

Intertidal Habitat Projects Monitoring Program

Elliott Bay/Duwamish Restoration Program

**Prepared for the
Elliott Bay/Duwamish Restoration Program Panel
by the
U.S. Fish and Wildlife Service, Western Washington Office**

**Panel Publication 23
March 2000**

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by
Curtis D. Tanner
U.S. Fish and Wildlife Service, Western Washington Office

Elliott Bay/Duwamish Restoration Program
NOAA Damage Assessment & Restoration Center Northwest
7600 Sand Point Way NE
Seattle, WA 98115-0070

Voice: (206) 526-4338 Fax: (206) 526-4322

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Habitat Development Work Group Members:

George Blomberg, Port of Seattle
David Bortz, Washington Department of Natural Resources
Pat Cagney, U.S. Army Corps of Engineers
Tim Clancy, National Oceanic and Atmospheric Administration
Robert Clark, National Oceanic and Atmospheric Administration
Margaret Duncan, Suquamish Tribe
Linda Hammons, City of Seattle
Jody Heintzman, King County
Larry Jones, King County
Roderick Malcom, Muckleshoot Indian Tribe
Joanne Polayes, Washington Department of Ecology
Curtis Tanner, U.S. Fish and Wildlife Service

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Report author: Curtis D. Tanner
U.S. Fish and Wildlife Service

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Introduction and Overview

This report describes the monitoring approach for intertidal habitat restoration projects undertaken by the Elliott Bay/Duwamish Restoration Program (EB/DRP). These projects are being completed under the sponsorship and guidance of the EB/DRP Panel of Managers (Panel) in partial fulfillment of requirements of a 1991 consent decree. The express purpose of this monitoring program is to evaluate progress in achieving EB/DRP goals and objectives concerning habitat development and restoration projects. Monitoring costs were included in the budget of each project at the time it was proposed for approval due to the Panel's acknowledgment of the importance and necessity for project follow through.

The first section of this document provides a summary of the EB/DRP foundation, the approach to habitat development, and the purpose of the monitoring program. The second section presents physical and biological criteria for determining project success, associated monitoring tasks, and the rationale for their inclusion as they relate to EB/DRP objectives. The third section addresses program management and the budget for tasks defined in the monitoring program. An appendix to this report provides a brief description of the four intertidal habitat projects addressed by the monitoring program.

EB/DRP Foundation

Program Establishment and Structure

In 1990, a lawsuit was filed against the City of Seattle and the Municipality of Metropolitan Seattle (Metro) by the United States of America on behalf of the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) under its authority as a natural resource trustee provided by the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). The lawsuit was filed to recover damages "for injury to, destruction of, and loss of natural resources resulting from releases of hazardous substances...into the environment in and around the Duwamish River and Elliott Bay, for the costs of restoring, replacing or acquiring the equivalent of the affected natural resources, and for the costs of assessing the damage to the affected natural resources" (U.S. vs. City of Seattle & Metro, 1991).

Rather than engage in lengthy and costly litigation, the City of Seattle and Metro, along with natural resource trustees, worked out a settlement agreement to establish a program to help restore and replace natural resources of Elliott Bay and the lower Duwamish River. The Consent Decree established a program for sediment remediation, source control, and habitat development, known as the Elliott Bay/Duwamish Restoration Program, or EB/DRP. Participating governments in the settlement include the United States, represented by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Fish and Wildlife Service (USFWS), the Department of Ecology on behalf of the State of Washington, and the Muckleshoot Indian Tribe and Suquamish Tribe in their roles as natural resource trustees in connection with treaty rights delineating usual and accustomed fishing areas. The natural resource trustees, together with the City of Seattle and Metro (now King County DNR) comprise the EB/DRP Panel of Managers (Panel). The Panel established two technical working groups to guide the sediment remediation and habitat development project selection process. Members of the Habitat Development Technical Working Group are listed under Acknowledgments at the beginning of this document.

