxic substances, often caused by releases of metals or synthetic organic chemicals to the environment.

ACKNOWLEDGMENTS

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The primary authors of this report are Mr. Pieter Booth and Dr. Robert Pastorok of PTI Environmental Services. Dr. Thomas Ginn of PTI provided technical review comments.

The Everett Harbor Action Program has benefited from the participation of an Interagency Work Group and a Citizens Advisory Committee. Duties of the Everett Harbor Interagency Work Group and Citizens Advisory Committee members included the following: 1) reviewing program documents, agency policies, and proposed actions; 2) providing data reports and other technical information to the U.S. Environmental Protection Agency; and 3) disseminating information to interest groups or constituencies. The past and continuing efforts of the Everett Harbor Interagency Work Group and Citizens Advisory Committee members are greatly appreciated. Special thanks are due to Ms. Joan Thomas, Mr. David Murdock, Mr. David Nunnallee, and Mr. John Williams for chairing the Everett Harbor Interagency Work Group and to Mr. Gary Wold for chairing the Everett Harbor Citizens Advisory Committee. Members of the Everett Harbor Interagency Work Group and Citizens Advisory Committee are listed below.

Everett Harbor Interagency Work Group

Name	Affiliation
Mr. Chuck Dunn	U.S. Fish and Wildlife Service
Ms. Katherine Fletcher	Puget Sound Water Quality Authority
Dr. Jack Gakstatter	U.S. Environmental Protection Agency
Mr. Dennis Gregoire	Port of Everett
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Mr. Edward Long	National Oceanic and Atmospheric Administration
Mr. Edward Lukjanowicz	U.S. Navy Homeporting Office
Mr. David Peterson	Snohomish Health District
Dr. Lawrence McCrone	Washington Department of Ecology
Mr. William Moore	Mayor of Everett
Mr. David Murdock	Washington Department of Ecology
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Name	Affiliation

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Everett Harbor Citizens Advisory Committee

Name	Affiliation
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Mr. Timothy Bechtel	Scott Paper Company
Mr. Ronald Brown	Friends of the Snohomish River
Mr. William Brust	Citizens for Everett's Future
Mr. T.M. Burns	Everett Chamber of Commerce
Mr. Carl Cady	Weyerhaeuser Company
Mr. Michael Deller	Snohomish County Economic Development Council
Mr. Alan Friedman	Sierra Club
Ms. Anne Grubb	Pilchuck Audubon Society
Ms. Lorena Havens	Friends of Snohomish Delta
Mr. James Heil	Puget Sound Alliance
Mr. Mark Houser	Port Gardner Information League
Mr. Peter Hurley	Evergreen Coalition
Mr. Henry Kral	Everett Mountaineers
Mr. Donald Kusler	Pilchuck Audubon Toxics
Ms. Sally Van Niel	Washington Environmental Council
Mr. Gary Wold	Trout Unlimited

EXECUTIVE SUMMARY

Previous studies of Everett Harbor and the lower Snohomish River have revealed extensive contamination of sediments by toxic metals such as copper, lead, zinc, and arsenic, as well as organic compounds such as petroleum products and polychlorinated biphenyls. Some of these substances may pose hazards to the aquatic ecosystem. For example, toxic contamination may decrease the abundance and diversity of bottom-dwelling (benthic) invertebrate communities, increase the prevalence of tissue disorders such as liver tumors in fish, and result in the accumulation of chemicals in tissues of fish and shellfish.

The U.S. Environmental Protection Agency and the Washington Department of Ecology (Ecology), working with the City of Everett and others, developed the Urban Bay Action Program to reduce toxic contamination in urban bays including the Everett Harbor system. The Everett Harbor Action Program 1) identifies existing areas of toxic contamination, 2) identifies known and potential sources of toxic contaminants, 3) establishes schedules for corrective actions to eliminate existing problems and investigate potential problems, and 4) identifies appropriate agencies for implementing corrective actions. Corrective actions may include both source controls and sediment remedial actions (i.e., cleanup), such as capping or removal of contaminated sediments. Source controls may include permit revisions (or permitting of unpermitted discharges) that require a reduction of contaminant concentrations or volume of discharges, and application of best management practices to reduce the contamination of surface runoff.

Priority problem areas were identified by analyzing data on chemical contamination and biological effects (PTI and Tetra Tech 1988). Areas received a high priority ranking if they exhibited particularly high levels of chemical contamination or biological effects, such as high prevalence of liver tumors among bottom-dwelling fish, or very low abundances of benthic invertebrate species. Known and potential contaminant sources were documented for each priority problem area and for the project area in general. This 1989 Action Plan focuses on controlling documented sources in priority problem areas. Generally, sources should be controlled prior to conducting sediment remediation to prevent or minimize recontamination of cleaned-up areas.

The 1989 Action Plan requires the coordinated action of many regulatory and management organizations in the Interagency Work Group to address particular problem areas and specific sources of contamination. In addition to the Interagency Work Group, business, industry, environmental, and citizen groups are represented in the Everett Harbor Citizens Advisory Committee. The Citizens Advisory Committee was consulted to provide direct input into all stages of program development.

The 1989 Action Plan is being carried out through the existing regulatory and resource management mechanisms of federal, state, and local government agencies. Ecology has assigned funding for one full-time employee to form the nucleus of a regional task force, the Everett Harbor Action Team, whose purpose is to identify and recommend controls for contaminant sources.

The regulatory and management efforts of the 1989 Action Plan focus on priority problem areas located in East Waterway, along the south Port Gardner shoreline near Mukilteo, and near industrial and marina areas of the Snohomish River.

The 1989 Action Plan is a working document designed to be refined as new data are made available. The Everett Harbor Interagency Work Group will be responsible for updating and implementing the 1989 Action Plan. The Interagency Work Group will continue to meet on a regular basis (at least quarterly) to review progress made on implementation of the plan, resolve any problems, and refine the plan to reflect new information.

INTRODUCTION

In response to widespread concern over the environmental health of Puget Sound, several agencies with regulatory, resource management, and research responsibilities joined forces in 1985 to initiate the Puget Sound Estuary Program (PSEP). A primary objective of this program is to minimize toxic chemical contamination of Puget Sound to protect fish, shellfish, wildlife, and other living resources. Inner harbors and waterways of Puget Sound, because of their poor flushing characteristics, are easily contaminated by toxic chemicals released into the sound or its drainage basin as a result of human activities. For example, localized areas of high contamination and associated biological effects have been found near discharges from industrial facilities, sewage treatment plants, and urban storm drains.

As a primary element of PSEP, the Urban Bay Action Program focuses on identifying and reducing contaminant releases through a series of coordinated actions by government agencies and private parties (e.g., industries and businesses). Pollution control activities may include improvement of drainage or treatment systems for stormwater and sewage; implementation and, where appropriate, revision of permit conditions for wastewater dischargers; enforcement of hazardous materials regulations; and implementation of best management practices or cleanup measures at sites of concern.

The 1989 Action Plan for the Everett Harbor Action Program is described in this report. The corrective actions developed for specific sites within the Everett Harbor project area are organized according to problem areas identified in *Analysis of Toxic Problem Areas* (PTI and Tetra Tech 1988). For each priority problem area and associated contaminant source, the plan specifies the status of discharges and corrective actions, recommended additional corrective actions, agencies responsible for implementing those actions, and approximate implementation schedules. The remainder of this introduction provides background information on the project area, a description of the Everett Harbor Action Program, and a summary of the technical approach used to evaluate priority problem areas and contaminant sources.

OVERVIEW OF EVERETT HARBOR AND ITS TOXIC CONTAMINATION PROBLEMS

The Everett Harbor project area, located adjacent to the eastern portion of Possession Sound in the north-central Puget Sound region, includes Port Gardner and the lower Snohomish River estuary (Figure 1). For the purpose of this program, Everett Harbor is defined as the area east of a line joining Elliott Point in Mukilteo with the western point of Mission Beach at the entrance of Tulalip Bay. The Snohomish River delta and the estuary east to Interstate 5 are within the project area.

