Natural Resources

Cherry Point Environmental Aquatic Reserve Management Plan

November 2010

Amended January 2017

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WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands

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Acronyms

ARCO	Atlantic Richfield Company
ACOE	Army Corps of Engineers
BP	British Petroleum
CBI	Chicago Bridge and Iron
CAA	Clean Air Act
CIG	Climate Impacts Group
CO	Carbon monoxide
CO2	Carbon dioxide
CP	Cherry Point
CWA	Clean Water Act
DNR	Washington State Department of Natural Resources
DOH	Washington State Department of Health
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
ET&S	Endangered, Threatened and Sensitive Species
GIS	Geographic Information Systems
GMA	Growth Management Act
gpm	gallons per minute
GSX	Georgia Strait Crossing
HII	Heavy Impact Industrial
HPA	Hydraulic Project Approval
MESA	Marine EcoSystems Analysis
MHHW	Mean Higher High Water
MHW	Mean High Water
MLW	Mean Low Water
MLLW	Mean Lower Low Water
MRC	Marine Resource Committee
MYA	Million Years Ago
NO_X	Oxides of nitrogen
NOAA	National Oceanic Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NWCAA	Northwest Clean Air Agency
OHWM	Ordinary High Water Mark
PAR	Photosynthetically Active Radiation
PDO	Pacific Decadal Oscillation
$PM_{2.5}$	Particulate matter 2.5 microns in diameter
PM_{10}	Particulate matter 10 microns in diameter
PHS	Priority Habitat and Species (WDFW)
PNW	Pacific Northwest
PSAMP	Puget Sound Ambient Monitoring Program
PSI	Puget Sound Initiative
RCW	Revised Code of Washington
SAV	Submerged Aquatic Vegetation
SEPA	State Environmental Policy Act
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SO_x	Oxides of sulfur
SVMP	Submerged Vegetation Monitoring Plan
U&A	Usual and Accustomed
UGAs	Urban Growth Areas
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
VEAT	Vessel Entries and Transit reports, produced by the Washington State Department of Ecology, Spill Program
VOC	Volatile organic compounds
WAC	Washington Administrative Code
WCC	Whatcom County Code
WDFW	Washington State Department of Fish and Wildlife
WMU	Watershed Management Unit
WRIA	Water Resource Inventory Area
WWU	Western Washington University

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Figures & Tables

1. Executive Summary

The Cherry Point Aquatic Reserve is a unique aquatic ecosystem located in the Strait of Georgia in northern Puget Sound—on the western shores of Whatcom County, Washington. It is bounded on the north by the southern boundary of Birch Bay State Park, and on the south by the northern boundary of the Lummi Indian Nation Reservation. Its environment includes cobble intertidal areas, submerged aquatic vegetation, and a steep gradient into deep water that supports a high diversity of fish and wildlife including: Cherry Point herring and other forage fish, marine and shore birds, and migratory waterfowl; ESA listed salmon; Dungeness crab; groundfish; bivalves and marine invertebrates and, marine mammals. Its marine waters and aquatic lands are a portion of Treaty-protected Usual and Accustomed grounds and stations of local Native American Indians, and are used by the Indians for commercial, ceremonial, and subsistence purposes. The aquatic lands in the reserve are also used by non-Indians and provide significant economic benefits, recreational opportunities, and other social values. Cherry Point's distinctive bathymetry provides deepwater access for large vessels without the need to dredge out shipping channels or berthing areas. Major water-dependent industries have located on the shores, bringing jobs in manufacturing, petroleum oil refining, shipping and commerce.

The Washington State Department of Natural Resources (DNR) is responsible for managing state-owned aquatic lands to provide a balance of public benefits. In 2000, DNR recognized the need to protect the significant environmental resource of aquatic lands at Cherry Point and designated those state-owned lands not already under a lease agreement as the Cherry Point Aquatic Reserve, in order to ensure long-term environmental protection. All aquatic lands within the Cherry Point Aquatic Reserve are state-owned and managed by DNR. The aquatic reserve does not include aquatic lands within the boundary of Birch Bay State Park, privately owned lands, or tribal lands. The effect of designating the aquatic lands at Cherry Point as a reserve was to withdraw the lands from further leasing, but at that time DNR did not develop a site-specific plan to guide management decisions for the Reserve.

