Post Point Lagoon Monitoring Project

City of Bellingham, Dept. of Public Works, Project Summary
Richard Hoover, October 2005

Introduction

The following report presents the preliminary findings of the Post Point Lagoon Monitoring Project, conducted by the City of Bellingham Department of Public Works in July 2005, in support of the Post Point Habitat Restoration Project. The primary monitoring project goals were to: 1) Quantify the effects-to-date of dogs on Post Point Lagoon and the surrounding habitat; 2) Establish a comprehensive baseline data set for continued monitoring of the health of the lagoon system, and; 3) Support the goals of the Post Point Habitat Restoration Project. To that end, the results presented below are designed to provide a benchmark by which the success of the habitat restoration project can be measured. Suggestions for further restoration, care and maintenance can be found at the conclusion of the report.

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1.0 Project Description

1.1 Site

Post Point Lagoon (48º 43' 00"/ 122º 31' 05") is a three acre saltwater embayment adjacent to Post Point Pollution Control Plant, Bellingham, WA. The Lagoon is surrounded on three sides by City of Bellingham (COB) property managed by the COB Public Works Department, and connected to Bellingham Bay through a narrow tidal channel that passes under a Burlington Northern Railroad (B.N.R.R.) trestle.

1.2 History

Post Point Lagoon was created during the 1930's when the Burlington Northern Railroad constructed a stone causeway to replace a lengthy trestle across a shallow cove of Bellingham Bay. During the 1960's and 1970's the area surrounding the lagoon was purchased by the City of Bellingham, and much of it was filled as part of the construction of the Post Point Wastewater Treatment Facility. Approximately two and a half acres of the public lands adjacent to Post Point Lagoon were purposely left open for future expansion of the wastewater treatment facility.

In 1998 the City of Bellingham opened the public lands adjacent to Post Point Lagoon to dog owners as an off leash park site (City Ordinance 9044 and 9561 and City Policy PAR 3.01.20). Because of its proximity, the lagoon is used heavily as a swimming hole for dogs. Over the past seven years, a large area (12,730 ft^2) directly abutting the lagoon has been completely denuded of vegetation from heavy dog use. The loss of vegetation is most apparent along the 75-foot (23-meter) access corridor to the lagoon, which includes an area of fragile salt marsh and the periphery of the lagoon's eelgrass beds (Map 1). A project to restore, enhance and protect the lagoon ecosystem was begun in late 2004.

1.3 Ecological Considerations for Post Point Lagoon

As the nearshore, intertidal and subtidal regions of small embayments provide habitat for many marine and terrestrial organisms, it is questioned if use of Post Point as a dog park is having significant effects on the Post Point Lagoon ecosystem. The following ecological considerations support the need for restorative and protective measures to be enacted for Post Point Lagoon and the surrounding habitat:

- Post Point Lagoon is one of only seven pocket estuaries remaining in Bellingham Bay. Considered a "priority habitat" by the Washington Department of Fish and Wildlife (WDFW 2005), the unique protected habitat associated with pocket estuaries is vital to many species of marine fish and birds. In nearby Skagit Bay, eighty-nine percent (89%) of historic pocket estuary area has been lost to human altercation (Beamer et al. 2003).

- Post Point Lagoon is utilized as rearing habitat for juvenile salmon (Lummi Natural Resources Department 2005). Under the Endangered Species Act of 1973, the estuarine rearing grounds of chinook salmon (*Oncorhynchus tshawytscha*) in this area are considered "critical habitat" and are so afforded protection from the U.S. Fish and Wildlife Service.

- Post Point Lagoon contains several sheltered beds of eelgrass (*Zostera marina*), which is designated as critical habitat for the above species of salmon as well as many forage fish. Brian Williams (2000) of the WDFW states: "The shoreline riparian corridor, upper inter-tidal saltmarsh, inter-tidal mud flat, macro algae, and eelgrass combine to form a complex interacting mosaic of marine habitats that provide critical rearing and refuge functions for migrating juvenile salmonids including chinook" and thus "From the WDFW perspective, any impact to eelgrass (*Z. marina*) habitat is unacceptable."

- Post Point Lagoon provides critical foraging grounds for the nearby colony of great blue heron (*Ardea herodias)*, considered a "priority species" by the Washington Department of Fish and Wildlife (WDFW 2005). The heron colony is located approximately 165 feet (50 meters) from lagoon and contained 19 nests in 2004 (Eissinger 2004). It is the last known heron colony found within city limits. Herons typically forage within 3.1 miles (5 kilometers) of their nesting site and are known to prefer foraging in the eelgrass habitat of protected embayments (Butler 1995, Short and Cooper 1985). Juvenile and fledging herons in particular are often observed experimenting with foraging techniques in the lagoon's protected environment (pers. obs.).

- Though the area is closed to harvesting, shellfish are often collected for human consumption from the intertidal area directly surrounding the outflow of the tidal channel connecting Post Point Lagoon to Bellingham Bay. This is of concern because the lagoon receives the bulk of rainwater runoff from the dog park area, and there is often dog fecal matter left behind by uncaring or inattentive owners. A single gram of dog feces can contain 23 million fecal coliform bacteria (Johannes 2005). In addition, humans sometimes utilize the lagoon for swimming. Swimmers are mostly comprised of young children and people training their dogs. After large rain events, the lagoon and surrounding waters may become unsafe for shellfish harvest and human contact.

1.4 Restoration Efforts

Based on the ecological considerations above, restoration efforts were begun in late 2004. The goal of the Post Point Habitat Restoration Project is to create a healthier, more productive habitat for aquatic and terrestrial wildlife while still allowing for multiple types of recreational use. The Post Point Lagoon Restoration Project will have two phases. Phase I will occur in the fall of 2005 and involves:

1) Placing up to 20 pieces of large woody debris within and around the lagoon.
2) Removing two culverts from a small ephemeral tributary stream.
3) Removing existing fill and increasing the saltmarsh area of the lagoon.
4) Re-establishing a native riparian buffer around the lagoon.
5) Protecting native vegetation and habitat elements by restricting access to sections of the upland, shoreline and intertidal zones.
6) Installing signs to educate visitors about the value of nearshore ecosystem functions and the cost effectiveness of the project.

Phase II is scheduled for the summer of 2006 as part of mitigation efforts for a new secondary outfall being installed for the Post Point Wastewater Treatment Facility. It will likely involve further expansion

of saltmarsh habitat and the placement of more large woody debris. For more information regarding habitat restoration efforts, refer to Appendix A.

1.5 Monitoring Project Goals

1) Quantify the effects of dogs on Post Point Lagoon and the surrounding habitat.
2) Establish baseline data for monitoring the continued health of the lagoon system.
3) Support the goals of the Post Point Habitat Restoration Project.

1.6 Monitoring Project Objectives

1) Comparative survey of eelgrass beds and shoreline plants from impacted and lesser-impacted portions of Post Point Lagoon.
2) Record baseline diversity and abundance measurements of benthic invertebrates in Post Point Lagoon.
3) Survey of fish species utilizing Post Point lagoon for rearing and refuge habitat.
4) Weekly measurement of fecal coliform bacteria levels at 5 established stations within and directly outside Post Point Lagoon.
5) Bathymetric survey of the Post Point Lagoon.
6) Compilation of historical data.

2.0 Study Design and Methods

2.1 Eelgrass Survey

Eelgrass surveys were conducted according to Washington State Department of Ecology (WDOE) Aquatic Plant Sampling Protocols (Parsons 2001) and Washington Department of Fish and Wildlife Intermediate Eelgrass/Macro Algae Habitat Survey Guidelines (WDFW 1996, attached as Appendix B).

- Surface mapping. A rowboat and survey grade Trimble GPS unit were used to map eelgrass (*Zostera marina*) beds within the Post Point Lagoon. All positional data were taken in reference to NAD1927 datum. The periphery of the eelgrass beds was mapped and parallel transects were run across the eelgrass beds to account for bare spots or "holes" within the beds. The boundary of the eelgrass beds was defined as areas containing ≥ 5 stems/.25 m^2.

- Remote sensing. Aerial photographs taken by the City of Bellingham in 1997 and 2002 were examined for changes to aquatic vegetation over time. Photographs from other years were not used due to issues with photograph scale, color resolution (2004) and the angle of orientation (2001).