The Snohomish River, which discharges into the eastern portion of Port Gardner, is the major source of fresh water to the project area and to north-central Puget Sound. Within the project area, the Snohomish River estuary includes four main branches: Ebey Slough, Steamboat Slough, Union Slough, and the lower Snohomish River channel. The Snohomish River channel carries the major portion of the river's flow. During the dry season, tidal saltwater intrusions have been observed as far upstream as 11 kilometers from Preston Point. The Snohomish River delta and associated sloughs and wetlands together provide one of the most biologically rich habitats in Puget Sound. Living

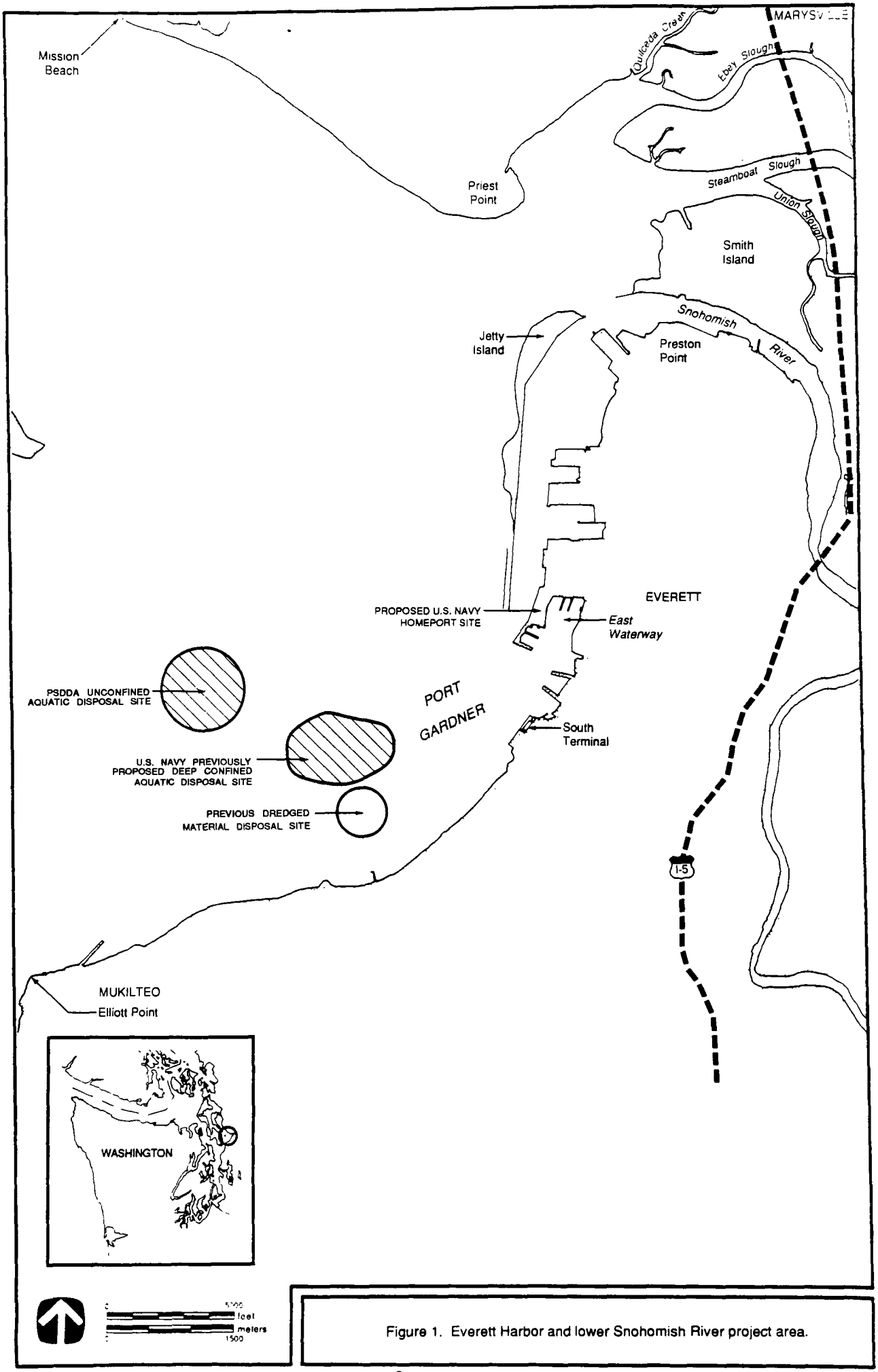


Figure 1. Everett Harbor and lower Snohomish River project area.

resources of Everett Harbor include commercially and recreationally harvested salmon and steelhead, abundant Dungeness crab populations, several species of perch and bottomfish, and intertidal clams.

In the early 1900s, a dike was built to divert Snohomish River flows southward along the Everett shoreline and to provide a channel for a freshwater port. A second dike was constructed from the shore to form the East Waterway. Historical as well as recent maritime and industrial activities have centered largely around the East Waterway and along the shoreline northward to Preston Point. At present, wastewater outfalls of major pulp and paper industries are located in the East Waterway, Steamboat Slough, and Port Gardner. The depth of the Port Gardner outfall is approximately 100 meters. The discharge from the city of Everett wastewater treatment plant enters the Snohomish River approximately 1.6 kilometers downriver of the Interstate 5 bridge. Other sewage discharges are located just offshore of Mukilteo (from the city of Mukilteo), in Ebey Slough (from the town of Marysville) and offshore from Mission Beach (from the Tulalip Indian Reservation). Historical activities may also have contributed contaminants to the Everett Harbor area. For example, in the late 1800s there were several industries along the Everett-Port Gardner waterfront, including a smelter with an arsenic concentrating facility, a wood preserving plant, several lumber mills, a steel barge works, and a pulp and paper mill.

The watershed draining to the project area encompasses about 280 square kilometers of primarily forested and agricultural lands within the Snohomish River basin. Surface water runoff from parts of Everett is collected by a combined sanitary and storm sewer system and treated at the Everett aerated lagoon wastewater treatment plant. Combined sewer overflows (CSOs) occur at several locations during wet weather conditions when the volume of stormwater and municipal wastewater (sewage) exceeds the flow capacity of the collection and treatment system. There are no CSOs in Marysville and Mukilteo because these cities have storm drain systems that are separated from the sewage collection systems. Most of the runoff from Mukilteo and southwest Everett enters directly into many small streams that discharge to southern Port Gardner. The northern portion of the project watershed is largely composed of forested and agricultural lands that drain to Quilceda Creek and Allen Creek (east of Interstate 5 on Ebey Slough).

As a result of urban and industrial influences, localized areas of nearshore Port Gardner and the lower Snohomish River have been contaminated by toxic chemicals. Investigations by the U.S. Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration, the Port of Everett, and the U.S. Navy have revealed harmful levels of toxic chemicals in sediments on the bottom of the bay and river. The discrete locations of pollutant discharges result in patches of toxic sediments that are among some of the most contaminated areas in Puget Sound. The contaminants include potential carcinogens, such as polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAH), and toxic resin acids and chlorinated organic compounds associated with wastewater from pulp and paper manufacturers.

In comparison with other contaminated embayments of Puget Sound, such as Elliott Bay and Commencement Bay where contaminated areas are more widespread, the severely contaminated areas of the Everett Harbor system are highly localized, occurring mainly within the East Waterway and near Mukilteo. Liver tumors were found in approximately 9 percent of English sole (a bottom-dwelling fish) caught in contaminated areas of Everett Harbor, whereas these lesions are usually absent in fish caught in relatively uncontaminated areas of the sound. In addition, populations of invertebrate animals living in the bottom sediments were severely reduced in highly contaminated areas.

EVERETT HARBOR ACTION PROGRAM

In January 1985, PSEP member agencies initiated the Everett Harbor Action Program. This program was built partly on the past and continuing environmental programs of the Washington Department of Ecology (Ecology), the Port of Everett, the city of Everett, and others.

Through a process of interagency coordination, local government support, and public participation, the Everett Harbor Action Program has focused new and continuing pollution control efforts on priority problem areas. The objectives of the Everett Harbor Action Program include the following:

- Identify specific toxic areas of concern in sediments of the project area based on chemical contamination and associated adverse biological effects
- Identify historical and ongoing sources of contamination
- Rank toxic problem areas and sources (to the extent possible) in terms of priority for development of corrective actions
- Implement corrective actions to reduce or eliminate sources of ongoing pollution and restore polluted areas to support natural resources and beneficial uses.

The Everett Harbor Action Program has followed a process in which corrective actions are developed and implemented in phases to take advantage of new scientific data and emerging ideas about practical solutions to toxic contamination problems (Figure 2). First, existing data on sediment contamination and biological effects were analyzed, and priority problem areas were identified (Tetra Tech 1985a). Second, data gaps were filled by further sampling and analysis (PTI and Tetra Tech 1988; Tetra Tech 1988). Finally, based on the results of the first steps of the program, the 1989 Action Plan was developed to determine priorities for corrective actions. The 1989 Action Plan may be revised in the future as new data become available to refine the definition of environmental problem areas and contaminant sources.

Sediment remedial actions and environmental monitoring are potential long-term components of the Everett Harbor Action Program. Examples of sediment remedial activities include capping contaminated sediments with clean materials or removing contaminated sediments by dredging. Generally, source controls should be implemented before remedial actions are taken on sediments to avoid recontamination of an area that has been cleaned up. Moreover, sediment remediation is an expensive and complex process that requires considerable site-specific data and review of environmental effects during the planning process. To determine the best course of action, regulatory and resource management agencies must evaluate the environmental benefits and risks of alternative sediment remedial actions relative to costs. Monitoring is conducted to evaluate the effectiveness of source control and sediment remediation (Figure 2).