This plan was created to identify the natural resources—habitats and species—existing within the Cherry Point Reserve, and the proposed uses, future threats, and management actions that will be employed by DNR to protect these resources. The aquatic reserve addresses the management of aquatic lands; it does not address the harvest of finfish or shellfish within the aquatic reserve. The harvest of finfish and shellfish are managed by affected tribal governments and the Washington Department of Fish and Wildlife pursuant to treaties and court decisions. The plan was developed with the help of independent scientists, federal, tribal and state resource agencies, site users, lessees, environmental and citizen groups who recognized the ecological importance of the site to both Puget Sound recovery and to commerce and industry.

The Technical Advisory Committee and the Cherry Point Workgroup identified the following current and potential threats to habitats and species of the Cherry Point Aquatic Reserve: shoreline modification, including overwater structures, loss of riparian vegetation, armoring, and derelict gear; pollution from groundwater contamination, stormwater runoff, point discharges, and air deposition; disturbance from unsustainable recreational activities; artificial light and excessive intermittent sound; vessel traffic, including oil spills; invasive species; and habitat impacts due to climate change. A number of species and habitats addressed in this plan have experienced declines over the past 40 years, such as the Cherry Point herring stock, which has shrunk from approximately 15,000 tons to between 800 and 2,100 tons over the last ten years. Other key species in decline include Puget Sound

Chinook salmon, bull trout, and certain species of rockfish, surf scoter, and Southern Resident orca whales (PSSS 2005; WDFW 2009; National Marine Fisheries Service 2008).

This plan identifies the management emphasis for Cherry Point Aquatic Reserve as environmental protection above all other management actions. The following goals are established for the Reserve:

Goal One: Identify, protect, restore and enhance the functions and natural processes of aquatic nearshore and subtidal ecosystems that support endangered, threatened and sensitive species and aquatic resources identified for conservation in the Reserve.

Goal Two: Improve and protect water quality to maintain public health, support fish and wildlife species and healthy functioning habitats.

Goal Three: Protect and help recover indicator fish and wildlife species and habitats, with primary focus on Cherry Point herring, Nooksack Chinook salmon, groundfish, marine mammals, seabird/duck and shorebird communities, Dungeness crab, and submerged native aquatic vegetation.

Goal Four: Facilitate stewardship of habitats and species by working in cooperation with lessees, recreational users and federal, state and tribal resource agencies to minimize and reduce identified impacts of human activities on the species and habitats within the Reserve.

Goal Five: Identify, respect, and protect archaeological, cultural, and historical resources within the Reserve. Continue to respect the right of Washington's tribes to use their own natural and cultural resources as recognized by treaties, statutes, executive orders, and court decisions.

The plan includes actions related to: protection, enhancement and restoration; outreach and education; monitoring, data collection, and research; and allowed and prohibited uses within the Reserve. DNR management will emphasize the long-term protection of the aquatic resources within and directly adjacent to the Reserve. In general and consistent with its statutory authority, the DNR will limit new uses in the Reserve to those that are consistent with this management plan. New activities authorized on state-owned aquatic lands within or adjacent to the reserve must support desired future conditions described in Chapter 4, through avoiding and minimizing adverse impacts to habitats and species. The existing industrial uses at Cherry Point do not conflict with aquatic reserve status. If the facilities are managed according to this plan and the lessees actively work to further goals for the Reserve, the uses can serve the objectives of the Reserve. Because DNR, Tribes, local, and state and federal regulatory agencies all are responsible for the state's aquatic resources, and DNR's authority is limited to proprietary management of state-owned aquatic lands, achieving the plan's goals requires partnerships among federal, state, and tribal natural resource agencies, landowners, and others. A Memorandum of Understanding or other forms of agreement may be used as a means for resource managers to address issues of mutual interest in the Cherry Point Aquatic Reserve. Other tools include use of existing regulatory and government decision processes and creation of advisory committees for specific projects.