Habitat Development Program Goals and Approach

Development of Habitat Goals

The Habitat Development Technical Working Group was established by the Panel to identify potential habitat projects, evaluate them against criteria that meet the goals of the Consent Decree and determine their feasibility. The working group also advises the Panel on "the acquisition of any right of access, lease, easement, fee title, or any other real property interest sufficient to permanently secure a site for any habitat development project..." (U.S. vs. City of Seattle & Metro, paragraph 30). A Concept Document (EB/DRP, 1994) developed by the working groups and the Panel outlines the program goals, objectives, and approach to project selection. The following specific goals were developed by the Habitat Development Technical Working Group and approved by the Panel:

"Habitat development projects will be undertaken to benefit fish and wildlife species and the habitat attributes on which they depend. The overall goal of the Program will be a net gain of habitat function relative to current conditions in the Elliott Bay and Duwamish River estuarine system. It is recognized that the aquatic ecosystem of Elliott Bay and the Duwamish River estuary cannot be returned to a pristine condition; however, it is possible and desirable to provide increases in habitat quantity and quality. While a general objective of ecosystem recovery will be pursued, priority will be afforded projects or actions that benefit injured trust natural resources" (EB/DRP, 1994; p. 48).

In addition to the ecological goals and objectives identified in this document, the Panel recognizes that the long-term viability of the restoration projects relies at least in part in community understanding and acceptance of these restored natural features in the urban landscape. Accordingly, project designs include provisions for public access where this is consistent with site-specific requirements. Also, and consistent and appropriate with the specific project's primary purposes, the project designs accommodate the related objective of providing educational displays and opportunities.

Habitat Development Approach

Property Acquisition and Protection

In seeking to meet EB/DRP habitat restoration objectives, the first step has been obtaining "real property interest" in sites for restoration work. The Consent Decree establishes a responsibility on the part of the City of Seattle and King County to provide up to \$5 million in property value for this purpose. Following a ranking of potential restoration sites by the Habitat Development Technical Work Group, project sites were then selected. The Panel requested either King County or the City of Seattle to engage in negotiations for either acquisition of real property or easements in perpetuity for priority sites. At the conclusion of successful negotiations, the Panel credited King County or the City the cost of property or easement acquisition, toward fulfillment of the real property obligation of up to \$2.5 million each.

To date, the following sites have been acquired:

- Seaboard Lumber site, acquired in fee title from a private owner by Seattle Parks and Recreation. Approximately 5 acres of formerly industrial uplands, and nearly 10 acres of adjacent submerged lands were acquired. The City has requested credit of \$2.5 million in fulfillment of its real property obligation under the

Consent Decree. This amount includes nearly \$1.5 million in funds set aside to complete soil contaminant remediation activities necessary to make the site available for habitat development.

- Hamm Creek site, made available by permanent conservation easement to King County by Seattle City Light. The County received a credit of \$750,000 for the purchase of an easement on approximately 7.1 acres of upland, for the purposes of restoring Hamm Creek to a surface water channel, and creating a new "estuary" at the mouth of Hamm Creek where it enters the Duwamish River.
- Kenco Marine, purchased from a private owner by the Muckleshoot Indian Tribe. This site includes 0.7 acres of upland, and an undetermined amount of adjacent tidelands. The tribe purchased this former marine salvage operations site with funds from King County, and \$518,000 from EB/DRP.
- North Wind's Weir, owned by King County Parks and Recreation. Approximately one acre of a three acre parcel is being made available to EB/DRP for intertidal habitat restoration, at a cost to the program of \$416,000.

(See Appendix A for a more complete description and site plans of EB/DRP intertidal habitat projects)

In addition to these habitat development sites in the lower Duwamish River, EB/DRP has committed up to \$700,000 for two sites upstream of this area in the Green River including Porter Levee and Lones Levee. At these sites, various riparian and off channel habitat restoration will occur with non-EB/DRP funds.