Implementation of Action Plans

The 1989 Action Plan serves as a blueprint for field investigations, permit review, site cleanup, and other activities intended to control pollutant sources. Activities specified in the action plan are to be carried out through the coordinated efforts of a

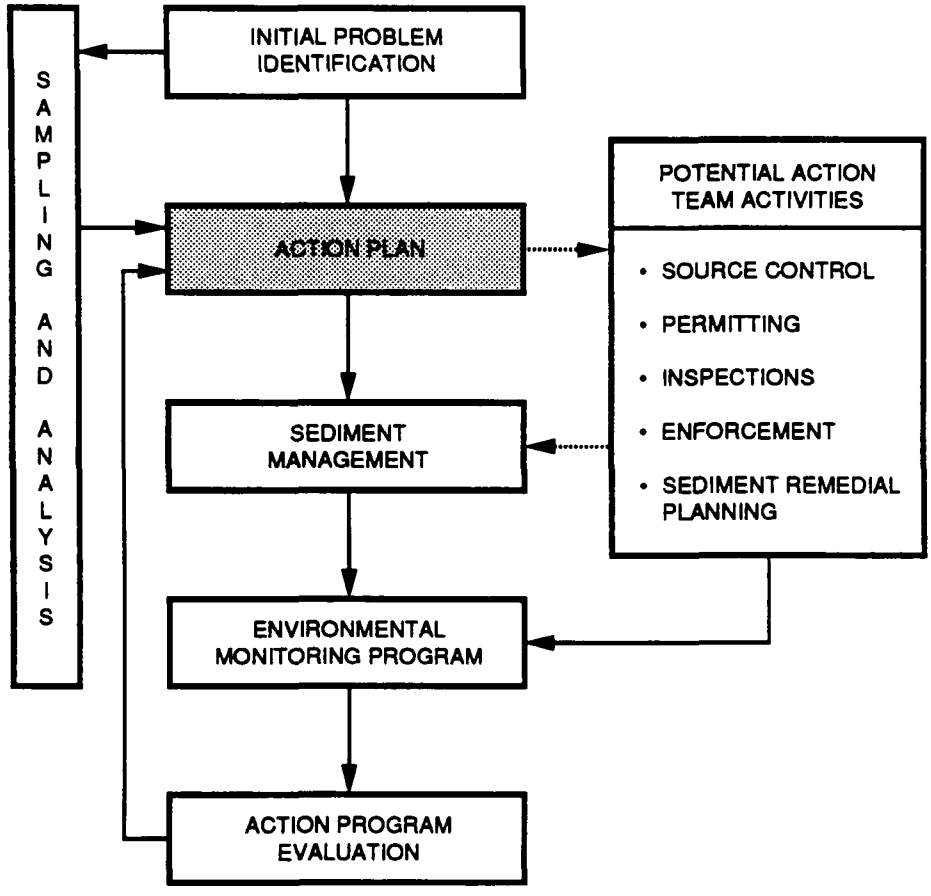


Figure 2. Elements of the Everett Harbor Action Program.

regional task force, the Everett Harbor Action Team (EHAT), and several agencies and other organizations. Presently, Ecology has funding for one full-time EHAT member. Ecology will use its resources primarily for carrying out source control actions. Such actions will include, but are not limited to, the following: issuing permits; performing facilities inspections, contaminated site assessments, site investigations, and site cleanup; enforcing existing regulations; and assisting in the development of educational programs.

Other important activities of Ecology and EHAT include the following:

- Involvement in the coordination of sediment remedial work (e.g., capping *in situ* contaminated sediments or dredging contaminated sediments followed by upland disposal)
- Oversight and coordination of 1989 Action Plan activities for which local jurisdictions are primarily responsible
- Source identification, including performing field evaluations and sampling and analysis, and responding to public complaints
- Coordination with Ecology's industrial section on matters concerning key permits
- Organization and chairing of quarterly Interagency Work Group meetings for Action Plan review and update, and preparation and distribution of meeting minutes.

Regulatory authority for EHAT stems primarily from Ecology, which is responsible for issuing discharge permits (including permits for storm drains) and conducting site inspections under state water pollution control laws and regulations, the federal Clean Water Act, and hazardous substance control programs. Major regulatory responsibility also lies with the City of Everett, which owns and operates lift stations, pump stations, regulators, and a sewage treatment plant. The City of Everett is responsible for issuing and enforcing permits for discharges from industrial or commercial facilities to the sanitary sewer system. The City of Everett also owns and maintains storm drain and sewer collection systems. Under various environmental regulations, other agencies (e.g., the Port of Everett) and private industries are responsible for pollution prevention and abatement related to their property and activities, including control of storm drain discharges.

Past Accomplishments

EPA funded the development of the Everett Harbor Action Program in January 1985. In 1985, EPA presented draft reports of the guidelines for defining toxic problem areas based on measures of contamination and biological effects, initial assessment of problem areas based on available data (Tetra Tech 1985a), and the sampling and analysis design for further investigations to fill data gaps (Tetra Tech 1985b).

The Interagency Work Group (IAWG) and the Citizens Advisory Committee (CAC) were formed in 1985 to contribute to the technical development of the program and to develop the action plan. The IAWG was composed of representatives from federal, state, and local government agencies, and the CAC was composed of representatives from business organizations, industries in the study area, and environmental groups, as well as residents of the Everett area who are interested in the reduction of contaminant inputs to the river

and harbor. Duties of the Everett Harbor IAWG and CAC members included: 1) reviewing program documents, agency policies, and proposed actions; 2) providing data reports and other technical information to EPA; and 3) disseminating action program information to respective interest groups or constituencies.

Ecology funded EHAT in September 1985. Between September 1985 and September 1987, EHAT, in conjunction with EPA, other groups at Ecology, and local government agencies, performed a variety of source control actions and initiated several investigations, including:

- Issuing notices of violation to two area industries discharging process water to Everett's sanitary sewer
- Initiating hazardous waste investigations (with Snohomish County) at Paine Field
- Conducting source evaluation investigations at two waterfront facilities
- Conducting an investigation at the Tulalip landfill
- Participating in ongoing investigations at the Mukilteo Defense Fuel Supply Depot (Ryan 1987).

TECHNICAL APPROACH

During late 1986, EPA conducted field surveys to collect data in support of the Everett Harbor Action Program. The field surveys were designed to provide an assessment of environmental contamination and effects (PTI and Tetra Tech 1988) and an initial evaluation of potential contaminant sources (Tetra Tech 1988). This section describes the approach used to identify and rank problem areas in terms of priority for action and the approach used to evaluate potential contaminant sources.

Identification and Ranking of Problem Areas

The five types of environmental indicators (Figure 3) used to identify and rank problem areas are:

- **Sediment Chemistry**
  - Contaminant concentrations
  - Apparent effects thresholds (AET), which are chemical concentrations in sediments above which a particular adverse biological effect is expected to be statistically significant ($P<0.05$) relative to appropriate reference conditions
- **Bioaccumulation**
  - Pesticide, PCB, and mercury concentrations in muscle tissue of English sole