'Adaptive management' is a key component of the Cherry Point Aquatic Reserve Management

Plan. Adaptive management is a systematic process for improving management actions by learning from the outcomes of actions previously taken. It requires managing and sharing data, tracking progress in carrying out the plan, making technical assessments about effectiveness of plan actions, evaluating and communicating progress, and determining course corrections needed to make the plan more effective over time. Because DNR does not have the resources to immediately implement all the plan's management actions, the following adaptive management actions are a high priority for the first five years of implementation:

1) Monitor the effectiveness of the protection actions in this plan that address existing and proposed use authorizations, and
2) Research the decline of targeted species (mentioned above in Goal Three) to reduce uncertainties that can directly improve the effectiveness of management actions.

This management plan will be reviewed and updated at least every ten years. Changes in ecosystem condition and existing uses of state-owned aquatic lands will be included in the updates. Actions include development of an evaluation process to set quantitative and qualitative goals for achievement, monitoring to measure success in meeting those goals, and learning from actions taken in order to make better decisions in the future. Research and monitoring will be used to guide DNR and cooperators in determining whether management actions are supporting the objectives of the Reserve. If management actions are not supporting the objectives of the Reserve, they will be modified, monitored and evaluated during the following 10-year review period in accordance with adaptive management strategies.

2. Introduction

Purpose and Content of This Plan

Cherry Point is a unique and very important place. It is located on the Strait of Georgia, on the western shores of Whatcom County. It is bounded on the north by the southern boundary of Birch Bay State Park, and on the south by the northern boundary of the Lummi Indian Nation Reservation. Cherry Point has a unique marine and freshwater ecosystem that supports a variety of natural resources, fish and wildlife. Aquatic diversity along this reach is very high with cobble intertidal habitat, large rocks and boulders, sandy beaches, eelgrass beds, and kelp. Additionally, the deep area close to shore and the steep intertidal gradient along this reach may be important to marine diversity. At one time Cherry Point provided spawning habitat for the largest herring population of Puget Sound and the Strait of Juan de Fuca. The area is a nearshore migratory corridor for juvenile salmon, and provides significant habitat and foraging areas for marine seabirds and migratory waterfowl populations. Five species of salmon — sockeye, Chinook, coho, chum, and pink — and three species of forage fish: Pacific herring, sand lance, and surf smelt rely upon these habitats. Various species of ground fish have been surveyed offshore.

Cherry Point supports a large recreational, commercial (both tribal and non-tribal), and tribal ceremonial and subsistence Dungeness crab fishery, and a smaller spot shrimp fishery is located offshore to the west (Whatcom County MRC 2001).

In addition to the unique habitat features of Cherry Point, the distinctive bathymetry and water depths of more than 70 feet relatively close to shore provide deepwater access for large vessels. Major water- dependent industries have located on the shores of Cherry Point, bringing jobs in manufacturing, shipping and commerce. In recognition of the importance of this economic base to the region, Whatcom County established the Cherry Point Management Area to provide a framework for balancing special port, industrial and natural resource needs.

This plan identifies the habitats and the species of the Reserve and the management actions that will be employed by the Washington State Department of Natural Resources (DNR) to conserve these resources with the management emphasis on environmental protection above all other management actions. This plan is being developed in accordance with the State Environmental Policy Act (SEPA), and will serve as DNR's primary management guidance for the 90-year term of the Reserve. At least every ten years after the adoption of this plan, it will be reviewed, and as necessary, updated with current scientific, management, and site-specific information. As with the development of this plan, DNR will update the plan through work with other jurisdictions, Tribes, interest groups, landowners and lessees, and local citizens to establish cooperative management actions for activities within and adjacent to the Reserve to conserve, enhance and restore habitats and species within the Reserve.

The primary focus of this plan is to protect, enhance and restore habitats used by Cherry Point herring stock, salmon, migratory and resident birds, Dungeness crab, groundfish rearing areas and marine mammals, as well as the protection of submerged aquatic vegetation and water quality. This management plan does not address the harvest of finfish or shellfish within the aquatic reserve.

The people who assisted with the development of this plan realize that the aquatic environment of Cherry Point: provides essential habitat and irreplaceable biological and ecological functions; is a portion of Treaty-protected usual and accustomed (U&A) grounds

and stations of local Native American Indians; and provides significant economic benefits, recreational opportunities and other social values.

