A Habitat Restoration-based Approach for Resolving Natural Resource Damages Claims

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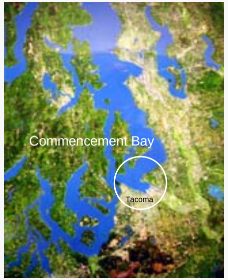
INTRODUCTION

The United States Congress enacted the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. § 9601 *et seq.* (CERCLA) in 1980. Under this act, parties responsible for releasing hazardous substances into the environment are liable both for the costs of responding to the release (by cleaning up, containing or otherwise remediating the release) and for damages arising from injuries to publicly owned or managed natural resources. Natural Resource Damage Assessment (NRDA) is the process of assessing the nature and extent of injuries resulting from a release, destruction or loss of natural resources and the various services they provide. NRDA also includes a process for determining compensation required to make the public whole for such injuries, destruction or loss. U.S. Federal and state agencies and Native American tribes are designated as natural resource trustees (Trustees) and are authorized to determine the damages, as well as present claims to responsible parties for the damages in a process known as natural resource damage assessment.

This poster summarizes a novel way to settle NRDA claims in a heavily industrialized coastal area in the Puget Sound region of the U.S. West Coast. It is a montage of components from several presentations developed over the past four years. It conveys a way to portray injuries to natural resources as levels of contamination in sediments, and to translate that contamination into losses of **ecological services** for the **biological community**. While the approach described in this poster may not necessarily be applicable to all other sites, it is believed that the concept could form the basis for settlements elsewhere: a truly habitat based NRDA settlement. For more details on this process, please visit our website at http://www.darp.noaa.gov/northwest/index.html

BACKGROUND



Commencement Bay is a 12.5 sq m embayment in southeast Puget Sound adjacent to Tacoma, WA extending outward from the Puyallup River delta. Until the late 19th Century, the coastal area of this bay consisted of about 4,600 ac of intertidal mudflat and emergent marsh surrounded by forested upland.

Then

Now

Periodic diking and dredging throughout the 20th Century gradually diminished the intertidal area of bay until less than 200 acres of intertidal habitat remained, and mostly in a highly degraded condition. A plethora of industrial activity replaced or occupied the intertidal habitat. The Trustees initiated a damage assessment in Commencement Bay in the early 1990s. They focused most of their attention on Hylebos Waterway, the eastern-most waterway in the bay. While completed studies provided a considerable portion of the information needed to complete a damage assessment for Hylebos, further work was needed. That was a problem. This situation proved troublesome for three reasons: time, money, and shrinking restoration options. The inclusion of injured Hylebos resources such as Chinook salmon as a species threatened with extinction under the Endangered Species Act underscored the need for prompt action to restore habitat. At the same time, development pressures in nearshore and tideflats areas were making nearby potential restoration sites increasingly scarce and expensive. It was becoming increasingly urgent for the Trustees to resolve damages claims promptly and move ahead with habitat restoration.

Negotiated settlement of injury liability instead of litigation seemed the best solution. Settlement would avoid the additional expenditures of time and money required in litigation, produce certainty for parties on both sides of the contamination issue, and more promptly bring the benefits of restoration to the public and the environment. The Trustees wanted to act quickly to settle NRD claims and develop restoration projects before the opportunities to do the greatest good at a reasonable cost were lost. This poster conveys steps followed to propose settlement and achieve restoration.

THE PROCESS OUTLINE

This poster proceeds through a series of steps used to translate injuries to biota into levels of ecological service losses that are portrayed as habitats with reduced ecological function. The steps we will follow include:

Defining Injuries as Lost Ecological Services
The Habitat Equivalency Model
Identifying Thresholds for Natural Resource Injuries
Defining Habitat Values
Mapping Injuries
Translating Liability From NR Injuries into Restored Habitat
A Restoration Example

DEFINING INJURY AS LOST ECOLOGICAL SERVICE

Defining Injury as Lost Ecological Services

-- Organisms live on finite energy budget
-- Organisms must redirect energy to deal with stressor
-- Redirecting energy comes at expense of usual processes
-- Stressful habitat provides less service
-- Less service means a percentage of services lost

Factors Used to Determine Lost Ecological Services

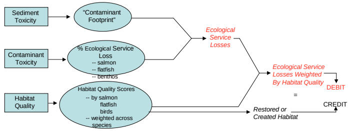
-- Concentrations of each contaminant at numerous locations
-- Contaminant concentrations when injuries are initiated
-- How injuries increase with greater concentrations
-- Types and values of habitats in "injury footprints"
-- Non-contamination factors diminishing habitat value
-- Areas for remediation or natural recovery

Relating Contaminant Toxicity to Services Lost

-- Different biota are affected at different concentrations
-- More biota affected, greater impact on community
-- Percent service losses reflect cumulative effects
-- Portrayed as a loss to entire biological community