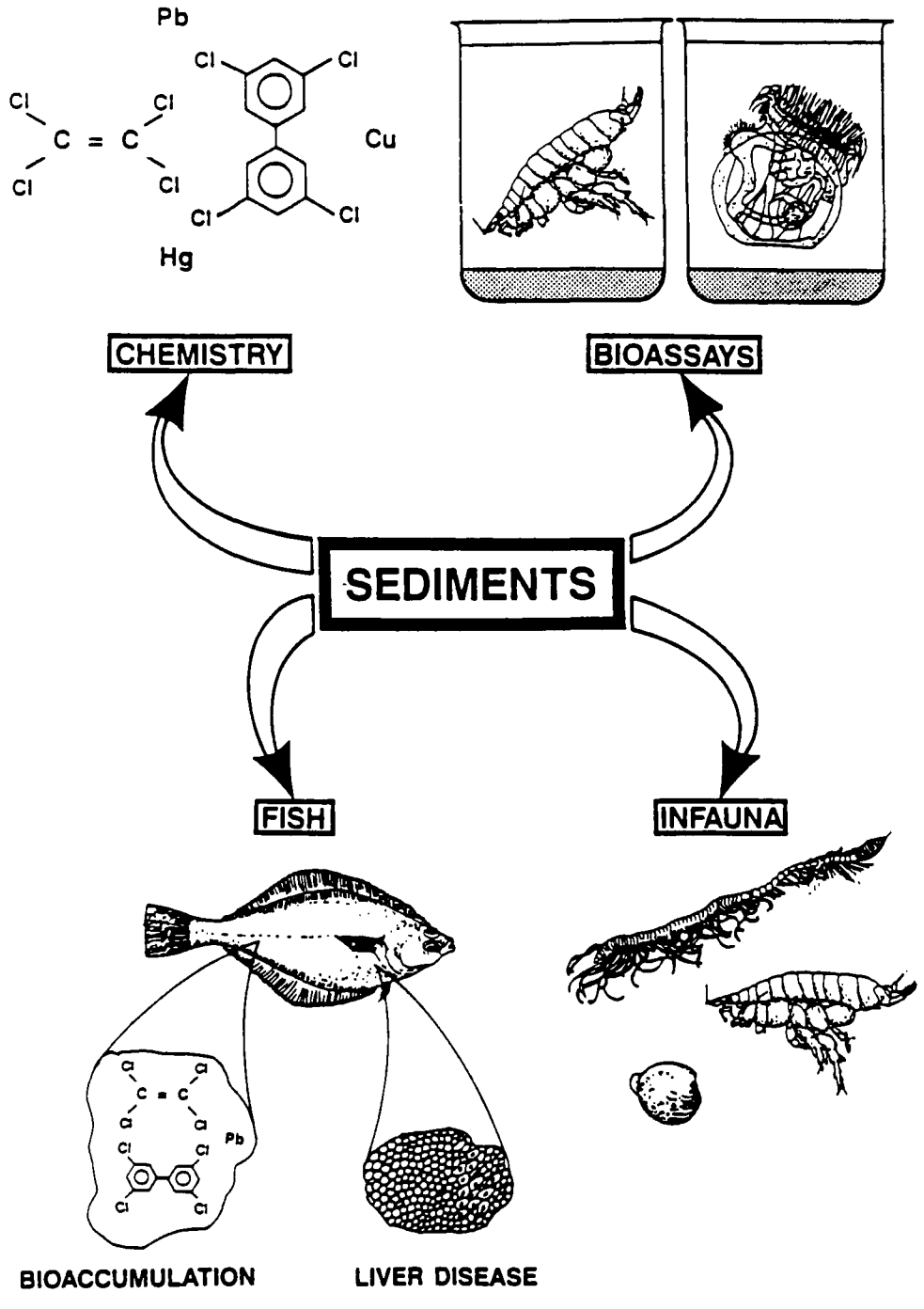


Figure 3. Environmental indicators used to define problem areas of sediment contamination and biological effects.

- **Sediment Bioassays**
  - Amphipod mortality (10-day bioassay)
  - Oyster larvae abnormality
- **Benthic Infauna Abundances**
  - Polychaete abundance
  - Crustacean abundance
  - Pelecypod abundance
  - Gastropod abundance
- **Fish Pathology**
  - Lesion (e.g., tumor) prevalence in livers of English sole.

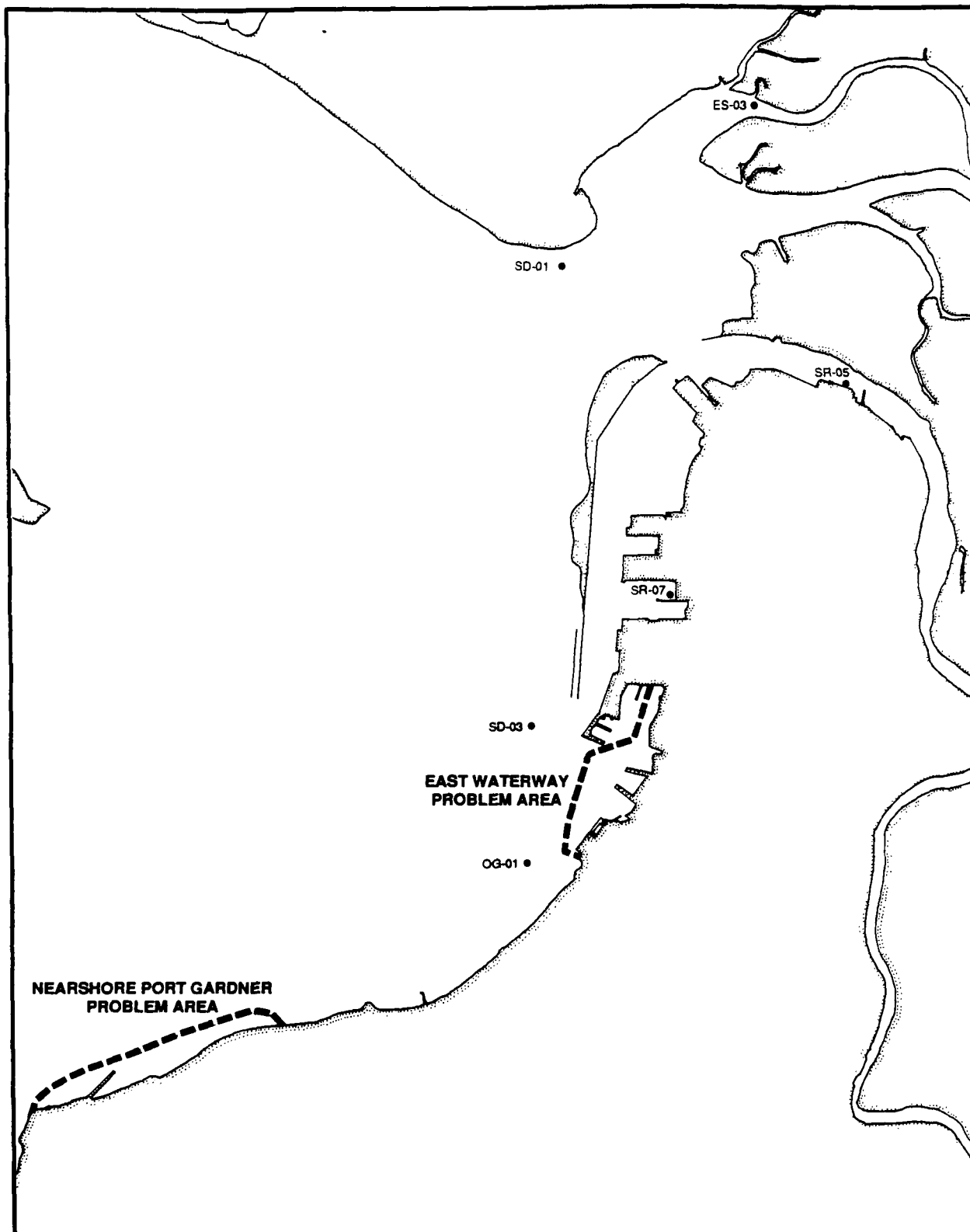
The rationale for using the five kinds of environmental indicators is provided in Tetra Tech (1985a) and Tetra Tech (1986). Puget Sound AET were used as sediment quality values to evaluate chemical data relative to predicted biological effects. Because AET are predictive, they were especially useful in interpreting historical data on sediment contaminant levels where no synoptic biological data were available. Although many other variables were evaluated throughout the decision-making process, those shown above formed the basis for problem identification and priority ranking.

An approach based on a preponderance of evidence was used to identify and rank problem areas. Study areas that exhibited high values for multiple indicators of contamination and adverse effects received the highest priority ranking. Priority problem areas and stations are illustrated in Figure 4. Corrective actions have not been identified in areas where problem sediments were not found, although source control activities may be necessary to meet other regulatory requirements. Prioritization of problem areas based on multiple indicators of chemical contamination and biological effects will facilitate effective use of resources for pollutant source investigations and remedial actions.

Identification of Potential Contaminant Sources

Potential sources of contamination in the lower Snohomish River and Everett Harbor include municipal wastewater treatment plants, CSOs, surface runoff, contaminated groundwater, industrial discharges, atmospheric deposition, and accidental spills. Contaminant sources in the Everett Harbor project area were identified based on the following: 1) existing information about past and present activities, and 2) information from site inspections and discharge permits. Information and some data were available from Ecology for facilities with permitted or known nonpermitted discharges, facilities contributing to contamination due to poor housekeeping practices, and sites with groundwater or soils contamination. Several major CSOs and storm drains were also identified as contaminant sources.

To better characterize contaminant inputs from CSOs and storm drains, EPA conducted a screening-level survey in 1986 (see Tetra Tech 1988). During this effort, sediments were collected from the downstream portions of two CSOs and one storm drain that discharge directly into the East Waterway. In addition, four groundwater samples were collected from three monitoring wells at the Mukilteo Defense Fuel



NOTE: Problem Stations - Criteria for defining problem stations are given in PTI and Tetra Tech (1988).

Problem Areas - Contain several problem stations. Lines delineating problem areas are estimated boundaries based on available data (including historical data) and are not highly precise. Stations not exceeding the criteria may exist within problem areas.

Reference: PTI and Tetra Tech (1988).

Figure 4. Problem areas and problem stations in the Everett Harbor project area.