- Depth. The depth of the eelgrass beds was calculated based on bathymetric survey. See section 3.3 for depth measurement methods.

- Density. The density of the eelgrass was measured along a centerline transect (Map 2) at 20 foot intervals by counting the number of stems within a .25 m^2 PVC quadrat. Three counts were taken at

each location and averaged to determine the reported density count. The transect included sections both on the landward margin of the eelgrass beds, as well as in the center of the beds. Density measurements were taken at low tide using SCUBA/snorkeling gear to reach the desired sampling location. A list of macro algae and epifaunal invertebrates observed living upon the eelgrass and other living substrates were recorded at the same time that eelgrass density was measured. For more detailed methodology, see Appendix B.

2.2 Saltmarsh Plant Survey

Saltmarsh plant surveys were conducted according to Salt Marsh Restoration and Monitoring Guidelines prepared under the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center Coastal Management Fellowship Program (Niedowski 2000) and the Washington State Department of Ecology publication: Restoring Wetlands in Washington (Stevens and Vanbianchi 1993).

Ten transects were established at different points surrounding the lagoon. Transects were placed systematically based on the amount of access afforded the dogs at those locations. Beginning at the lowest visible margin of salt marsh plants, three digital photographs were taken monthly along each transect at + 1 m, + 2 m, and + 3 m landward. Each photograph was framed by a m^2 PVC quadrat. Plant species within quadrats affected by dog park traffic (Map 2) were identified, categorized as native or invasive, and measured for change in percent coverage. Aerial photographs taken by the City of Bellingham in 1997 and 2002 were also examined for changes to saltmarsh vegetation over time.

2.3 Benthic Invertebrate Survey

As a rough measurement of biotic health, samples of benthic infauna were collected along four transects within the lagoon using a .15 m^2 Eckman grab. Sampling and analysis techniques were similar to those found in: Recommended Protocols for Sampling and Analyzing Subtidal Benthic Macroinvertebrate Assemblages in Puget Sound (PSEP 1987). Three samples were taken on each transect at depths of 1 ft, 2 ft, and 3 ft (Map 2). Samples were taken during low tide and sampling locations recorded using GPS.

Benthic samples were analyzed immediately upon collection. Each grab was progressively sorted by passing the sample through ¼ inch and 500µm sieves. The amount of substrate/benthos collected was noted for each sample, and sampling was repeated if adequate substrate penetration is not achieved. The total abundance (individuals per 0.15 m^2) as well as the major taxa abundance (number of Annelida, Arthropoda, Mollusca, Echinodermata and miscellaneous organisms per 0.15 m^2) was recorded. Colonial organisms such as hydrozoans, sponges, bryozoans, etc. were also noted for presence/absence. The size and type of substrate (mud, sand, gravel, etc.) was recorded at each sampling site.

2.4 Fish Survey

A survey of fish species utilizing Post Point Lagoon habitat was conducted September 20-21, 2005 in cooperation with Dr. Leo Bodensteiner, Dept. Environmental Sciences, Huxley College, WWU. In an effort to supplement data collected through beach seining efforts of the Lummi Natural Resources Department in 2003, trap nets were used to sample from within the eelgrass beds where beach seines could not reach. The trap nets were set parallel to the long axis of the pond, near center, at two locations within the lagoon's eelgrass beds (Map 2). Two net configurations and mesh sizes were used. The first net was an Ace style net with ⅛ inch mesh, and a 40 foot lead. The second net configuration was two

Indiana-style trap nets (fyke nets) with 3'x 4' foot frames, ½ inch mesh and 25 foot leads set with leads joined in the south eelgrass bed. At time of setting, the tide was outgoing and below the rip rap sill that separates the lagoon from Bellingham Bay. Both net configurations were set at a depth of approximately 4 feet. The nets were left to fish overnight, when the max tidal height reached 8.2 feet (depth of 6.2 feet in lagoon). Fish were identified and counted upon retrieval of the nets. Results are presented in Catch Per Unit Effort (CPUE) that in this case was: 'one trap net night'.

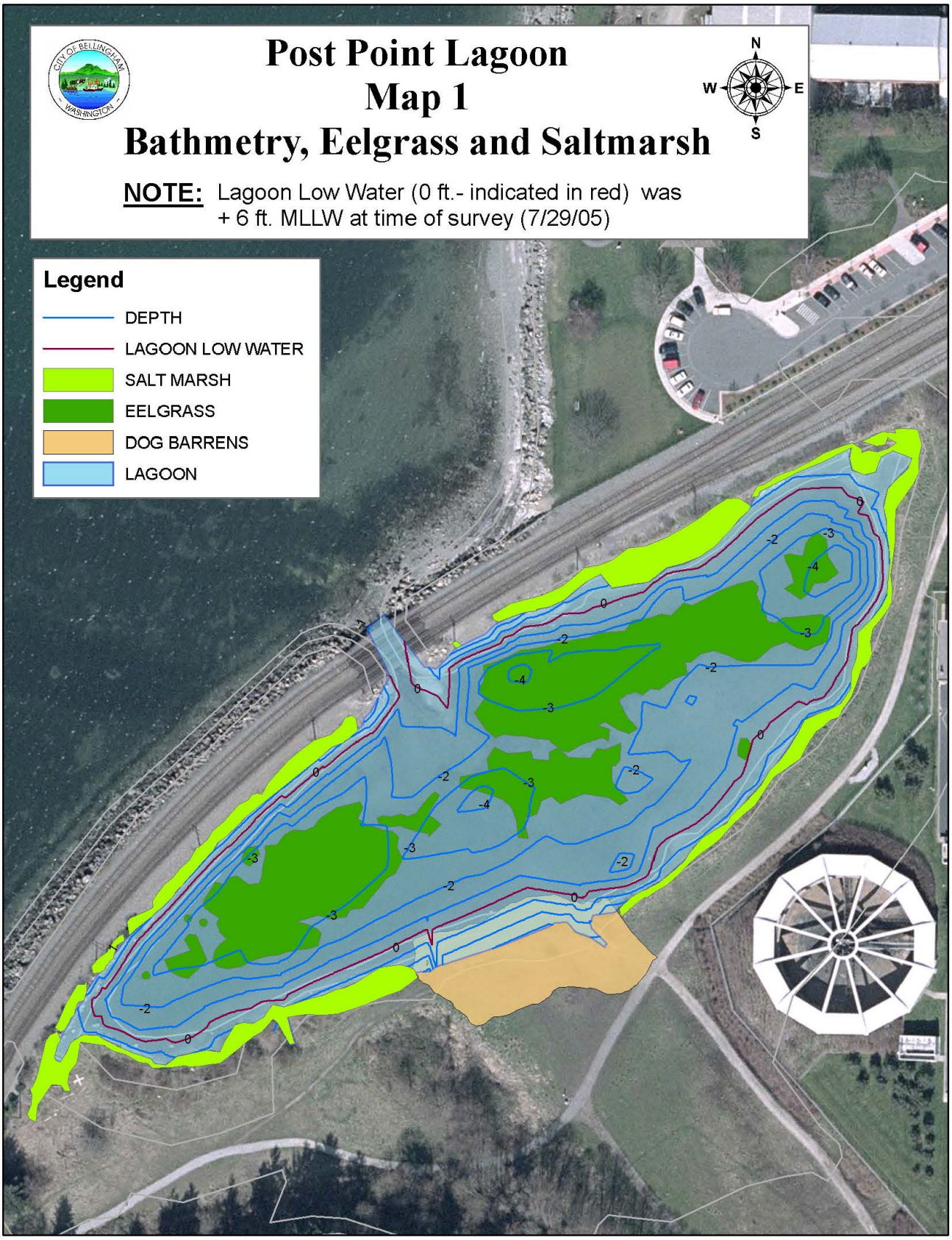
A number of small schooling fish were observed at the time of trap net setting, but were not captured by the mesh size of the trap nets. In order to determine what species the schools were comprised of, a 1.3 m^2 lift net with 1-mm nylon mesh was used to collect several specimens for identification. Fish were identified based on the expertise of Dr. Leo Bodensteiner and utilizing the web database: www.Fishbase.org (Froese and Pauly 2005).