Finally, a nearshore substrate enhancement project was completed with EB/DRP support in the marine environment of Elliott Bay. This project occurred on property managed by the Washington Department of Natural Resources; EB/DRP incurred no property acquisition costs for this project. These projects are outside the scope of the intertidal habitat monitoring program described in this report.

Restoring Habitat Functions

Restoring the conditions necessary to provide habitat for fish and wildlife in an urban industrial environment often requires a combination of actions once a site has been made available. Habitat project restoration activities undertaken by the Panel in the lower Duwamish River entail one or a combination of the following actions: remediation and cleanup; source control; fill removal, excavation and regrading; stream daylighting; substrate modification; revegetation; and project follow-through. Monitoring tasks and contingency measures address these actions as required by specific projects. The following is meant as a general description of actions, some or all of which are being applied at each of the four Duwamish River estuary habitat development sites.

Remediation and Cleanup

Project sites selected for habitat development activities have a varied land use history. At Seaboard Lumber, industrial activities have contributed to soil contamination which requires remediation prior to habitat development. This has included both removal and isolation of site contaminants. At North Wind's Weir and Kenco Marine, required cleanup activities involve demolition and removal of previous residential and commercial infrastructure.

Fill Removal, Excavation, and Regrading

All four intertidal habitat project sites require the removal of historic fill material and regrading to reestablish intertidal elevations. At Seaboard, North Wind's Weir and Hamm Creek, "basins" are being created to restore intertidal habitat area. At the Kenco Marine site, benches or terraces are being excavated to create suitable elevations for mudflat, marsh, and riparian habitat development.

Stream Daylighting

Hamm Creek currently discharges into a storm drain system and flows underground before it discharges to the Duwamish River. The project at Hamm Creek involves "daylighting" this stream by creating a new surface water channel and mouth. The new channel will include various log and rock features to provide habitat structure and complexity. The new mouth will provide intertidal habitat where the stream meets the Duwamish River.

Substrate Modification

Prior to reestablishing riparian and emergent marsh vegetation, the project sites have required varying degrees of substrate modification. This ranges from simply amending existing upland soils with organic material to promote riparian vegetation growth, to a substantial import of soil at the Seaboard Lumber site for emergent marsh area establishment.

Revegetation

All projects involve efforts to promote native plant community establishment, including riparian areas with trees and shrubs and intertidal emergent marsh areas. Tasks necessary to promote initial plant growth, may include the installation of irrigation systems in riparian areas, and the protection of newly established plants from herbivores, especially Canada geese.

Project Follow-through

The EB/DRP Panel has recognized that habitat development does not end with project construction. Meeting program goals will necessitate follow-through activities, including site stewardship, monitoring, and implementation of contingency measures.

Intertidal Habitat Projects Monitoring Program

Development of the Monitoring Program

The monitoring program was developed by USFWS for EB/DRP, with input and assistance from the Habitat Development Technical Working Group (HDTWG). Assistance in monitoring program review was also sought from those with regional expertise in habitat restoration and monitoring. A draft was presented to the Technical Working Group after the real property acquisition phase and habitat project selection process had been largely concluded.

With the exception of the Elliott Bay Nearshore subtidal habitat development project, this monitoring program will be implemented for all EB/DRP funded habitat development projects, as follows:

- Seaboard Lumber - project management provided by Seattle Department of Parks and Recreation

- Hamm Creek Estuary - project management provided by King County DNR in cooperation with the U.S. Army Corps of Engineers
- (former)Kenco Marine site at Turning Basin Number 3 - project management provided by the Muckleshoot Indian Tribe Fisheries Department
- North Wind's Weir - project management provided by King County Parks Department in cooperation with King County DNR

Purposes of Monitoring Program

The monitoring program serves the necessary purposes of the Panel by identifying explicit project objectives against which project performance can be measured; providing criteria which indicate success in meeting those objectives, and delineating specific tasks to be completed to assess project performance. The monitoring program also identifies some of the potential problems that can reasonably be anticipated and contingency measures that could be taken in response. The program is intended to meet applicable requirements under the Clean Water Act (§404), any permit conditions under WDFW's Hydraulic Project Approval (HPA), and other environmental compliance activities.