Supply Depot (an area of groundwater contamination). Samples of groundwater from the Mukilteo Defense Fuel Supply Depot and samples of sediment from the drains were analyzed for the same contaminants measured in offshore sediments. Groundwater, storm drains, and other potential sources were evaluated for their potential contribution of contaminants to priority problem areas and problem stations identified in Figure 4. Tetra Tech (1988) evaluated various potential sources based on the following elements:

- Proximity of the potential source to the problem station offshore
- Similarity of problem chemicals in sediments of drains and in the receiving environment
- Similarity of the relative percent distribution of chemicals within the drain and in the receiving environment (i.e., percentage composition for a particular contaminant within a group of related contaminants [e.g., low molecular weight PAH (LPAH), high molecular weight PAH (HPAH), and metals])
- The spatial distribution of contaminants in offshore sediments
- Available information on past and ongoing practices possibly contributing to observed contamination.

Appendix A provides a summary of the source evaluation for each problem area and problem station as presented by Tetra Tech (1988). The locations of potential sources of contaminants are shown in Figures 5 and 6.

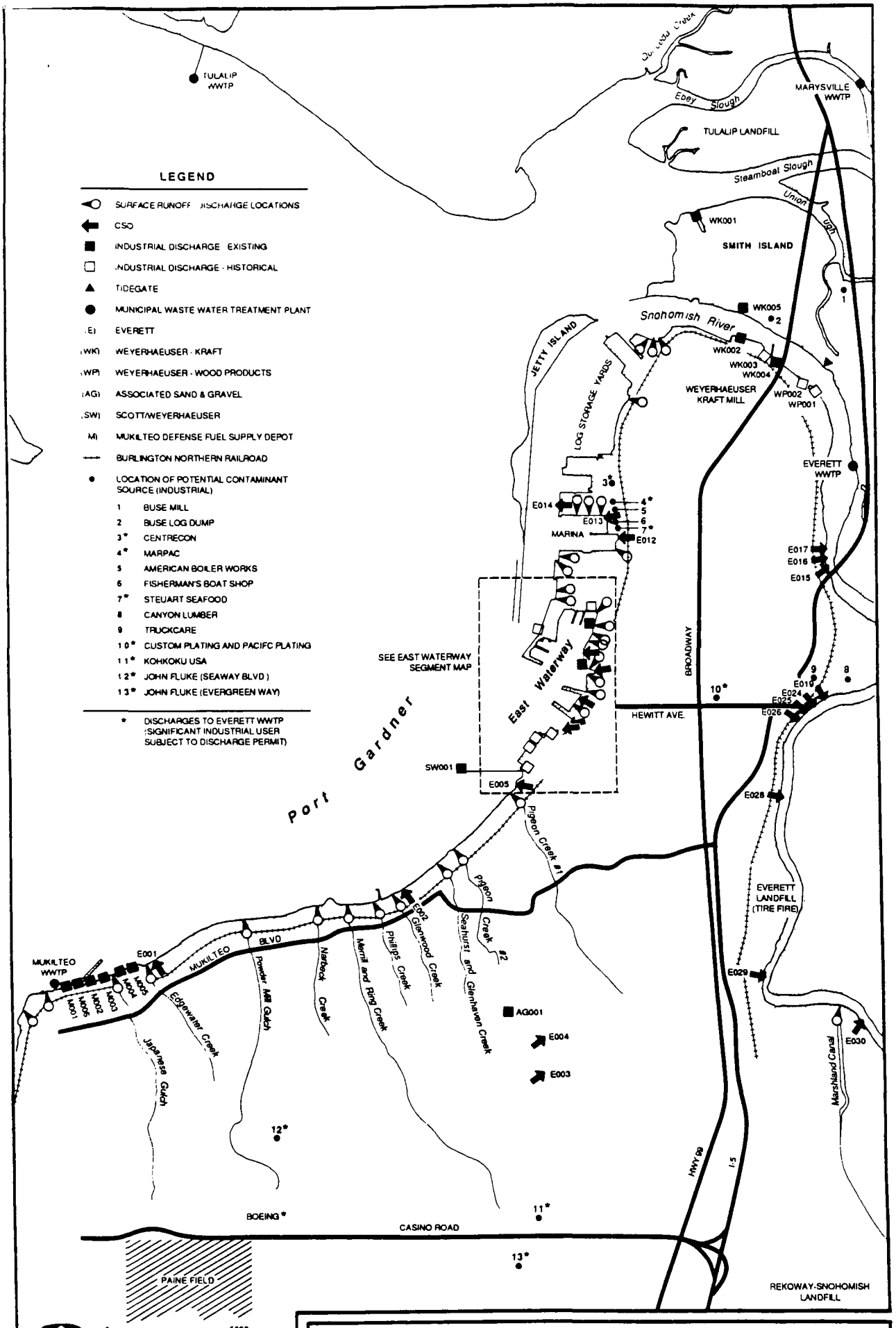


Figure 5. Locations of potential sources of contamination in the Everett Harbor project area.

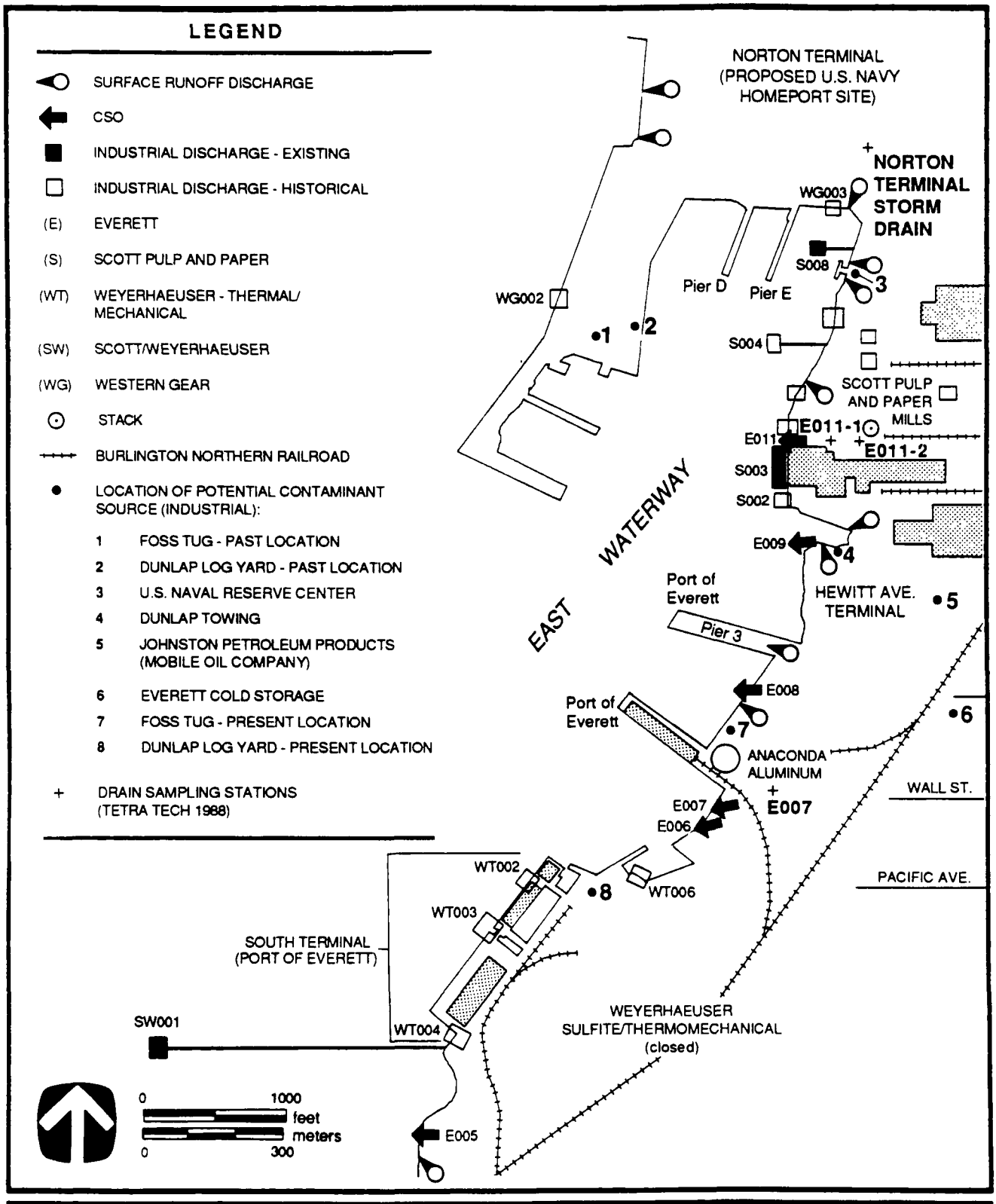


Figure 6. Locations of drain sampling stations, industrial discharge outfalls, CSOs, and storm drains in the East Waterway study area.

1989 ACTION PLAN FOR EVERETT HARBOR

Many planned or ongoing actions to control contaminant inputs to the project area are part of comprehensive programs or planning activities of federal, state, and local government agencies. The first part of this section describes these programs. The second part of this section presents a detailed action plan for controlling contaminant discharges to priority problem areas.