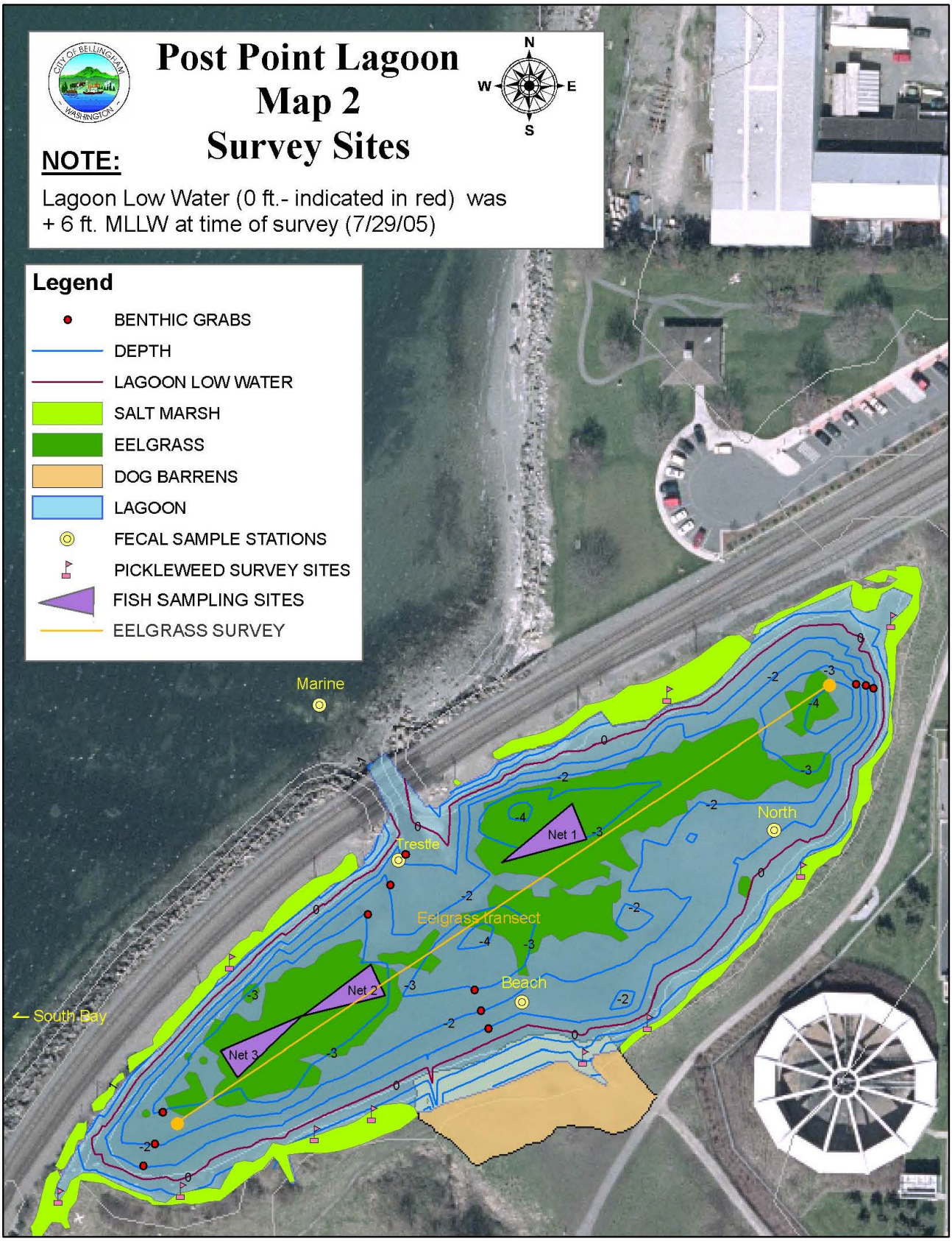
2.5 Fecal Coliform Sampling and Analysis

Fecal coliform samples were collected weekly according to Standard Methods (SM) 1060 B protocol. Three samples were taken within the Post Point lagoon (Map 2), and two samples were collected from Bellingham Bay directly outside the lagoon. To assess same-site precision and total variability, a duplicate sample was taken at one of the five sites each sampling period. All sites were located using GPS. Samples were collected in pre-cleaned, sterile, labeled 250mL bottles. Sterilized latex gloves were worn during collection. To collect the sample, the cap was removed while holding the bottle from the base, care taken not to touch the inside, and placing the bottle several centimeters below the surface. A headspace was left so that the analyst can mix the sample. No rinsing was required. The samples were immediately stored on ice in the dark and transported to the City of Bellingham Publicly Operated Treatment Works laboratory for immediate analysis. Samples were analyzed within six hours of collection in the City's laboratory, which is accredited to perform the method employed by the Washington State Department of Ecology. Samples were analyzed utilizing the most probable number technique with A1 media (SM 9221 C) and incubated at 44.5 °C for 24 ± 2 hours. Duplicate samples were collected at one site during each sampling period. These samples were used to check field and laboratory precision, which was determined by calculating the standard deviation of the difference between the paired measurements. Fecal coliform data were compared to a previous study conducted in 2000.

2.6 Bathymetric Survey

Following the same transects used for eelgrass mapping, a surveying rod (marked for measurement in tenths of feet) was extended from the lagoon basin to the surface of the lagoon at approximately 10 m increments. The surface elevation and position of each depth sample was determined using a survey grade Trimble GPS unit. Positional data was taken in reference to NAD1927 datum. Vertical data was taken in reference to 1947 USCGS Mean Lower Low Water (MLLW) datum. The accuracy of the MLLW datum was verified by comparison to NOAA 2005 tidal predictions and a City of Bellingham established benchmark in Marine Park. In order to standardize tidal height, bathymetric surveys were conducted at extreme low tides when there is no longer water exchange between the lagoon and Bellingham Bay. The highest elevation of the tidal channel connecting the lagoon to Bellingham Bay was also recorded to check the accuracy of GPS surface elevation readings.


Post Point Lagoon
Map 1
Bathmetry, Eelgrass and Saltmarsh
NOTE: Lagoon Low Water (0 ft.- indicated in red) was + 6 ft. MLLW at time of survey (7/29/05)
N
W
E
S
Legend
DEPTH
LAGOON LOW WATER
SALT MARSH
EELGRASS
DOG BARRENS
LAGOON


Post Point Lagoon
Map 2
Survey Sites
NOTE:
Lagoon Low Water (0 ft.- indicated in red) was
+ 6 ft. MLLW at time of survey (7/29/05)
N
W
E
S
Legend
BENTHIC GRABS
DEPTH
LAGOON LOW WATER
SALT MARSH
EELGRASS
DOG BARRENS
LAGOON
FECAL SAMPLE STATIONS
PICKLEWEED SURVEY SITES
FISH SAMPLING SITES
EELGRASS SURVEY
Marine
Trestle
North
Beach
Eelgrass transect
Net 1
Net 2
Net 3
South Bay

3.0 Results

3.1 Eelgrass Survey

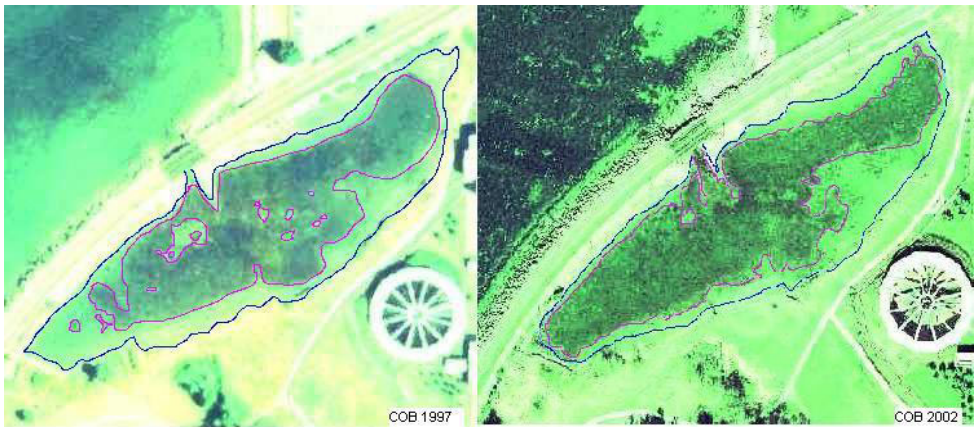
The results of surface mapping (Map 1) show 11 eelgrass beds (*Zostera marina*) of various sizes, covering a total area of 34,224 ft^2 (0.79 acres). The average density of eelgrass in Post Point Lagoon was 35.8 stems m^{-2} and the highest density observed was 96.0 stems m^{-2} at a site near the center of the northernmost eelgrass bed. Density was noticeably lower (1-3 stems m^{-2}) in fringe sites and the area in the center of the lagoon between the dog access beach and the tidal channel. The majority (97.3%) of the eelgrass was found between -2.0 ft and –5.0 ft of depth in mud and gravel substrate. There was one small patch located on the eastern shore (Map 1) that approached the lagoon low water mark.