The plan is intended to provide the basis for greater understanding of factors affecting the aquatic ecosystem of the Cherry Point Aquatic Reserve, provide site-specific guidance for management actions, and allow for adaptive management in order to protect these resources, while recognizing the importance of the continued industrial and other water-dependent uses located in and adjacent to the Cherry Point Aquatic Reserve. The plan contains the following chapters:

1. **Introduction:** This section describes the role of the Washington State Department of Natural Resource, the background on the aquatic reserve, how the plan was developed, the aquatic reserve boundary, relationship to federal, state, local and tribal management, and local land use designations.
2. **Cherry Point Resources Characterization:** This section provides an overview of the ecological characteristics and current conditions of the site, and provides a summary of the current and potential future impacts.
3. **Management Goals and Objectives:** This section describes the desired future ecological conditions for the Cherry Point Aquatic Reserve, and the goals and policies to help ensure the desired conditions can be met.
4. **Management Actions:** This section contains the management actions developed to address the goals and objectives of this plan. It includes actions for protection, enhancement, and restoration; outreach and education; monitoring, data collection, and research; and allowed and prohibited uses within the Reserve.
5. **Plan Implementation:** This section describes recommendations for how the plan should be implemented, including monitoring and adaptive management to assess the success of the recommended actions in achieving future desired conditions.

Washington State Department of Natural Resources

DNR is responsible for protecting and managing 5.6 million acres of state-owned land for the people of Washington. Much of the land (3 million acres) is state trust land that provides revenue to help pay for construction of public schools, universities, and other state institutions, and funds many county services. The state-owned aquatic lands within the Cherry Point Aquatic Reserve are not held in trust for beneficiaries and are, instead, lands that are held as a 'public trust' for the people of the state and managed in accordance with statutory directive.

Upon statehood, all states received title to lands underlying navigable waters within state boundaries from the Federal Government. In its Constitution, Washington State claims ownership to its aquatic lands:

> "*The state of Washington asserts its ownership to the beds and shores of all navigable waters in the state up to and including the line of ordinary high tide, in waters where the tide ebbs and flows, and up to and including the line of ordinary high water within the banks of all navigable rivers and lakes…*" (Article XVII, §1).

The State has sold about two-thirds of all tidelands[1] and some shorelands[2] to local and private interests. In 1971, the Legislature prohibited the sale of tidelands and shorelands to private parties.

[1] The area in marine water between ordinary high tide and extreme low tide

[2] The area in freshwater between ordinary high water and the line of navigability

The State retains ownership of all bedlands[3]. The Legislature directs DNR to manage a majority of state-owned aquatic lands (approximately 2.6 million acres). In some cases, treaties between Tribes and the United States reserved tidelands as part of Indian Reservations prior to statehood and were never tidelands managed by the state. Further detail on state aquatic lands can be found on http://www.dnr.wa.gov.

In the Revised Code of Washington (RCW) 79.105.030, the Legislature gave DNR general management guidance to manage aquatic lands for a balance of public benefits. Benefits that are to be provided by state-owned aquatic lands include:

1. Encourage direct public use and access;
2. Foster water-dependent uses;
3. Ensure environmental protection;
4. Utilize renewable resources.