COMPREHENSIVE PROGRAMS AND PLANS

The following programs and plans are described in terms of actions that can be taken to identify or control ongoing sources of contamination to the project area. Programs and plans are organized by major implementing agency or local government body. Programs and plans addressing remediation of contaminated sediment statewide are presently under development by Ecology. In addition to potential future plans for sediment remediation, contaminated sediment removal may occur incidentally, as a result of dredging in navigation channels by the U.S. Army Corps of Engineers (COE) or dredging by the U.S. Navy, the Port of Everett, or other shoreline property owners or tenants.

U.S. Environmental Protection Agency - Superfund

In addition to the Urban Bay Action Program, EPA programs under the federal Comprehensive Environmental Response, Compensation, and Liability Act (Superfund, as amended) may result in activities to solve toxic contamination problems in the project area. Under Superfund, EPA, Ecology, responsible parties, or potentially responsible parties investigate the extent of contamination in environmental media, assess chemical risks to human health and the environment, and design and implement cleanup actions to reduce or eliminate risks at hazardous waste sites of national priority.

Currently, there are no National Priorities List sites in the project area. However, site discovery programs under Superfund may contribute to source identification efforts of other agencies. The following Everett area sites are currently in the Superfund Comprehensive Environmental Response and Compensation Law Information System database for potential site discovery, assessments, or other actions: Boeing Commercial Airplane Company, Everett Landfill, Pallister Paint, Scott Paper Company, Simpson Lee Company Pulp/Deinking Plant (closed), Snohomish County Reckoway Landfill, Weyerhaeuser Sulfite Pulp Mill (closed), Lake Stevens Landfill, Berringer Berry Farm, Boeing Company Tulalip test site, Tulalip landfill, and Mukilteo Defense Fuel Supply Depot.

Proposed U.S. Navy Homeport for a Carrier Battle Group

The U.S. Navy proposes to construct and operate a carrier battle group homeport at the Norton Avenue Terminal in Everett. New facilities, including berthing space, are to be constructed, requiring the dredging of sediments in the vicinity of the East Waterway. The Navy had initially planned to dispose of contaminated sediments at a deep site in Port Gardner (see Figure 1), capping them with uncontaminated sediments dredged from other portions of the project area. As a result of an appeal of the COE

dredging permit for this project by a group of environmental organizations, the plan to employ confined aquatic disposal for the contaminated sediments was dropped.

The in-water portion of the homeport construction project has three independent elements, each requiring a separate environmental assessment. Element 1 will accommodate the carrier Nimitz and six support vessels at the South Mole Wharf and a new Carrier Pier. A COE dredging permit for Element 1 will be applied for during the summer of 1989, with dredging to begin by the end of 1989. This dredging is expected to required the disposal of approximately 975,000 cubic yards of sediments. These sediments, from the less contaminated portion of the harbor, will nevertheless be subjected to a 3-tier analysis (i.e., review of existing data, bulk chemical analysis, and acute bioassays) required by the Puget Sound Dredged Disposal Analysis (PSDDA) program, as well as additional analyses (i.e., bulk chemical analyses for polar organics, and sublethal bioassays) to determine the appropriate disposal option. If these sediments are found to be suitable for unconfined open-water disposal, then they may be disposed of at the PSDDA site in Port Gardner (see Figure 1), at the previously proposed confined aquatic disposal site in Port Gardner (see Figure 1), or at an approved upland site, subject to negotiations between the state and the Navy. If these sediments are found to be unsuitable for unconfined open-water disposal, then they will be disposed of at an approved upland site (with an option to store them for up to 5 years on the Navy property). Completion of Element 1 is scheduled for the summer of 1992.

Elements 2 and 3 of the homeport project will involve construction of additional berthing facilities and additional dredging, including dredging of contaminated sediments from the East Waterway. One option under consideration for disposal of these sediments is to construct an earthen berm in the inner portion of the East Waterway, dispose of the contaminated sediments inside this berm, and cover these sediments with a cap of clean fill material. Further details of Elements 2 and 3, including the selected sediment disposal option, will be specified at a later date.

Washington Department of Ecology

In addition to the Urban Bay Action Program, Ecology has a number of ongoing programs and planning activities related to toxic contamination in the Everett Harbor project area. Programs that are most directly related to the control of toxic contaminants are described below.

National Pollutant Discharge Elimination System (NPDES)--Permits are generally issued on a site-by-site basis and can include more than one discharge or source of pollutants. Permits for municipal wastewater treatment plants cover sewage system discharges throughout the plant's service area. Industrial permits may include requirements for storm drain control (for surface runoff) and wastewater discharge control. NPDES permits may specify effluent limits (concentration or total loading) for toxic contaminants and may include provisions for instituting best management practices to reduce nonpoint contaminant inputs.

There are three NPDES-permitted facilities in the project area: Mukilteo Defense Fuel Supply Depot, Weyerhaeuser Kraft Mill, and Scott Pulp and Paper Mills (Tetra Tech 1988). New NPDES regulations require property owners and tenants in certain land use categories to submit data regarding surface water runoff. Ecology is reviewing this information to assess the need for issuing stormwater permits for selected facilities.

Resource Conservation and Recovery Act (RCRA)--The joint EPA/Ecology RCRA program governs the generation, handling, and disposal of hazardous wastes. Spill prevention and containment measures, material handling requirements, groundwater monitoring, and site cleanup can be required as part of a RCRA permit.

Sediment Standards Development--Ecology has been a lead agency or key participant in several efforts to develop tools for evaluating and managing contaminated sediment (e.g., Commencement Bay Superfund project, PSDDA, Urban Bay Action Program, and Puget Sound Water Quality Management Plan). Ecology is currently developing sediment quality standards, effluent particulate controls, standards for confined disposal of dredged material, and remedial action (i.e., cleanup) guidelines. In addition, guidelines for unconfined disposal of dredged material have been developed under PSDDA in an interagency effort led by the COE.

Snohomish Conservation District

Snohomish Conservation District is responsible for providing planning assistance to farmers in Snohomish County. The district's main source of funding for this task is a 4-year grant from Ecology. The grant specifies that the district work within the boundaries of the Snohomish River watershed. The scope of work for this effort consists of the following four major elements:

- Inventory existing commercial livestock operations
- Provide conservation planning assistance on a voluntary basis to livestock operations, with an emphasis on reducing agricultural nonpoint source pollution
- Provide technical assistance to implement conservation plans for livestock operations
- Provide information-sharing and educational services on improving water quality to commercial and small farm operators.

The Everett Harbor Action Plan identifies Quilceda Creek and Allen Creek as potential sources of agricultural nonpoint contamination. These streams are within the boundaries of the Snohomish River watershed and are part of the Conservation District's planning responsibility. The Conservation District has completed an inventory of livestock operations, and has identified 14 dairies within the Quilceda Creek and Allen Creek drainages. Conservation plans have been completed for 2 of the 14 dairies and the remaining dairy operators have been encouraged to participate in conservation planning activities. In addition, the Conservation District assisted in the installation of winter manure storage facilities at five dairies in the Quilceda Creek and Allen Creek drainages.

The Conservation District publishes the *Snohomish Conservation News*, which encourages farmers to get involved in improving water quality by adopting agricultural best management practices and participating in ongoing watershed planning activities. All commercial and noncommercial livestock operators in Snohomish County receive *Snohomish Conservation News*.

The Snohomish River watershed project is funded by Ecology through 1990. After 1990, local funding support will be essential for continuation of the program.

Snohomish Health District

The Snohomish Health District is responsible for the protection of public health in Snohomish County, including all incorporated cities and towns. As a regulatory agency, the Health District's mandated responsibilities include enforcing solid waste disposal regulations and monitoring existing solid waste facilities, permitting upland disposal sites for dredged material, and permitting private onsite sewage treatment systems. Other important activities and responsibilities of the Snohomish Health District include the following:

- Participation on the Snohomish County Solid Waste Committee, the City of Everett's Solid Waste Committee and Wastewater Disposal Committee, and the Snohomish County Watershed Advisory Committee
- A notification program to educate the public about possible health risks associated with the harvesting of shellfish and bottomfish in Everett Harbor
- Operation of a drinking water certification laboratory
- Public assistance concerning household hazardous waste and small quantity waste generators.

City of Everett

The City of Everett has three programs to reduce contaminant inputs to the Everett Harbor project area: the CSO control plan, the industrial pretreatment program, and ongoing activities at the sewage treatment facility.