The lagoon was also found to support a variety of macro algae species (Table 1), providing additional habitat and ecosystem functions for fish, birds, and invertebrates. Aerial photographs taken it July of 1997 and April of 2002 were visually compared for changes to aquatic vegetation before/after opening of the area as a dog park (Figure 1). Though the extent of aquatic vegetation can be seen changing over time, seasonality, unknown changes to nutrient inputs (from dogs), and variable growth make it impossible to link changes to aquatic vegetation with dog park use.

Table 1. List of macro algae found in Post Point Lagoon.

Species	Common Name
Pseudolithophyllum spp.	crustose coralline red
Sarcodiotheca gaudichaudii	cylindrical branched red
Desmarestia ligulata	acid kelp
Desmarestia aculeata	profuse branched acid kelp
Mazzaella spp.	red bladed algae
Fucus gardneri	rock weed
Ulva spp.	green bladed algae

Figure 1. Aerial photographs from 1997 (left) and 2002 (right). Aquatic vegetation is outlined in purple.



According to a 2002 study by the Washington Department of Natural Resources (Berry et al. 2002), the average density of eelgrass in the San Juan/Straits region was 66.8 stems m^{-2}, varying with depth and substrate type. Eelgrass was generally found in 2.5 ft to 22 ft of water, with the highest densities generally found between 0.0 m and -2 m (-6.56 ft) in depth. Sandy substrates supported the most prolific eelgrass populations, followed by mud and gravel.

Considering the presumably warmer temperatures, incomplete water exchange, and the mud/gravel substrate that is commonplace to lagoon ecosystems, the eelgrass density of 35.8 stems m^{-2} in Post Point Lagoon is moderately healthy. The eelgrass meadows are able to support a variety of ecosystem functions, including providing adequate rearing, refuge, and foraging habitat for many invertebrates, shellfish, crabs, fish, and birds (See section 3.3-3.4). However, 2.21 acres of benthic substrate, mostly between 0.0 ft and -2.0 ft of depth, remains void of eelgrass. This is likely due to: 1) the swift tidal flood that enters through the trestle channel during high tide, and; 2) heavy use of the lagoon's shallow nearshore habitat by recreating dogs. Withholding the area directly inside of the tidal channel, the bulk of the unvegetated substrate is suitable for colonization by eelgrass. Thus, through careful restoration and protective efforts, the aquatic vegetation habitat of Post Point Lagoon has the potential to grow to support larger fish populations, larger invertebrate populations, as well as greater overall diversity.

3.2 Saltmarsh Survey

The saltmarsh habitat is comprised of the nearshore areas surrounding the lagoon (Map1, Figure 2). This area is found between tidal elevations of 7.5 ft and 9.5 ft, covering an area of 16,600 ft^2 (0.38 acres). Nine native saltmarsh plant species were identified at the Post Point Lagoon site (Table 2), with *Salicornia virginica* (pickleweed), *Distichlis spicata* (seashore saltgrass), and *Juncus gerardii* (mud rush) being the most dominant species.

Table 2. List of native saltmarsh species identified around the Post Point Lagoon.

Species	Common name
Salicornia virginica	pickleweed
Distichlis spicata	seashore saltgrass
Poa macrantha	seashore bluegrass
Juncus gerardii	mud rush
Atriplex patula	orache/spearscale
Plantago maritima spp.	sea plantain
Triglochin maritimum	sea arrow grass
Hordeum spp.	meadow/foxtail barley
Deschampsia spp.	tufted hairgrass

An estimated 3200 ft^2 of Post Point saltmarsh habitat has been denuded of vegetation by heavy use. Most noticeable is the dog access beach and fringing areas (Figure 2). Disturbed saltmarsh habitat can be susceptible to colonization by invasive grass and rush species (Niedowski 2000), however, if these areas are protected quickly this can likely be avoided. Revegetation and expansion of native saltmarsh plants can already be seen along transects protected by the fencing installed in late 2004. In a

comparison of two photographic transects located directly adjacent to each other but on either side of the protective fencing, the protected site showed a 17% increase in coverage over the summer growth period as compared to a 5% increase in the unprotected site.

Figure 2. *Left*: The saltmarsh habitat has been completely denuded by heavy use at the dog access site to the lagoon. *Right*: The effects of recent trampling are apparent in this 1.5 m wide strip where left-over root structure is evidence of the previous extent of the salt marsh habitat.

Saltmarsh is a niche habitat often overlooked for its important role in supporting lagoon health. The salt resistant plant species that grow in these fringe areas provide oxygen, nutrients, cover and toxin removal faculties to the lagoon (Niedowski 2000). Along with the submerged vegetation, the saltmarsh habitat of Post Point Lagoon should be considered a restoration/conservation priority.

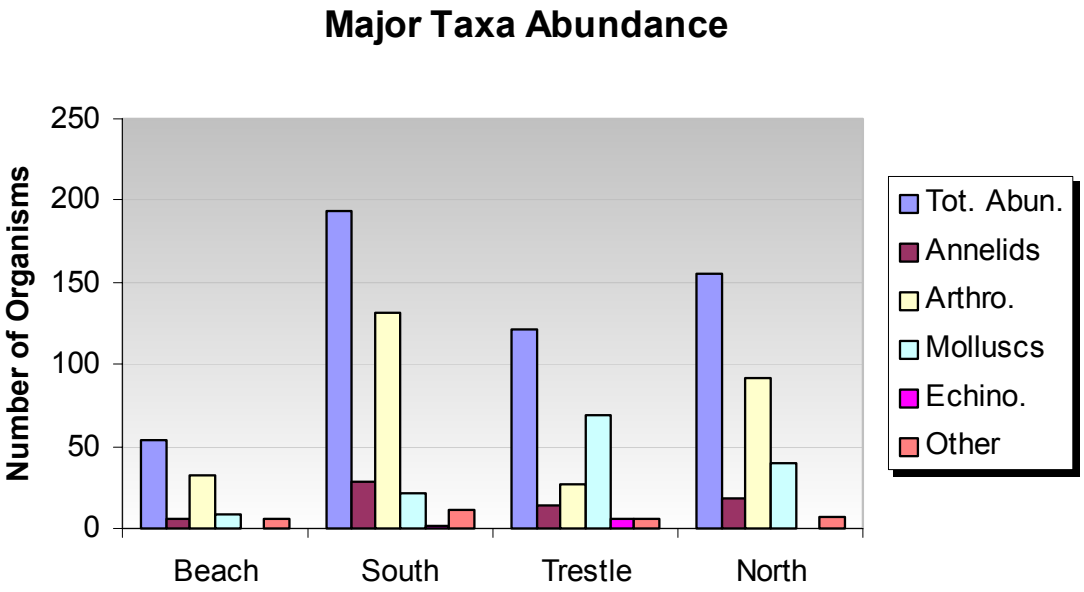
3.3 Benthic Invertebrate Survey

The composition and diversity of the benthic infaunal community was examined by measuring major taxa abundance from 4 transects (12 sites) within Post Point Lagoon (Map 2). Sites were selected to compare varying degrees of impact from dogs. The sites were statistically compared using a 1-way Analysis of Variance (ANOVA) and Tukey's HSD post hoc test. Results (Figure 3) show that the average total abundance of benthic invertebrates was significantly lower ($P = 0.045$) at the heavily used beach site than the other three sites. The difference is most apparent in the annelid ($P = 0.024$) and

mollusc (P = 0.002) groups, which are more dependent upon the benthic substrate for feeding and refuge than the other groups. As both annelids and molluscs generally require loose sediment to burrow in and feed from, compaction of benthic substrate by heavy dog traffic is the most probable cause for lower infauna abundance at the beach site. A lack of nearby eelgrass habitat also likely plays a role.