This document also serves as an outreach tool by providing program and budget information to interested parties, including local stakeholders, schools, and consultants and others in the private sector. It is anticipated that activities undertaken pursuant to this monitoring program will contribute to the growing body of knowledge concerning restoration programs. The monitoring program budget provides a useful tool to others interested in estimating habitat restoration project monitoring costs.

Finally, the Panel recognizes the inherent scientific interest in these projects and activities. Hence, landowners of habitat project sites are encouraged to accommodate scientific research activities where the Panel determines that the activities are compatible with the objectives of specific habitat project(s). Research activities that are beyond the scope of this monitoring program and independently supported are encouraged. Towards this end, the Panel will make available all monitoring program data.

Project Success Criteria, Monitoring Tasks, and Contingency Measures

The following chapter identifies the specific criteria which will be used to determine if project goals for restoring intertidal habitat functions have been met. Criteria are broadly grouped into categories of “physical” and “biological” success criteria. For each criterion, quantifiable performance measures are detailed, the sites and monitoring years to which the criterion apply identified, and the general approach to evaluating the criteria described. Rationale for including the criterion and a relationship to habitat goals are discussed at the end of each subsection. Table One, located at the end of this chapter, provides a summary of the five physical criteria and eight biological criteria.

Physical Success Criteria

The first challenge to be met in restoring intertidal habitat functions involves the establishment of physical conditions necessary for habitat development. The following success criteria provide guidance in determining whether post-construction site characteristics meet these necessary requirements. Evaluating project performance against each of these is intended to be an on-going process that will continue until the tenth year following project construction. Assuming project construction is completed in mid to late 2000, project monitoring would begin in 2001, with the final year of project monitoring taking place in 2010. Monitoring project reports which summarize results would be completed in each of the years of major sampling activities; this would include post-construction years 1, 2, 3, 5, 7, and 10.

Intertidal Area

Physical Success Criterion 1

The total restored area between an elevation of +12.0 ft. MLLW and -2.0 ft. MLLW will be at least 90% of the target intertidal elevation for each site.

Project Sites

2.0 acres for Seaboard Lumber and no moorage of vessels within the property boundaries of the site

1.0 acres for Hamm Creek estuary

0.3 acres for Kenco Marine/Turning Basin vicinity and no moorage of vessels within the property boundaries of the site

1.0 acres for North Wind's Weir

(note – moorage restrictions apply to those sites where interest in subtidal “submerged land” was obtained along with the upland area)

Monitoring Task

Using standard areal calculation techniques, such as geo-referenced aerial photogrammetry, GPS or other field survey techniques, estimate the total acreage of the project that is intertidal, i.e. below an elevation of +12.0 ft. MLLW.

In addition to tasks identified for completion as part of this monitoring program, it is

anticipated that the entities implementing each of the projects will provide as-built surveys upon completion of construction activities. This will assist in further quantifying project area and features, as well as serve to verify that projects were constructed as designed (compliance monitoring).

Years

This task is to be completed in post-construction years 1, 2, 3, 5, 7, and 10.

Contingency Measures

None, unless gross deviations from the criterion are determined to warrant corrective measures by the EB/DRP Panel of Managers. A gross deviation is considered to have occurred if the reduction in area has compromised the desired functions of the site.

Discussion

The ultimate goal of the EB/DRP habitat development program is improvement in the quality of habitat conditions for the benefit of fish and wildlife. Quantity is especially important in an area like the Duwamish River estuary, where the amount of intertidal habitat is severely limited. Certain minimum expectations for project size are legitimate success criteria. If some habitat elements are too small, they will provide little benefit and will not be able to maintain themselves. It is, however, necessary to recognize that this is not a perfect science, and that some variation in the amount of intertidal area is to be expected. Therefore, this criterion is stated as a range of acceptable values. It is also recognized that one of the benefits of the Kenco Marine/Turning Basin vicinity project was removal of barges and vessels moored over intertidal land at and adjacent to the site. A similar benefit associated with the Seaboard Lumber site was the purchase of adjacent submerged lands that preempts moorage of barges or vessels over this portion of the site. While these adjacent areas are not included in the calculation of restored intertidal area, the benefits of these intertidal or submerged lands will be considered during the evaluation of whether the sites meet this criterion.