Combined Sewer Overflow Control Plan--The City of Everett developed a CSO control plan in 1987 (CWC-HDR and Ott Water Engineers 1987) in response to the requirements of Ecology. The city's 10-year implementation plan includes installing a new interceptor line from Port Gardner to the Snohomish River, constructing a south-end interceptor line, implementing a program to identify and control inflows to the south-end system, constructing a siphon and oxidation pond in the Snohomish River area, achieving stormwater/sewer separation at three Snohomish River CSOs, and constructing a Snohomish River interceptor (CWC-HDR and Ott Water Engineers 1987). CSOs are currently monitored by the city to determine their frequency and intensity for the purpose of establishing CSO control priorities. A plan approved by Ecology provides that control efforts for CSOs discharging to the sound (i.e., E006, E007, E008, E009, E011, E012, and E013) will not begin until at least 1993. The city will concentrate CSO control efforts on the Snohomish River where CSO volumes are at least ten times greater (Thomas, R., 14 November 1988, personal communication).

Industrial Pretreatment Program--The City of Everett has developed and implemented an industrial pretreatment program, which includes industrial waste surveys, discharge limitations, a monitoring enforcement system, and a public participation program. As

of September 1988, the city had identified industries needing permits and had issued permits to two facilities (Thomas, R., 24 August 1988, personal communication). As of November 1988, the city had drafted permits for Kohkoku, Inc.; Centrecon, Inc.; Cathcart Landfill; Stewart Seafoods; Boeing, Inc.; Pacific Plating; Custom Pacific Plating; and Truckcare, Inc. (Thomas, R., 14 November 1988, personal communication). These permits are currently being reviewed by Ecology.

Municipal Wastewater Treatment Plant--The City of Everett has conducted studies of 1) an alternative outfall site and addition of a flow-paced chlorination system for effluent disinfection and 2) ambient lead concentrations in the Snohomish River. The city has constructed recirculation channels for the existing lagoons. Sediment will be removed from the aeration cells by mid-1989. The city will design and construct a mechanical treatment plant by 1991 (Thomas, R., 24 August 1988, personal communication).

Puget Sound Water Quality Authority

Puget Sound Water Quality Authority (PSWQA) is a state agency mandated to develop a comprehensive plan for water quality protection in Puget Sound for implementation by existing state and local governments. The 1989 Puget Sound Water Quality Management Plan, released in November 1988, builds on elements and goals set out in the 1987 Puget Sound Plan (PSWQA 1988). The 1989 plan delineates criteria, guidelines, sources of funding, management strategies, budgets, and schedules for 10 programs relating to nonpoint source pollution control, shellfish protection, municipal and industrial discharges, contaminated sediments and dredging, stormwater and combined sewer overflows, laboratory support, wetlands protection, oil spill prevention and response planning, household hazardous waste, and legal and personnel support.

In addition, the 1989 plan identifies three new initiatives (i.e., for monitoring, research, and education and public involvement) and a 14-item unfinished agenda. Implementation of the plan has resulted in the adoption of new state regulations and the formation of state and local programs that are important to the Everett Harbor Action Program (e.g., watershed planning). Of most importance to the Everett Harbor Action Program are the requirements for Ecology to develop and adopt sediment quality standards, enhance the control of contaminant discharges from permitted facilities, and develop a stormwater control program.

U.S. Army Corps of Engineers - Puget Sound Dredged Disposal Analysis

The COE conducts regular maintenance dredging in the Snohomish River navigation channel and settling basins every 2 years. In addition, the COE is one of the principal agencies in Puget Sound regulating the dredging and disposal of dredged material (including contaminated sediment). The COE is the lead agency for PSDDA. Other major participants in the program are the Washington Department of Natural Resources, EPA, and Ecology.

The primary objectives of PSDDA are to 1) identify acceptable sites for the open-water unconfined disposal of dredged material, 2) define dredged material evaluation procedures for sediments that are being considered for disposal at the PSDDA sites, and 3) formulate management plans for disposal sites. Phase I of PSDDA, completed in

December 1988, focuses on central Puget Sound (including Everett Harbor). The PSDDA unconfined aquatic disposal site for Port Gardner has been established (see Figure 1). As of February 1989, no permits have been issued. Phase II deals with the remainder of Puget Sound and is expected to be completed by Fall 1989.

Port of Everett

Planned expansion of port facilities may incidentally result in the remediation (i.e., removal) of contaminated sediment. By 1989, the Port of Everett plans to demolish the shoreline area now occupied by a dock on the old Weyerhaeuser property (South Terminal). This project may create an opportunity for the nearshore or upland-confined disposal of an estimated 3,800 cubic meters of contaminated sediment from the East Waterway problem area.

Paine Field Cleanup Committee

The Paine Field Cleanup Committee was formed in 1987 to assess hazardous waste-related problems and oversee their solution. This interagency group is composed of representatives from Ecology, Snohomish County Airport, Olympus Terrace Sewer District, Snohomish Health District, Snohomish County Safety Department, and the COE. This group supervised the sampling and analysis of approximately 120 underground storage tanks in 1987 and 1988 and is coordinating various other investigations and cleanup efforts, including sampling and disposal of drums, installation and sampling of groundwater monitoring wells, sampling and removal of underground storage tanks, mapping the storm drain and sanitary sewer system, and managing landfill operations.

SITE-SPECIFIC ACTION PLAN

Table 1 presents the 1989 Action Plan for EHAT and associated agencies. Problem areas and problem stations correspond to those defined in PTI and Tetra Tech (1988). Figure 4 above illustrates the locations of problem areas and problem stations in the Everett Harbor project area. (Problem Station SD-03 does not appear in Table 1 because there are no known potential sources associated with the area sampled.) Sources listed in Table 1 are those identified in *Evaluation of Potential Contaminant Sources* (Tetra Tech 1988) and those identified by members of the IAWG. The actions and personnel specified in Table 1 reflect information and commitments from IAWG members. The implementation dates document actual and projected start/finish dates for each action.

TABLE 1. SITE-SPECIFIC ACTION PLAN FOR EVERETT HARBOR PRIORITY PROBLEM AREAS

Problem Areas & Stations	Potential Source	Action	Responsible Entity	Implementation Date
East Waterway Problem Area	Norton Terminal storm drain	Develop an approach for addressing infiltration of contaminants.	Ecology/EHAT	1989
	Scott Pulp and Paper	Perform a Class II inspection and modify permit to include toxic chemical control if necessary.	Ecology	1989
	Anaconda Aluminum Dome	Inspect site and issue permit if needed.	Ecology	1989
	Everett Cold Storage	Inspect site and issue permit if needed.	Ecology	1989
	Mobil Oil Co.	Inspect site and issue permit if needed.	Ecology	1989
	Dunlap Towing	Inspect site and issue permit if needed.	Ecology	1989
	Everett Terminal Company	Inspect site and issue permit if needed.	Ecology	1989
	U.S. Naval Reserve	Issue NPDES permits for storm drains.	EPA	Ongoing
	CSO E011, E008, E009, E006, and E007[a]	To be eliminated	City of Everett	Starting date ~1993
Nearshore Port Gardner Problem Area	Defense Fuel Supply Depot	Work with EPA personnel to institute remedial activities (e.g., product recovery). Remedial investigation in progress.	Ecology/EPA	1989
	Mukilteo wastewater treatment plant	Construct pump station and transfer effluent to Olympus Terrace sewage treatment plant.	City of Mukilteo	1990
	Powdermill Gulch	Implement drainage basin plan, including sampling.	City of Everett	1989
		Conduct a reconnaissance survey for surface drainage sources.	Ecology/EHAT	1989
	Japanese Gulch	Conduct an investigation of past disposal practices and land use.	Ecology Hazardous Waste Division	1990
		Conduct sampling and analysis to characterize discharge.	Ecology/Water Quality Investigation	1989
	Snohomish County Airport - Paine Field	Investigate potential sources.	Ecology	Investigation Completed 7/88
		Continue activities to characterize, clean up, and prevent contamination.	Paine Field Cleanup Committee	Ongoing
	CSO E001/Edgewater Creek[b]	Install interceptor sewer to eliminate CSO.	City of Everett	Completed 1988
Problem Station OG-01	Scott-Weyerhaeuser deepwater diffuser	Conduct a Class II inspection and modify permit to include toxic chemical control if necessary.	Ecology	1989

TABLE 1. (Continued)