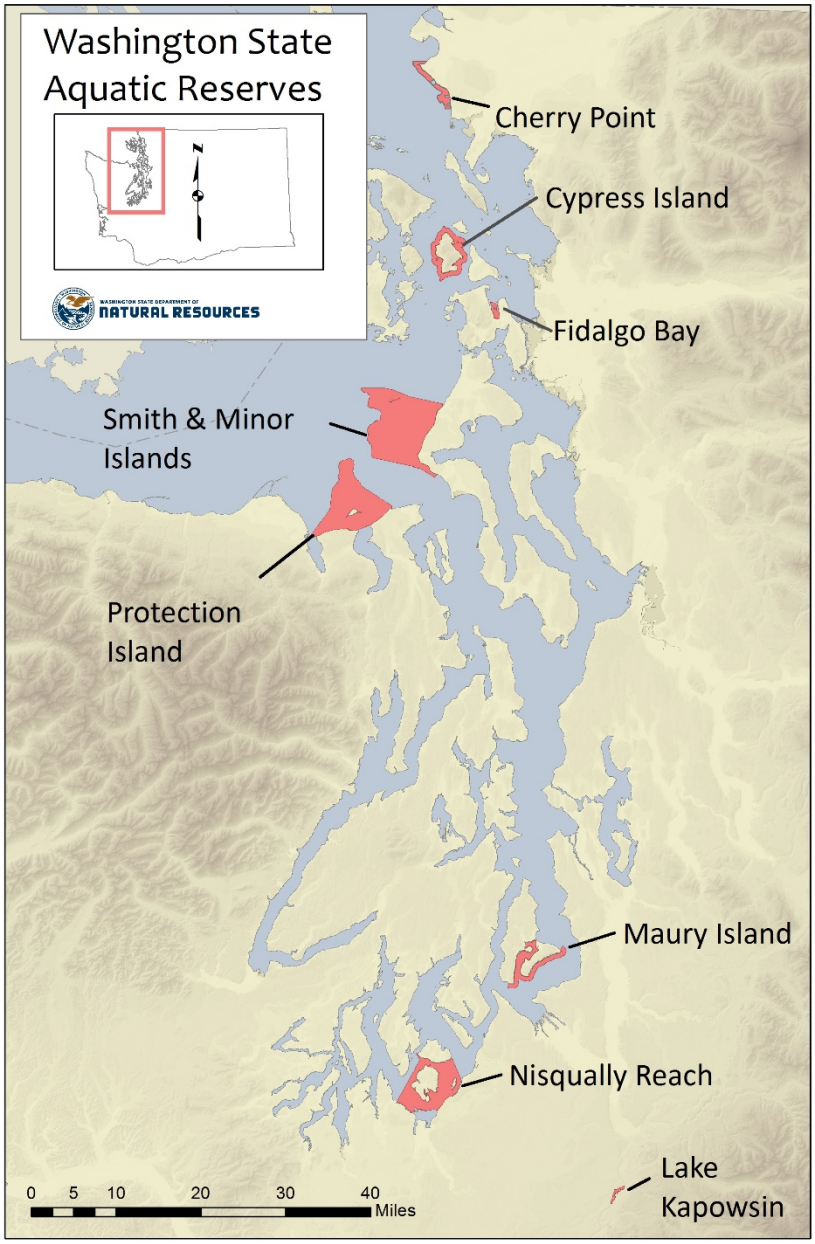
When consistent with the above public benefits, revenue generation is also considered a public benefit. DNR generates revenue from aquatic lands by leasing these lands for private and commercial use (such as docks and marinas) and by selling the materials harvested from aquatic lands. Such materials vary from gravel to wild geoducks. These revenues fund DNR aquatic land management activities as well as other local and state programs to restore and enhance aquatic lands habitat and improve public access to these lands.

DNR's proprietary management of state-owned aquatic lands is governed by RCW Chapters 79.105-.140 and WAC Chapter 332-30. In addition, federal laws, Treaties, intergovernmental agreements, and court decisions affect DNR's management activities. Other entities, such as the U.S. Army Corp of Engineers, Washington State Department of Fish and Wildlife and the Washington State Department of Ecology have responsibilities to regulate certain activities on both private and publicly-owned aquatic lands, and DNR's management is subject to such regulations. The Public Trust Doctrine also applies to DNR managed lands. This common-law principle protects public use and access to navigable waters for navigation, fishing, and recreational activities.

DNR is authorized to identify and protect state-owned aquatic lands for their natural ecological systems. RCW 79.105.030 identifies environmental protection — the overarching goal of the Aquatic Reserve Program — as one of DNR's primary mandates for the management of state-owned aquatic lands. RCW 79.10.210 authorizes DNR to identify and withdraw from all conflicting uses public lands that can be utilized for their natural ecological systems. RCW 79.105.210 further authorizes DNR to withhold lands with significant natural values from leasing or to provide for protection of natural values within any lease. WAC332-30-151 directs DNR to consider lands with educational, scientific, and environmental values for aquatic reserve status, and identifies management guidelines for aquatic reserves. WAC 332-30-106(16) defines environmental reserves as sites of environmental importance, which are established for the continuance of environmental baseline monitoring and/or areas of historical, geological, or biological interest requiring special protective management. WAC 332-30-151(2) states that aquatic reserve designation should not conflict with current or projected uses of the area. Figure 1 identifies the location of existing and proposed aquatic reserves.