It should also be noted that the trestle/tidal channel sampling area had a noticeably different community makeup than the other three sites. Water movement in this area is likely responsible the lesser number of arthropods, greater number of molluscs, and greater number of echinoderms. Small arthropods are easily swept away by strong currents while the echinoderms and mollusks are better suited to securing themselves to feed from the prey-rich incoming tide.

Figure 3. The average abundance of benthic infaunal invertebrates compared by major taxa and sampling site within Post Point Lagoon.



In a comprehensive study of Puget Sound substrate quality as it relates to benthic invertebrate populations, NOAA and the WDOE found annelids to be the dominant taxonomic group in most samples, while arthropods rarely dominated (SQPS 2002). In contrast, arthropods and molluscs dominate the Post Point Lagoon community assemblage. Invertebrate community assemblages vary based on a wide range of natural and anthropogenic factors (SQPS 2002), making it difficult to identify the factors controlling the lagoon benthic community makeup. The factors most likely to affect Post Point Lagoon are the result of the lagoon's small, shallow nature and incomplete water exchange (See section 3.6). However, annelids in particular are sensitive to water and sediment toxicity, so lower than average numbers may be indicative of pollutants in the lagoon system. Due to the lagoon's proximity to both the Post Point Pollution Treatment Facility out-fall and the Harris Avenue Shipyard (WDOE Model Toxics Control Act site), water and sediment toxicity cannot be discounted as a factor influencing lagoon health.

With consideration of the many species of invertebrates that are not infaunal, the lagoon could be said to support a healthy diversity of invertebrates. In particular, the lagoon's eelgrass beds provide excellent habitat to a variety of epifaunal species. A list of invertebrates observed during during lagoon studies is presented below (Table 3).

Table 3. Invertebrate species observed during lagoon studies.

Crabs & Shrimp	**Sea Stars, Brittle Stars, & Sea Cucumbers**
Cancer magister (dungeness)	*Leptasterias hexactis* (six rayed sea star)
Cancer productus (red rock)	*Cucumaria piperata* (white tentacles)
Cancer gracilis (Graceful, smooth carapace)	*Cucumaria miniata* (orange common)
Pagurus spp. (hermit crabs)	*Amphiodia occidentalis* (long-rayed brittle star)
Pugettia gracilis (Graceful kelp crab)	**Amphipods & Isopods**
Pugettia producta (Northern kelp crab)	*Idotea* spp. (small amphipod)
Heptacarpus spp. (smalleyed & Sitka shrimp)	**Sponges**
Hemigrapsus oregenensis (Oregon crab)	*Haliclona* spp. (encrusting sponge)
Hemigrapsus nudus (nude claw)	*Leucilla nuttingi* (small urn sponge)
Snails, Citons, & Clams	**Ascidians**
Clinocardium spp. (littleneck clam)	*Distaplia occidentalis* (colonial tunicate)
*Batillaria attramentaria (*mud snail*)*	**Nudibranchs**
Gemma gemma (tiny clam)	*Melibe leonina (*hooded nudibranch*)*
Mopalia spp. (chiton)	*Haminaea vesicula* (clear shell)
Collisella pelta (limpet)	*Anisodoris nobilis (*orange nudibranch*)*
Lacuna variegata (Chink shell)	**Bryazoans, Hydroids, & Anemones**
Oysters, Mussels, & Barnacles	*Bugula* spp. (bryazoan)
Mytilis edulis (bay mussel)	*Obelia* spp. (hydroid)
Crassostrea gigas (Japanese oyster)	*Tealia lofotensis* (white-spotted rose anemone)
Balanus spp. (barnacle)	*Epiactis prolifera* (brooding sea anemone)

3.4 Fish Survey

At the time of survey (Sept. 2005), Post Point Lagoon was found to support healthy populations of both shiner perch and pacific staghorn sculpin (Table 4). In addition to high abundances, there was a large size distribution for both species, indicating that several year classes were present. Thirty-one small striped staghorn sculpin were caught in Net 1 (smaller mesh), likely of the 2005 year class. It should be noted that due to the limitations of sampling methods, the diversity of fish inhabiting the lagoon during the fall season might not be fully expressed. Many schools of small fish too little to be retained by our mesh sizes were observed swimming throughout the eelgrass beds. A square 1.3 m^2 lift net with 1mm mesh was used to capture a few representatives of these small fish for identification. The majority of small schooling fish caught were common sticklebacks (*Gasterosteus aculeatus aculeatus*), which are known for their tolerance to a wide range of temperatures and salinity (Bodensteiner, pers. comm.). A few tube-snout (*Aulorhynchus flavidus*) were also captured.

Shiner perch, sticklebacks and other forage fish found during the fall season are known prey of both salmonids and marine birds (Bargmann 1998, Butler 1995, Morrow 1980, Larson and McIntire 1993). However, *additional fish species utilize Post Point Lagoon during different seasonal/abiotic regimes.* For example, juvenile sandlance are known to spawn during the winter months on the beaches directly outside of the lagoon (WDFW 1997), and it is likely that many spend the first few months of their lives

in the shelter of the lagoon's eelgrass. Juvenile chinook salmon have historically utilized the lagoon during the spring (Lummi Tribe 2005). Regardless of the season, the majority of fish entering the lagoon system are there to utilize the protected, fertile eelgrass meadows as refuge and foraging grounds (Froese and Pauly 2003). Accurate assessment of species diversity can only be made upon future surveys of Post Point Lagoon, conducted on at least a quarterly basis, with subsequent monitoring of environmental conditions. Only then could a complete understanding of fish use of the lagoon be achieved.

Table 4. Fish caught during preliminary survey using trap nets (9/21/05).

Common Name	Fish Species	CPUE 1	CPUE 2
shiner perch	*Cymatogaster aggregata*	98	328
pacific staghorn sculpin	*Leptocottus armatus*	49	128
starry flounder	*Platichthys stellatus*	1	11
pacific herring	*Clupea pallasii pallasii*	1	0
tube-snout	*Aulorhynchus flavidus*	0	1
Avg. Temp: 15.9 °C	**Total :**	**149**	**468**

3.5 Fecal coliform analysis

From July 21 until October 20, 2005 samples of lagoon surface water were analyzed weekly for the presence of fecal coliform bacteria. The minimum and maximum one-time-grab fecal coliform bacteria counts for each station are presented in Table 5. When examining single grab bacterial population counts, there are a number of important environmental influences to consider. In the lagoon, tidal influence, runoff from rain events, dog feces, and the presence of migrating birds all play a part in determining bacteria counts. For the two sites in Bellingham Bay, tides bringing water over from the Nooksack river and rough conditions stirring up bottom sediments add to the above influences.

Table 5. Min/Max fecal coliform bacterial counts during the 2005 sampling period. Numbers in parenthesis indicate on how many occasions min/max counts were found to be the same.

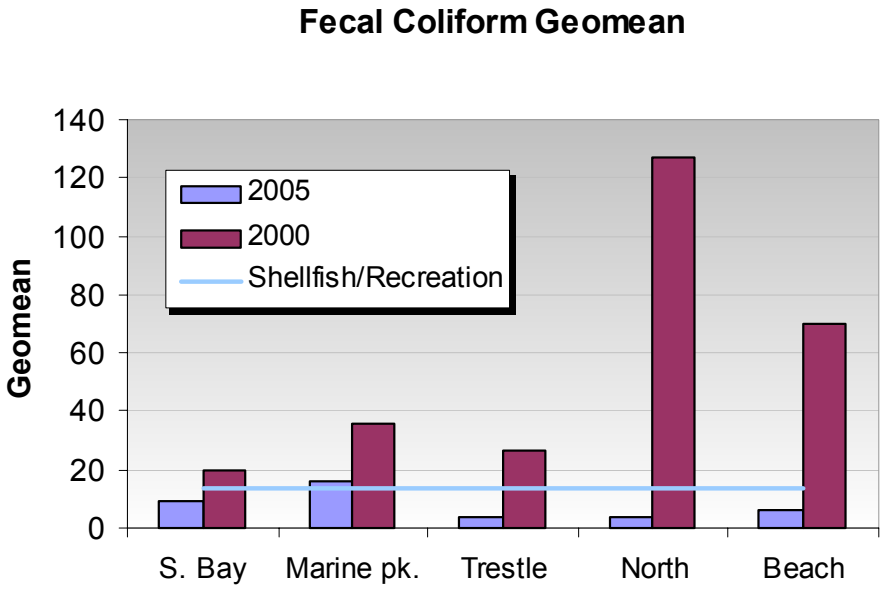
Site	Min. (cfu/100 ml)	Max. (cfu/100 ml)	Site Conditions During Maximum Value.
S. Bay	< 2 (2)	170	Rough conditions in bay.
Marine Pk.	2 (2)	240	Rough conditions in bay.
Trestle	< 2 (3)	80	Heavy rain, post restoration work.
North	< 2 (3)	50	Heavy rain, post restoration work.
Beach	< 2 (2)	900	Heavy rain, post restoration work.