Tidal Regime

Physical Success Criterion 2

Tidal amplitude, as determined by both timing and elevation of high and low tide events, is equivalent inside and outside of the project area.

Project Sites

This criterion and associated task are to be applied to Seaboard Lumber, Hamm Creek estuary, and North Wind's Weir habitat project sites. The criterion will not be applied to the Kenco Marine/Turning Basin Vicinity project because this site will always have adequate tidal connection because it is along the river channel.

Monitoring Task

Tide gauges (water surface elevation vs. time) will be installed in projects with a semi-enclosed basin. Data from the gauges will be compared to that from similar instruments deployed outside the project area within the Duwamish River estuary.

Years

This task is to be completed in post-construction years 1, 2, and 5.

Contingency Measures

Failure to meet this criterion should trigger discussions on the need to increase the size of

the tidal connection between the project area and the river.

Discussion

The development of adequate tidal connections between the project sites and the Duwamish River estuary is essential. Inadequate connection would lead to a dampened tidal hydrology, which may in turn favor the establishment of invasive plant species over desired native plant communities. Other possible consequences include reduction in fish access to and use of the sites, reduced export of organic material from the site and associated food web support for the estuary, and excessive current velocities within the channels and openings that provide the connection, and associated problems with erosion.

Slope Erosion

Physical Success Criterion 3

No evidence of erosion that threatens property, infrastructure, or is otherwise unacceptable is observed after a period of initial site stabilization.

Project Sites

This criterion will apply to all sites.

Monitoring Task

Periodic visual inspections of the project area for signs of excessive erosion will be completed. Areas of concern will be photographed from a stable photo point periodically so that the rate and severity of erosion can be judged. Where available, "as-built" site surveys will be used to monitor changes in site geomorphology, especially where these surveys are repeated on a periodic basis. Cross section elevation data collected across permanent transects through the project sites will provide another way of evaluating how the site morphology is changing.

In addition to visual inspection tasks specific to this criterion, analysis of aerial photos and elevation cross section survey data to be obtained under Physical Criterion #1 tasks will assist in quantifying the extent of erosion at the project sites.

Years

This criterion will be applied in years 1 through 10.

Contingency Measures

The first line of defense against excessive erosion should be non-structural approaches, such as vegetation, fiber mats, or other "soft" approaches. Engineered approaches such as riprap or other shoreline "hardening" (e.g. logs, rootwads) should only be utilized as a last resort, and in cases where the property owner, EP/DRP Panel, and relevant permitting authorities agree that a hazardous condition to property exists or the need to preserve function and integrity of the site that warrants corrective action.

Discussion

Given the urban setting of these projects, a balance must be struck between allowing the sites to develop naturally, and protecting the interests of property owners. Furthermore, soil disturbance during construction will leave many of the sites vulnerable to erosion until the planted vegetation matures and the root mat binds and stabilizes the soil. Concern about erosion has been raised, and the need to evaluate the "stability" of newly graded slopes generally agreed to by the EB/DRP Panel. It is difficult to express an entirely objective criterion for this factor; the one proposed will require a fair amount of

interpretation by the EB/DRP Panel and the affected land management entity.

At the Seaboard Lumber site, evidence of erosion at areas containing residual soil contamination would trigger sediment sampling nearby. This contingency measure would be a condition of Washington Department of Ecology's approval of cleanup at the site.

Sediment Structure

Physical Success Criterion 4

Over time, sites will accumulate fine grained material and organic matter. This would be evidenced by a decrease in mean grain size, and an increase in organic carbon, in surface sediments.