HABITAT EQUIVALENCY MODEL

The Trustees expressed natural resource injuries as reduced ecological services resulting from contaminated sediments. Injury thresholds were identified for each contaminant in the bay, mapped via a Geographic Information system, and related to types of habitat. This was done through a Habitat Equivalency Model that was used to express both injured and to-be-restored habitats In the same metric: lost ecological Services over Acres of habitat through the Years, or SERVICE ACRE YEARS (SAYs)

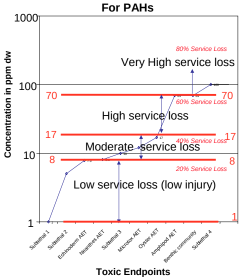


ABSTRACT

Natural resource injuries, for purposes of negotiated NRDA settlement, are quantified in terms of degraded habitat rather than numbers of species impacted. "Currency" used in this Habitat Equivalency Analysis is expressed as ecological services, both for losses by injuries to habitats and gains through restoration of habitats. In determining ecological services provided by a habitat, relative values are assigned in the impacted area based on the habitat type and its importance to key species. Those values are adjusted on the basis of physical/environmental conditions that may affect functional value, and on factors such as relative scarcity of a habitat and importance to the biological community. Scientific literature, applicable regulatory standards, and site-specific data are used to determine the effect that concentrations of hazardous substances have on key species or species groups. This information is used to develop a series of injury threshold levels for each substance; concentrations between those thresholds are assigned a corresponding percent reduction in ecological services. A Geographic Information System is used to map habitats, and hazardous substance footprints where concentrations exceed injury thresholds. The intersection of mapped chemical footprints and habitats identify areas where percent service losses are calculated. Injury duration is based on estimates of when the injury commenced and time to remediation or natural recovery. Losses are converted to current year value by multiplying yearly losses by a discount or compound factor corresponding to each calendar year during injury period: past years compounded, future years discounted. Benefits from restoration projects are calculated by using assumptions of initial habitat value, current conditions at the site, project initiation date, rate of development for habitat types, and expected longevity of the project. The end goal of this process has values of restoration projects equal losses estimated from the injury determination portion of the HEA.

IDENTIFYING INJURY THRESHOLDS

For PAHs



The above represents concentrations of total polycyclic aromatic hydro-carbons (PAHs) estimated to cause injuries to invertebrates and fishes in Hylebos Waterway. Injuries are based on toxicopathic and reproductive injuries to English sole and invertebrate bioassay apparent effects thresholds (AETs) from the State of Washington Sediment Quality Standards. Fish Sublethal Effect 1 = initial effects on fecundity and occurrence of cancerous/ pre-cancerous lesions in liver tissue. Sublethal Effect 2 = fecundity reduced by up to 15% and lesion occurrences in up to 30% of individuals. Sublethal Effect 3 = fecundity reduced by up to 25% and lesion occurrences in more than 40% of individuals. Sublethal Effect 4 = fecundity reduced by up to 50% and lesion occurrences in more than 75% of all English sole examined.

Basic assumptions were used to define initiation of injury and increasing injury levels. We reviewed scientific literature, applicable regulatory standards and the results of our own studies to determine effects from sediment-related concentrations of different contaminants on species or species groups. We judged contamination to be injurious when a concentration of the contaminants in sediments was sufficient to result in an adverse effect to an identified species. The evaluated information showed that as contaminant concentrations increased in sediments, the number of species adversely affected increased and the effects themselves increased in severity. From this, we developed a series of contamination threshold levels for each contaminant, and assigned to each threshold an increasing percent reduction in ecological services per unit of habitat

To the left and below are two examples of the ranges of service loss by different contaminants. Again, the greater number of organisms affected or severity of effect, the greater the ecological service loss.

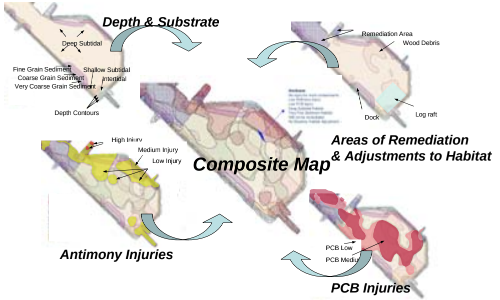
For Zinc

BIOASSAY	CONCENTRATION (ppb)	INJURY
Benthic Community Analysis	410	5% Service Loss
Echinoderm AET	460	
Neanthes AET	530	10% Service Loss
"Bivalve" AET	839	not used *
Microtox™ AET	1,600	15% Service Loss
Oyster AET	1,600	
Amphipod AET	3,800	20% Service Loss

** The "bivalve" bioassay AET is not used if values are present for the more-accepted Oyster bioassay*

Concentrations of Zinc estimated to cause injuries to natural resources in Puget Sound. Injuries are based on State of Washington Sediment Quality Standards and Apparent Effects Threshold (AET) values, expressed in parts per billion (dry weight).