To establish reasonable safety standards for shellfish harvest, the WDOE and the Washington State Department of Health (WDOH) uses the geometric mean (g.m.) of all samples taken within a defined period as the best estimation of fecal coliform population counts. The geometric mean measure of fecal coliform determined to be safe for the harvest of shellfish as well as for primary recreational activities (i.e. swimming) in marine waters is 14 colonies/100 ml (WAC 173-201A). With the exception of the Marine Park site (g.m. = 16), geometric mean values for 2005 were all below this standard. Further, the

three sites within the lagoon all showed significant decreases in fecal coliform counts when compared to a similar study conducted in 2000 (Figure 4).

This reduction in bacteria levels is considered an early success for the restoration project, as it is likely that the native plants and fencing installed in 2004 helped to reduce the amount of dog feces left nearshore and washing into the lagoon during rain events. It is also to the credit of *The Grateful Dogs* dog owner association, who have encouraged visitors to the dog park to utilize dog waste bags and disposal bins which they arranged to have placed on site.

Figure 4. Fecal coliform geometric means for 2000 and 2005. The blue line indicates WDH safety standards.



3.6 Bathymetric Survey

In order for Post Point Lagoon to receive tidal influence, the tidal height in Bellingham Bay must be 6+ feet above the Mean Lower Low Water (MLLW). This is due to a rip rap sill (elevation: 6.0 ft.) under the BNRR trestle that likewise restricts the lagoon from fully draining. Lagoon depths were recorded at low tide and thus the lagoon low water (presented as 0.0 ft in Map 1) was actually 6.0 feet above MLLW. Based on the observable build up of rip rap directly inside the tidal channel, it appears that the sill now holding the lagoon waters at + 6.0 ft MLLW will continue to rise due to shoreline deposition and sedimentation from Bellingham Bay.

Considerations and potential effects of incomplete drainage:

1) Eelgrass habitat is not tidally restricted to the MLLW, possibly creating a more stable population.
2) Subtidal organisms are able to take advantage of the protected habitat year round.
3) During periods of low tides, water exchange may become limited, and could lead to:
   a) Elevated temperature (solar warming).

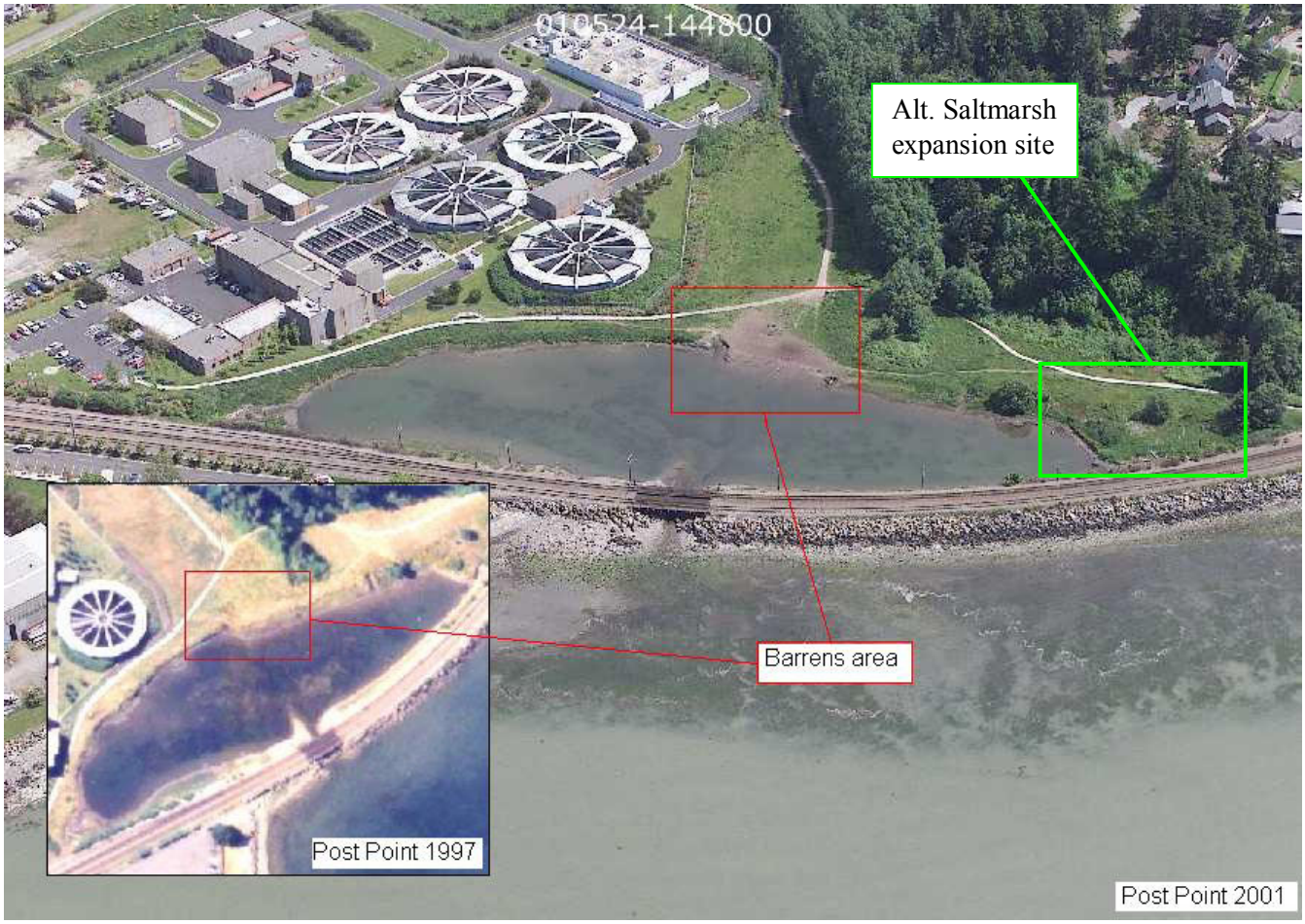
b) Elevated salinity (evaporation).
c) Decreased amounts of dissolved oxygen (used by organisms).
d) Conditions adverse to supporting fish stocks.
e) Conditions conducive to bacterial growth.

- Note: As the mean tidal range for Bellingham Bay is 5.22 feet and the mean tidal height is 5.09 feet (NOAA 2005), extreme low tide occurrences do not occur often, nor for long periods of time. Suggestions for future management of the lagoon tidal restrictions are included in section 4.

3.7 Review of historical data

Historical aerial photographs show a continuing expansion of the denuded area created by heavy use for access to the lagoon (Figure 5). While only a very small area (~ 30 ft^2) appears denuded in 1997, the measured denuded area in 2005 was 12,730 ft^2 (0.29 acres). Estimation of change to eelgrass beds was not possible due to the scale and resolution of the aerial photographs. See Figure 2 for changes to overall aquatic vegetation between 1997 and 2002.

Figure 5. Comparative analysis of aerial photographs from 1997 (pre dog park) and 2001 (post dog park) shows a considerable denuded area labeled "barrens". An alternative site for saltmarsh expansion (for mitigation) is also included.