Project Sites

This criterion will be applied to all sites.

Monitoring Task

Sediment grain size samples will be collected at each site in areas that will also be sampled for benthic invertebrates. Where appropriate, consideration will be given to stratifying the project sites into two sampling areas, vegetated (+10 MLLW ft. and above) and unvegetated (+9 ft. MLLW and below) and a total of 6 samples collected (3 samples @ 2 elevations). Samples will be taken by the use of cores. Cores will be processed for grain size distribution in the laboratory using nested sieves. Organic content will be analyzed using standard procedures. Samples will be taken from habitat reference sites within both the Turning Basin and Kellogg Island areas and similarly processed.

Data will be reported as a percent of grain size category (by weight). Percent organic matter will be reported as a proportion of the overall sample. These values will be compared to reference site data, and to comparable data from the same site in previous years (time series).

Years

The monitoring task is to be completed in all years where benthic invertebrates are sampled; the recommended frequency is years 1, 2, 3, 5, 7, and 10.

Contingency Measures

None.

Discussion

Several intertidal habitat functions are associated with depositional environments. Specifically, the accumulation of fine grained sediment is indicative of environments that support the build up of organic matter and a detritus based food web. Soft sediments and organic rich areas provide an environment where benthic invertebrate prey resources flourish, and the capacity for fish and wildlife to forage. Of special interest to EB/DRP is the provision of habitat for juvenile salmonids, other estuarine fish, and shorebirds.

Sediment Quality

Physical Success Criterion 5

No evidence of contamination due to sediment transport or on-site migration of upland contaminants to groundwater or aquatic area.

Project Sites

This criterion will be applied primarily to Seaboard Lumber and to other projects only as needed.

Monitoring Task

Visual monitoring to ensure that riprap and soil are staying in place, and groundwater monitoring to ensure that contaminants have not mobilized due to construction.

Groundwater monitoring is not included as a task in this monitoring program, but is a separate responsibility of the landowner (Seattle Parks and Recreation Department) related to site remediation activities that preceded habitat development.

Years

This criterion should be applied in years 1-10.

Contingency Measures

If monitoring results indicate that contaminants may be migrating at the Seaboard Lumber site, sediment monitoring will be required.

Discussion

Sediments at project sites may become contaminated due to pollution sources and sediment transport from off-site. Sediment monitoring will occur only as a contingency measure to determine cause if selected biological success criteria are not being met. Biological success criterion 8, production of benthic invertebrate prey taxa, is expected to be the most sensitive to sediment contamination.

Based on sampling activities and analyses undertaken prior to purchase of the property for habitat purposes, the Washington State Department of Ecology did not require cleanup of aquatic sediments under the state Sediment Management Standards at the Seaboard project site. However, visual and groundwater monitoring is required by the Department of Ecology as a condition of its approval of the upland cleanup to ensure that upland contamination does not migrate into the aquatic system.

The Panel considered whether sediment sampling should be included in this monitoring program, particularly for the Seaboard Lumber site upland areas, which were contaminated during the time the site was used as a lumber mill and for wood treatment. As part of the habitat restoration, soils contaminated with mercury, pentachlorophenol and polycyclic aromatic hydrocarbons (PAHs) were excavated and disposed of at an authorized sanitary landfill. Some petroleum contaminated soils were also removed, but it was not feasible to remove some additional low-level petroleum contaminated soils which occur at depths below the groundwater table. The areas of residual petroleum contamination on the upland were capped with clean soil and stabilized with riprap filled with fish rock. Groundwater has tested clean, indicating that the petroleum is currently non-mobile.

Biological Success Criteria

Biological success criteria identified in this monitoring program generally fall into one of two broad categories. First, there are those criteria that provide evidence that "attributes" of functioning intertidal habitat are developing within the project area (see Simenstad et al., 1991, for a discussion of this concept). For example, are the prey resources, essential to the function of foraging by juvenile chinook salmon, present in sufficient numbers to indicate the habitat is functioning properly? Second, there are criteria that directly