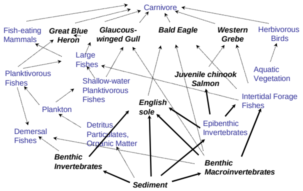
MAPPING INJURIES



DEFINING HABITAT VALUES

To assure a maximum potential benefit from restoration actions, a range of habitat types was evaluated in terms of their relative importance to key local species. From the Commencement Bay biological community shown below, Chinook salmon and English sole were used as surrogates to assess the value of habitats to all fish, and an assemblage of bird species, rather than individual species, was used to assess habitat value to birds. Benthic organisms were also considered.

COMMUNITY PARTS USED IN THIS HEA

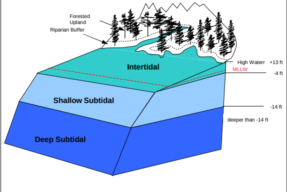


Relative Habitat Values For Species

Habitat Type	Relative Value for Individual Species: juvenile chinook	birds	English sole	Weighted Value for All Species Combined (Fully Functional*)
-- Estuarine marsh	1.00	1.00	1.00	1.00
-- Intertidal	0.67	0.67	1.00	0.90
-- Shallow subtidal	0.40	0.40	1.00	0.70
-- Deep subtidal	0.05	0.05	1.00	0.30

**Fully functional habitats are achieved when associated with vegetated upland buffers. Conversely, the combined values are diminished when habitats occur without the buffers (Baseline Adjusted) or when non-contaminant impacts are present. Examples of the latter include log rafts, wood waste on sediment, and sunlight-limiting docks.*

Graphic Portrayal of Habitats in This Example



TRANSLATING LIABILITY FROM INJURIES INTO RESTORED HABITAT

Habitat Equivalency Analysis: A Simple Example

Injury to 10 acres of deep subtidal habitat with 100% loss of function.

INJURED HABITAT 10 acres of deep subtidal area
HABITAT VALUE PER ACRE 0.30
CALCULATION OF HABITAT VALUE 10 x 0.30 = 3.0 functional units

Compensation Requirements

INJURY TO 10 ACRES OF DEEP SUBTIDAL HABITAT (3.0 functional units lost) WOULD REQUIRE CREATION OF :

10.00 acres of deep subtidal habitat, or
5.45 acres of shallow subtidal habitat, or
4.00 acres of intertidal habitat, or
3.00 acres of estuarine marsh.

Habitat Equivalency Analysis: Factors That Complicate a Simple Example

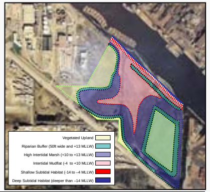
-- Different habitats recover to full function at different rates
-- Multiple contaminants may affect each habitat
-- HEA values losses in present day terms (2004)
-- Injuries compounded by 3%/year back to 1981
-- Injuries discounted by 3%/yr until habitat remediated

A RESTORATION EXAMPLE

Below is an example of habitat restoration where an upland adjacent to a marine waterway is converted to a complex of fully functioning intertidal mudflat and marshland with vegetated buffers. In this scenario, floating log rafts are removed, over 12 acres of upland is excavated to create tideflat and marsh elevations, marsh vegetation is planted, and the remaining upland area is enhanced by planting native vegetation to maximize ecological functions of the adjacent intertidal habitats.

Before

After



Initial Habitat Type	Acres	Ecological Service Value	Restoration Actions	Final Habitat Type	Ecological Service Value	DSAYs
Deep subtidal (degraded)	0.736	0.1	remove log rafts	Deep subtidal (FF)	0.3	4.9
Shallow subtidal (degraded)	1.095	0.1	remove log rafts	Shallow subtidal (FF)	0.7	21.4
Intertidal (degraded)	1.564	0.1	remove log rafts	Intertidal (FF)	0.9	41.0
Intertidal (degraded)	1.393	0.1	substrate enhancement	Marsh (FF)	1	40.00
Intertidal (degraded)	0.118	0.1	substrate enhancement	Vegetated buffer	0.40	1.1
upland	6.422	0.0*	upland plantings	Vegetated buffer	0.4	77.4
upland	7.493	0.0*	excavate & upland plantings	Greenbelt	0.15	33.9
upland	8.529	0.0*	excavate & intertidal plantings	Marsh (FF)	1	264.5
upland	3.689	0.0*	excavate and contour	Intertidal (FF)	0.9	104.9
Totals	31.039					589.1

* Assumed to be lost to industrial development without project, resulting in zero services