[3] The area below extreme low tide or the line of navigability

Figure 1. Existing and Proposed Aquatic Reserves.



Cherry Point Aquatic Reserve Background

DNR has been involved in aquatic land management in the Cherry Point area since the 1950s when the first refinery pier was constructed on state-owned aquatic lands. As additional facilities were proposed at Cherry Point, DNR and other stakeholders recognized the need for striking a balance between economic development and environmental protection. In 2000, then Commissioner of Public Lands, Jennifer Belcher designated an environmental aquatic reserve for state-owned aquatic lands at Cherry Point not already under a lease agreement, ensuring environmental protection as a long-term management objective. While state aquatic lands at Cherry Point were reserved and withdrawn from conflicting uses, there was no site-specific plan to guide management decisions for the Reserve. This set in motion DNR's actions to develop a plan that protects the Cherry Point Aquatic Reserve's unique ecosystem while managing the area consistent with Whatcom County's "Cherry Point Special

Management Unit" shoreline designation. In 2001, interim management guidance was finalized and applied to Cherry Point Aquatic Reserve. This guidance was modeled after the Interim Management Guidance was finalized and approved for the Aquatic Reserves Program, and applied to the Cherry Point Aquatic Reserve until a management plan was adopted.

DNR began discussing the future management plan for the Cherry Point Aquatic Reserve in 2003. In 2003, the Technical Advisory Committee (TAC), an independent group of scientists tasked with evaluating the Cherry Point site against DNR aquatic reserve criteria, unanimously recommended managing the site as an environmental aquatic reserve. In developing their recommendation, the committee recognized Cherry Point as an extraordinary stretch of shoreline with excellent potential to maintain the relatively undeveloped character of the area. The herring spawning in the area was recognized as a unique biological feature of Puget Sound and its importance to the ecosystem was emphasized. Additionally, it was recognized that aquatic diversity along this reach is very high with cobble intertidal habitat, large rocks and boulders, and kelp just offshore. The deep area close to shore and the steep gradient of the intertidal along this reach could be important to marine diversity.

The Technical Advisory Committee specifically noted:

> *"…while initially disturbing, industrial development associated with the piers appears to be compatible with aquatic reserve status and noted the opportunity to facilitate multiple-uses as an example where commercial activities and environmental resources can co-exist."*

DNR staff and scientists prepared preliminary documents providing background information regarding the uses in the area and a list of potential issues of concern relating to the aquatic ecosystem in the Cherry Point area. Outreach included the various resource agencies and interest groups in the area. Information was gathered to broaden the issues to be considered in the planning process. Public meetings were held to further refine the scope of the planning process. This led to the development of an outline for future discussion of planning needs.

The planning process was put on hold temporarily in 2004 while DNR attempted to address concerns by the Cherry Point industries regarding the continued designation of Cherry Point as an aquatic reserve. In 2005 DNR considered revising the language of WAC 332-30-151 —*Reserves*—to address industry concerns; however, attempts to successfully resolve these issues to the satisfaction of all stakeholders could not be achieved and resulted in further delays in the planning process. DNR completed management plans for three other reserves while issues at Cherry Point were being addressed. Simultaneously, the county was updating their critical area inventory and shoreline analysis leading to an updated Critical Area Ordinance (CAO) that covered Cherry Point, which was adopted in September 2005.