Problem Areas & Stations	Potential Source	Action	Responsible Entity	Implementation Date
Problem Station SR-05	Weyerhaeuser Kraft Mill WK002, WK004, WK005	Perform a Class II inspection and modify permit to include toxic chemical control if necessary.	Ecology	1989
	Everett wastewater treatment plant	Conduct a study for alternative outfall site and flow-paced chlorination system.	City of Everett/Ecology	Completed
		Conduct a study on ambient lead levels in the Snohomish River, including low-flow (summer) conditions.	City of Everett	Completed
		Implement pretreatment program.	City of Everett	Ongoing
		Construct recirculation channels for lagoons and dredge sediment from aeration cells.	City of Everett	6/89
		Design and construct mechanical plant.	City of Everett	1988-1991
	Log storage yards	Inspect site and issue permit if necessary.	Ecology	1989
Problem Station ES-03	Tulalip landfill	Develop financing mechanisms for placing capping material over landfill.	Tulalip Tribes	Ongoing
		Sample leachate and receiving water for pathogens.	Ecology/EHAT, EPA	Completed 1988
	Quilceda Creek	Continue conservation planning and technical assistance efforts at dairies, and continue public education/public involvement effort	Snohomish Conservation District/Tulalip Tribes	Ongoing
		Perform a regional detention facility study.	Snohomish Conservation District	1990
	Marysville wastewater treatment plant	Add eight influent aerators and three grinders.	City of Marysville	1990
	Boeing test facility	Investigate possible hazardous waste leachate to Quilceda Creek.	Boeing/Ecology	1989
Problem Station SR-07	Marina area	Investigate potential sources, including pretreatment permitted facilities, boat repair facilities, storm drains, and boat basin.	Ecology	Completed 1987
		Issue permits	Ecology	1989
	CSO E012[c]	To be eliminated	City of Everett	1992
	CSO E013[d]	To be eliminated	City of Everett	1992
	Surface runoff	Monitor	Ecology/COE	1989

[a] CSO E006-Approximately 100 meters southeast of Pier 1
CSO E007-Approximately 80 meters southeast of Pier 1
CSO E008-Approximately 100 meters southeast of Pier 3 (at the foot of Hewitt Avenue)
CSO E009-Approximately 300 meters north of Pier 3 (at the foot of 25th Street).
CSO E011-Approximately 300 meters north of CSO E009 (at the foot of 23rd Street).
[b] CSO E001-Adjacent to Eedgewater Creek.
[c] CSO E012-At the foot of 16th Street in the marina.
[d] CSO E013-At the foot of 14th Street in the marina.

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APPENDIX A

SOURCE EVALUATION SUMMARY

SOURCE EVALUATION SUMMARY

This appendix presents a summary of the source evaluations for each high priority problem area and problem station [Figure 4; see Tetra Tech (1988) for additional information].

EAST WATERWAY PROBLEM AREA

Many compounds related to the pulp industry (e.g., resin acids, chlorinated phenols, and chlorinated guaiacols) were found at elevated concentrations in the sediments of the East Waterway. The most likely sources of these contaminants are historical and current discharges from pulp and paper mills. Scott Paper Company and an inactive Weyerhaeuser thermomechanical plant located near the East Waterway problem area have historically discharged effluent in or near the problem area through nine identified outfalls.

The Scott Paper Company has operated a plant at its East Waterway location since 1930, and currently discharges effluent through a deepwater diffuser (SW001), a nearshore diffuser (S003), and the secondary treatment plant outfall (S008).

Weyerhauser operated a sulfite-based paper and pulp mill from 1936 until 1975. Before 1951, discharges included untreated wastewater from washing, bleaching, and drying processes (WT002 and WT003); stormwater runoff and wastewater from limestone cleaning operations (WT004); and stormwater runoff from other areas of the plant (WT006). After 1951, most sulfite waste liquor was discharged through the plant's deepwater diffuser (SW001). In 1975, the plant was converted to the thermomechanical process, and outfalls WT001 and WT003 were sealed and abandoned. After 1975, outfalls WT004 and WT006 were used only for stormwater discharge. Weyerhaeuser closed operations at its East Waterway plant in 1980.

Six CSOs and 10 storm drains also discharge to the East Waterway problem area. Only the Norton Terminal storm drain and CSOs E011 and E007 were sampled during the 1986 source investigation. Analytical results indicate a lack of similarity in problem chemicals (presence of chemicals and their relative distributions) between the Norton Terminal storm drain and offshore sediments, suggesting that the storm drain was not a significant contributor to organic chemical contamination in the East Waterway. However, the storm drain may have contributed to metals contamination offshore that had not reached problem levels at the time of sampling (Tetra Tech 1988).

Based on the large number and relative distributions of problem chemicals common to both CSO E011 and stations in East Waterway, it is likely that CSO E011 has contributed to chemical contamination of sediments in East Waterway (especially by 4-methylphenol and PAH). However, the data indicate that there were probably other significant sources in the vicinity of CSO E011, especially for compounds related to the pulp industry.

Chemical analyses of sediment sampled from CSO E007 indicate that the CSO may be a source of HPAH and metals to the East Waterway, but is not likely a major source of 4-methylphenol. The sediment sample from CSO E007 was not analyzed for pulp mill compounds.

NEARSHORE PORT GARDNER PROBLEM AREA

Polar organic compounds (e.g., 4-methylphenol, benzoic acid, and phenol) were the major contaminants in the sediments of this problem area. Some stations demonstrated relatively high concentrations of PAH and PCBs. Potential sources of contamination in the vicinity of this problem area include the Mukilteo Defense Fuel Supply Depot, the Mukilteo municipal wastewater treatment plant, and three surface water discharge points (i.e., Japanese Gulch, Edgewater Creek, and Powder Mill Gulch). Although groundwater samples taken from wells at the Defense Fuel Supply Depot in 1986 were visibly contaminated with oily substances, chemical analyses yielded only a few target compounds (i.e., a few metals and PAH) at relatively low concentrations (Tetra Tech 1988).

No data are available for characterizing surface waters discharging to the offshore Port Gardner problem area. A number of potential sources of contamination are present in the drainages of the three creeks mentioned above (e.g., abandoned landfills and dumps, and training areas for firefighting exercises in the Snohomish County Airport/Paine Field area). An Ecology field investigation of the Paine Field area was underway at the time of this writing.

PROBLEM STATION OG-01

Station OG-01 was located near the Scott Paper Company diffuser (SW001). This area was characterized by contamination from 4-methylphenol, PAH, resin acids, and a cymene isomer. These contaminants have varying degrees of association with the pulp industry. Outfall SW001 is currently used to discharge effluent from the Scott Paper Company primary clarifiers. Prior to 1980, the outfall was also used by Weyerhaeuser for the discharge of a variety of effluents including untreated sulfite waste liquor. These discharges may have been the source of resin acids in the vicinity of Station OG-01.

PROBLEM STATION SD-03

Station SD-03 was located in the Snohomish River delta offshore from a historical Western Gear outfall (WG002). Western Gear specialized in the manufacture of heavy equipment and machinery for the oil drilling industry, and discharged noncontact cooling water prior to 1988. Sediments in this area exhibited contamination by benzoic acid, benzyl alcohol, DDT, and 4-methylphenol. No potential sources for any of the problem chemicals have been identified. The presence of DDT in sediments from this area may be due to historical agricultural uses in the Snohomish River drainage basin.

PROBLEM STATION SR-05

Station SR-05 was located in the Snohomish River offshore of the Weyerhaeuser Kraft Mill. Sediment in this area was contaminated with benzoic acid, 4-methylphenol, and resin acids. Discharges from one or more Weyerhaeuser outfalls are likely sources of resin acids and possibly 4-methylphenol. Historical outfall WP001 was upriver of Station SR-05 and discharged filtration backwash. Outfall WK002 is slightly downriver of Station SR-05 and discharges noncontact cooling water. Outfall WK005 is slightly downriver and across the river from Station SR-05 and discharges surface runoff from Smith Island. Outfall WK001 is on the northwestern side of Smith Island and discharges

effluent from aerated treatment lagoons. This outfall was probably not a source of contaminants to the area because of its distance from Station SR-05. Potential sources of benzoic acid have not been identified.

PROBLEM STATION ES-03

Station ES-03 was located in Ebey Slough southeast of the mouth of Quilceda Creek. Sediments in this area exhibited contamination from benzoic acid, 4-methylphenol, and phenol. A potential source of the benzoic acid and phenol contamination is leachate from the Tulalip landfill, which has been known to contain these contaminants. Wood waste and treating facilities are present at various locations throughout the lower Snohomish River and its sloughs, and were possible contributors to the 4-methylphenol contamination observed at this station. Weyerhaeuser Outfall WK001 is another potential source of 4-methylphenol in the vicinity of Station ES-03.

PROBLEM STATION SR-07

Station SR-07 was located near the Everett Marina in the Snohomish River, and was designated a problem station because of benthic effects. Sediments at Station SR-07 are composed of 96 percent fine-grained material. Fine-grained sediments may be the cause of the observed benthic effects. Sediments contained elevated concentrations of tributyltin and sulfides. Other chemicals were not significantly elevated. Tributyltin is used in marine paints as a biocide and may have originated from boat painting and refinishing activities in the marina area. Potential sources of sulfides in this area have not been identified.

PROBLEM STATION SD-01

Station SD-01 was located in the Snohomish River delta, and was designated a problem station because of benthic effects. Sediments in the area contained 12 percent gravel, less than 5 percent fine-grained material, and low concentrations of organic carbon and sulfide. No significantly elevated concentrations of problem chemicals were observed at this station. Benthic effects observed in this area may be the result of natural physical stresses such as those caused by swift currents in the area rather than chemical contamination (PTI and Tetra Tech 1988).