4.0 Summary and Recommendations

Post Point Lagoon and the surrounding area form a complex, fragile and unique habitat. Supporting this system at its base is the algae, eelgrass and saltmarsh vegetation. These plants and algae provide the food/nutrients on which all other organisms utilizing the lagoon depend. To illustrate the point, herbivorous amphipods, (which feed on the primary producers), were found in great abundance during benthic invertebrate surveys. The amphipods not only are a great food resource to fish populations, but also limit certain algae from overwhelming the lagoon system (Duffy and Hay 2000). As a result the lagoon is able to support a greater number and wider diversity of species on which other organisms like salmon and great blue herons feed. Therefore, to ensure the health of the major species of concern, protecting the eelgrass, algae and saltmarsh vegetation of Post Point Lagoon should be the first priority of restoration efforts. Presented below are recommendations for the continued study, management and protection of the Post Point Lagoon ecosystem.

1) **Monitoring of important water quality parameters** such as water temperature, salinity, dissolved oxygen, turbidity, pH and nutrient content should begin immediately after completion of restoration efforts and continue at least through the next summer. A combination of high temperatures and nutrient loading has been shown to reduce eelgrass abundance (Bintz et al. 2003) as well as affect fish survival (WAC 173-201A). WDOE Aquatic Life Uses Criteria (WAC 173-201A) should be used as benchmarks to assess whether water quality conditions support biotic uses of the lagoon. This is most important when concerning salmonid migration and rearing. Analysis of benthic sediments for toxins associated with adjacent industrial uses should also be conducted for a comprehensive understanding of the factors influencing lagoon health.

2) **Continued monitoring of ecological health** should be done incrementally over next five years in order to measure the success of restoration efforts. Fish surveys should be conducted on a quarterly basis to document how the lagoon fish populations vary seasonally. The eelgrass and saltmarsh populations could be monitored every summer at the height of their growing seasons, and should be surveyed at the least two and five years after restoration. Benthic invertebrates and bathymetry, should be surveyed after five years. Fecal coliform levels should be monitored as often as possible in order to build a long-term data set that accounts for variation in season, tide and weather.

3) **Continue to limit dog access to lagoon and surrounding area.** Likely the single most detrimental influence to the lagoon ecosystem, the amount of access afforded to dogs and their owners should continue to be limited. Restoration efforts to improve fencing and place large woody debris on the shoreline are good. However, to further reduce impact, it is suggested that fencing and/or woody debris be extended into the water as well as placed around the denuded “beach” area. This would concentrate recreational use to specific access points and keep the already impacted area from further expansion.

4) **Fencing.** The addition of more aesthetically pleasing, permanent fencing along native planting areas would add visual appeal to the natural barrier being created between the public and the lagoon while further restricting dogs from using the nearshore grass/scrub area for defecation. Wood fence-posts (4x4) with a coated wire mesh fence would be attractive and more cost affective than chain link. Physical barriers have been observed to be the single greatest deterrent to allowing dog access to sensitive saltmarsh areas (pers. comm. Lesli Higginson).

5) **Thinning and maintenance of native plantings** would improve aesthetics and maintain heron flight corridors. Species not suited to the nearshore environment should be removed. Pruning of scrub species and removal of larger plant species (fir, pine, oak, etc.) should be done in areas used by herons as flight corridors.

6) **Control and removal of invasive plant species** such as blackberry, tansy ragwort, and non-native grass needs to be done regularly to ensure native plantings are allowed to establish and are not out-competed by noxious weeds.

7) **Watering and care of new native plantings** should continue in order to assure a high survival rate and quick establishment of natural barriers to protect the heron, lagoon and saltmarsh habitat.

8) **Excavation of the tidal channel** under the railroad to an elevation between + 4.0 and + 5.0 ft above MLLW would allow more water exchange, supporting more moderate water temperatures/salinities, expansion of the lagoon intertidal area, and improved access to the lagoon for migrating salmon and forage fish. The overall result would be an enhanced ability to support a healthy biotic community in the lagoon. There are very few foreseeable negative impacts from this action, however, excavation deeper than + 5.0 ft MLLW would put the existing eelgrass habitat in jeopardy of desiccation and risk exposing the effluent outfall pipe that runs under the trestle at that location. It should also be noted that the rip rap sill now holding the lagoon waters at + 6.0 ft MLLW will likely continue to rise due to shoreline deposition and sedimentation.

9) **Expansion of intertidal and saltmarsh habitat** would enhance the ability of the lagoon ecosystem to support critical and endangered species. Improvements could be used as mitigation for impacts from construction of a new outfall for Post Point Pollution Control Facility. The dog beach and area surrounding the ephemeral steam has been recommended for habitat expansion. Public access to the lagoon should be considered carefully when planning habitat expansion, as the high traffic associated with the dog park could lead to heavy erosion and will undoubtedly make the area surrounding access unsuitable for saltmarsh immigration/planting. An alternative, more protected site for habitat expansion is identified in Figure 5.

10) **Blocking trail access to the B.N.R.R. at the west-end of park** would reduce traffic through the area and release the City from the liability of providing easy access to the privately owned and potentially dangerous stretch of railroad south of Post Point. This could be achieved by removing the southern extent of the existing trail, fencing it off, and connecting the native planting areas currently on either side of the trail.

11) **A permanent heron viewing station** may want to be considered as a way to bolster public interest and gain support of local bird watching groups. Such a viewing station could be placed along the path that now leads to the B.N.R.R. and have permanent binoculars accompanied by a educational sign giving a brief history of the great blue heron and describing the importance of the area to the birds.

12) **Community involvement and stewardship.** There are several community groups with vested interests in the Post Point public space. One group, Grateful Dogs, has already been instrumental in establishing rules and facilities to manage dog waste on the site. Another interested party is the local

chapter of the Audubon Society, known for their advocacy and protection of bird and wildlife habitats. It is suggested that these groups be allowed to remain involved and informed during the restoration process. Cooperative efforts with outside entities such as Western Washington University, the Whatcom County Marine Resource Committee, The North Sound Baykeeper, the Port of Bellingham (Waterfront Futures), local tribal governments, and interested community groups should also be considered as a way to bolster community support for future projects.

13) **Permanent educational signs** should be used to inform the general public of the history, ecology and use of Post Point. In addition to signs already in place, a large sign placed at the dog beach should be installed describing: 1) the history of Post Point and the lagoon; 2) lagoon/eelgrass biology and its ecological significance (i.e. salmon refuge and rearing); and 3) showing the impact of heavy traffic on the saltmarsh community. A second sign describing great blue heron nesting and foraging habitat could be placed at the viewing station suggested above (12). Direct contact with the public that utilizes Post Point has revealed that most individuals are concerned about protecting their environment, but lack educational information to connect their behaviors with environmental impacts.. It may be that once the public understands the sensitive nature of the site and their impact on it, they will choose to remediate the situation for themselves.

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6.0 Acknowledgements

I would like to extend special thanks to all those who contributed to the successful outcome of this project: Larry Bateman for initiating and guiding the direction of my work; Renee Lacroix for her advice, guidance, and for being the driving force behind completing the task at hand; Peg Wendling and her entire staff for allowing me to work in their lab and lending me their scientific expertise; Geoff Smyth and Clare Fogelsong for overseeing the project and keeping goals realistic; Leo Bodensteiner, Ann Eisinger, Brian Williams and Jim Johannessen for their scientific expertise; and finally the crews of the Washington Conservation Corps, who will put into place the restorative effort to enhance and protect Post Point Lagoon for future generations.

Appendix A

Memo

To: Clare G Fogelsong, Geoffrey M Smyth, Peg Wendling, Richard A Hoover, Larry Bateman

From: Renee LaCroix

CC: Nick R Saling, Michael R Koenen, Ann Eisinger

Date: 10/20/2005

Re: Post Point Lagoon habitat restoration

Where?

Post Point Lagoon is a three-acre pocket estuary and is one of seven pocket estuaries found within Bellingham Bay. Pocket estuaries are shallow, low energy shoreline areas that range from the mouths of small streams and creeks (such as Chuckanut creek) to nearly enclosed bays and lagoons (such as Padden lagoon). They can be composed of habitats such as unvegetated flats, salt marsh and tidal channels and as such, may or may not be considered an estuarine wetland. Cumulatively, pocket estuaries are very important to several life history stages of federally listed juvenile Chinook and juvenile Chum salmon. Post Point Lagoon and adjacent lands provide habitat for many species of wildlife including Great Blue Heron.