In 2006 DNR staff working with Whatcom County Shoreline planners and their consultants examined the opportunity to merge planning efforts. The County Shoreline Master Plan (SMP) update was underway and needed to examine and plan for environmental and public access considerations in the Cherry Point Management Area. Believing there were common interests to be addressed, the County and DNR considered the option of incorporating certain aspects of an aquatic reserve management plan into the Shoreline Master Plan and at the same time provide a potential alternative to the Cherry Point Aquatic Reserve. DNR agreed to this process based on the understanding that any alternative approach to managing this area must meet or exceed the protection for resources provided under the Aquatic Reserves Program, and its management plan. The Cherry

Point Workgroup was formed to evaluate this and other resource planning alternatives.

Plan Development and the Cherry Point Workgroup

In 2007, DNR brought together a group of stakeholders with a wide range of interests in the community and Puget Sound to assist DNR in evaluating management options for the Cherry Point Aquatic Reserve. The Cherry Point Workgroup first met in July 2007 for a preliminary discussion of the goals and possible outcomes of the process.

Between July 2007 and April 2008 the Workgroup and several subcommittees examined the management of activities in the vicinity of Cherry Point during the previous 10 years. The group sought out information and answers from a wide range of professionals regarding all aspects of resource and industrial management in the area. The Workgroup developed a common aim to provide consistent guidance for the development of this management plan. They contributed technical information and developed recommendations for actions to be included in the management plan. As a result of the Workgroup's efforts, DNR determined that state-owned aquatic lands within the Cherry Point Aquatic Reserve would continue to be managed as an aquatic reserve. The Workgroup took an ecosystem-based approach towards identifying the habitats, species and threats associated with the Cherry Point Aquatic Reserve. The common aim and the key tasks of the Workgroup are described in Appendix G.

Areas outside the Reserve are discussed in this plan to provide an ecosystem-based approach to habitat and species protection, minimize the gaps in understanding of Cherry Point resources, and facilitate coordination of plan implementation amongst the agencies, stakeholders, and others. DNR will work collaboratively with resource managers that have authority under federal, state, and local laws to help address off-site impacts on the aquatic reserve and achieve the goals and objectives of this plan.