Juvenile Chinook and chum salmon depend heavily on nearshore and estuarine environments, such as the Post Point Lagoon, at a critical stage in their lives. Brian Williams, an Area Habitat Biologist for the WDFW, visited the site in April of 2000. The following is an excerpt from a letter he wrote concerning the site. The letter contains information on the species and life history stages that will be affected.

> "At the risk of being redundant, I want to re-emphasis the biological importance of the Post Point Lagoon to juvenile salmonids and in particular to juvenile Chinook. In my letter dated April 28, 2000, I stated that 'the shoreline riparian corridor, upper inter-tidal salt marsh, intertidal mud flat, macro algae, and eelgrass combine to form a complex interacting mosaic of marine habitats that provide critical rearing and refuge functions for migrating juvenile salmonids including Chinook.' Of all the salmonid species, Chinook salmon have demonstrated the greatest dependence upon the estuary, intertidal and shallow subtidal marine habitats for early juvenile survival. The estuary and near shore marine habitats in Bellingham Bay are used extensively by juvenile Chinook. Juvenile salmonid sampling data for Bellingham Bay demonstrates that juvenile Chinook are present in the intertidal and shallow subtidal marine habitats of Bellingham Bay from mid March through mid September (Lummi Tribe, 1995). Estimated resident times for Chinook juveniles in Washington State estuaries range from 1-189 days (Simenstad et al. 1982). Research in the Skagit River estuary demonstrated an average individual juvenile Chinook residence in the estuary and near shore marine habitats of approximately

65 days (Congleton et al. 1982)."

Post Point restoration is being proposed based on our understanding of the ecological importance of this type of habitat and its scarcity locally. In addition to the letter quoted above referring to life stage use and benefits, other technical assessments attest to the importance of marine habitats. Studies conducted in 1995 and 2005 by the Lummi Nation documented the use of Post Point Lagoon by juvenile salmonids. The Bellingham Bay Demonstration Pilot Project ranked a project at this site as a high priority in its Final Habitat Restoration Documentation Report of February 19, 1999. Table 1 of the Interim Strategy: Geographic Priority Areas by Species and Life History Stage, identifies Bellingham Bay as High Priority Habitat for North Fork Spring Chinook and Priority Habitat for South Fork Spring Chinook. The restoration of the Post Point Lagoon fits with the WRIA 1 interim salmon recovery project prioritization criteria. The Marine Resources Committee and the Bellingham Bay Habitat Action Team also support this project.

What?

The Post Point Lagoon Restoration project involves six elements:

1. Placing up to 20 pieces of LWD within and around the lagoon;
2. Removing two culverts from a small ephemeral tributary stream;
3. Removing existing fill and increasing the saltmarsh area of the lagoon;
4. Re-establishing a native riparian buffer around the lagoon;
5. Protecting native vegetation and habitat elements by restricting access to sections of the upland, shoreline and intertidal zones;
6. Installing signs to educate visitors about the value of nearshore ecosystem functions and the cost effectiveness of the project.

Element 1: Installing LWD around the lagoon to increase salmon and wildlife habitat complexity. The goal of the project is to create aquatic and terrestrial wildlife habitat by placing logs in an estuarine lagoon so that they appear as though they were naturally washed up on shore during a storm event. The City will place up to 20 pieces of large, weathered, drift wood logs (20-40 feet long each) that will fit the aesthetic of the lagoon.

- Approximately 12-14 pieces of LWD (without root wads) will be placed parallel to shoreline above the high water mark. Log placement will mimic placement achieved by natural processes. LWD will not be placed on top of existing native saltwater marsh vegetation.

- Four to six pieces of LWD (with root wads attached) will be placed perpendicular to the shoreline at the edges of the area denuded by dog traffic. The logs will be placed so that the root wads will remain on shore as though the tree was blown over and the treetop fell into the lagoon. The root wads will be dug into the existing shore bank using the excavator to prevent the logs from rolling or drifting. These logs may need to be anchored using Manta or Helical anchoring systems. Anchoring will remain landward of +7.7 tide elevation based on MLLW = 0.00. Log placement perpendicular to the shore will help limit the ongoing sprawl of the area denuded by dog traffic. (See attached figure for conceptual drawing of log placement.)

LWD will be placed using an excavator, operator and Washington Conservation Corps (WCC) crews. The excavator will stay on the existing trails and devegetated areas and will try to

minimize impact to the recently re-vegetated riparian buffer area. All logs will remain landward of +7.7 tide elevation based on MLLW = 0.00.

Element 2: Removing two culverts located on the small, ephemeral, tributary stream flowing into the lagoon. The upstream culvert will be replaced with a wooden footbridge. The downstream culvert (at mouth) will be removed entirely and that section of stream will be daylighted.

Element 3: JOY_ THIS MAY NOT HAPPEN THIS YEAR_ Removing existing fill and increasing the saltmarsh area of the lagoon. An area at the mouth of the stream will be excavated to increase: 1) habitat complexity in the lagoon and 2) area of available estuarine salmonid habitat in the lagoon (see attached drawings). Excavation will occur above +8.5 tide elevation based on MLLW = 0.00. A band of saltgrass (*Distichlis spicata*) will be disturbed during excavation but because the excavation will increase the available area for this species, a net gain is expected over the long term. (Additional option: Existing fill could also be removed from a second location to the east. A small green plastic pipe drains into a ravine adjacent to the lagoon. The pipe should be removed and the mouth of the ravine excavated to increase 1) habitat complexity in the lagoon and 2) area of available estuarine salmonid habitat in the lagoon.). Excavation will occur above +8.5 tide elevation based on MLLW = 0.00.)

Element 4: Re-establishing a native riparian buffer around the lagoon. Create a functioning native riparian buffer and allow the native saltmarsh grasses to re-colonize the area denuded by dog traffic. Native trees and shrubs were planted along the upland shoreline in the winter of 2004. The plantings experienced a 90% survival rate the first year. These plantings will be expanded in the fall/ winter 2005. The area under the heron nests will be revegetated as well. After the heron fledge- the blackberries will be removed and the area along the stream corridor will be planted with nootka rose, alders and whatever else Ann says is good for the heron.

Element 5: Protecting native vegetation and habitat elements by restricting access to sections of the upland, shoreline and intertidal zones. The re-vegetated area was fenced off to protect the upland and saltmarsh vegetation from human and canine disturbance and allowed the saltmarsh vegetation to begin to re-colonize naturally. This fall the fenced area will be expanded to increase the size of the native upland buffer and saltmarsh vegetation zone (see map). This area under the heron nests should also be temporarily fenced off to allow establishment of a dense rose thicket.

Element 6: Installing signs to educate visitors about 1) the value of pocket lagoons, 2) nearshore ecosystem functions and processes, 3) the lack of functioning estuarine habitat available to federally listed juvenile Chinook, 5) the importance of the area to heron and 4) the cost effectiveness of the project.

Why?

Restoration will positively impact the characteristic uses of Post Point Lagoon while still allowing for multiple types of recreational use. The anticipated result of the lagoon and estuarine environment restoration is a healthier, more productive habitat for aquatic and terrestrial wildlife. Placing LWD within and around the lagoon will naturalize the lagoon and provide both salmonid cover and waterfowl perches. Removing two culverts from a small ephemeral tributary stream will further naturalize the area. Removal of the fill in the areas will quickly increase functional estuary value by increasing estuary area

and habitat complexity. Planting the riparian areas of the lagoon will improve water quality as well as provide food sources for fish utilizing the lagoon for forage habitat and provide a visual screen between the lagoon and recreational areas (appealing for heron). Limiting access to the shoreline and water will lead to natural regeneration of these habitats. This will also reduce the disturbance to the fish utilizing the lagoon for refugia or foraging and improve water quality. Providing education relevant to the specific project and marine nearshore habitat in general will increase the public's awareness of the importance of the marine environment and will lead to an increased sense of informal stewardship of the lagoon. This project will also increase the aesthetics of the site because the City has purchased old, silver, barnacle-covered, weathered logs that fit the look and feel of a salt water lagoon.

The habitat is critical to endangered and priority species. It is important to undertake this project now in order to stem the degradation and return the lagoon to a healthy, productive state while there are still salmonids present and habitat left to restore.

*** Appendix B to be attached to final draft.**