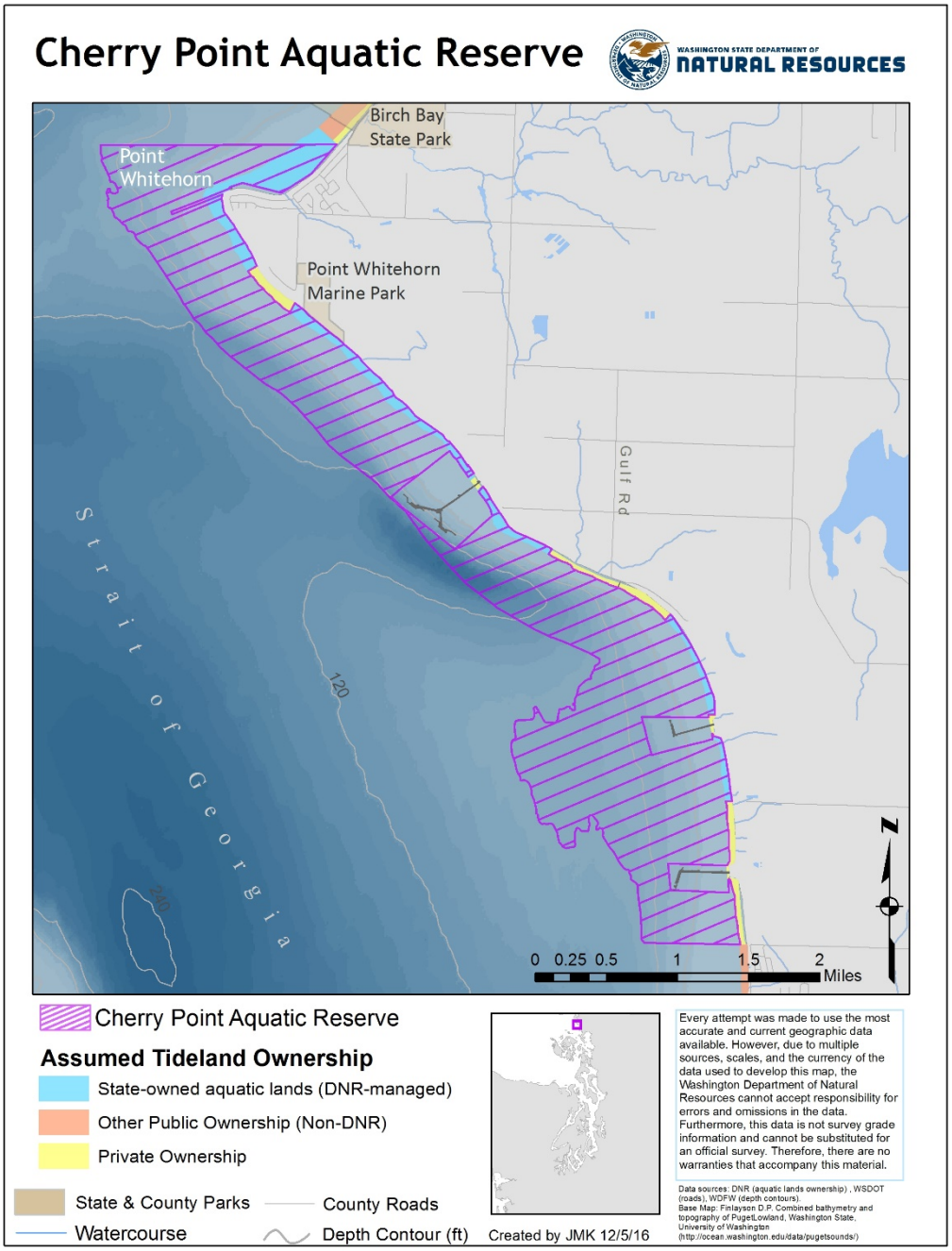
Cherry Point Aquatic Reserve Boundary

The Cherry Point Aquatic Reserve (Figure 2) is within the state-defined Water Resources Inventory Area 1, known as the "Nooksack WRIA". The existing boundary for the aquatic reserve includes all state-owned tidelands and bedlands within approximately 5,000 feet of the marine shoreline and any adjacent state-owned bedlands within the -70-foot bathymetric contour as shown in Figure 2. The legal description for the reserve is located in Appendix E.

2017 Boundary Change Amendment

In 2016, DNR evaluated a request to change the reserve boundary to add aquatic lands previously excluded under the August 1, 2000 and November 18, 2010 Commissioner's Orders. A technical advisory committee met in November 2016 to evaluate the proposal to include the 45-acre "cutout" left for then-proposed Gateway Pacific Terminal into the reserve. The technical advisory committee unanimously recommended incorporating the "cutout", citing important herring and eelgrass habitat vital to local salmon runs. DNR also conducted a public State Environmental Policy Act (SEPA) review to evaluate the boundary change. Over 5,000 interested parties provided comments or signed petitions regarding this Determination of Nonsignificance, the majority of which were in support of the boundary change. On January 3, 2017, the Commissioner's Order (Appendix F) amending the reserve boundary was signed and the management plan maps and reserve legal description were revised to reflect this change.

Figure 2. Cherry Point Aquatic Reserve Assumed Aquatic Tideland Ownership



Current Ownership

All bedlands within the Cherry Point area are owned by the State of Washington and managed by Washington State Department of Natural Resources. Of the approximately 296 acres of tidelands in the Cherry Point area, 69 acres are privately owned and approximately 227 acres are managed as part of the Cherry Point Aquatic Reserve and are not under a lease. Figure 2 depicts ownership at Cherry Point Aquatic Reserve.

Also, there are no existing use authorizations on state-owned aquatic lands within the reserve. There are four existing use authorizations in the "cutouts" directly adjacent to or abutting the reserve (see Figure 2 showing leased areas and cutouts). These include:

- BP (lease and outfall easement),
- Intalco (lease and outfall easement),
- ConocoPhillips (lease and outfall easement),
- Birch Bay Water and Sewer District (outfall easement),

The bulk of the uplands adjacent to the Reserve are privately owned, primarily by five entities: BP, Pacific International Terminals, Intalco-Alcoa, Cherry Point Industrial Park, and Conoco Phillips. North of the industrial area, private residential lots exist with the exception of a small county-owned public access area just east of Point Whitehorn. Birch Bay State Park is located to the north of the residential lots and the aquatic reserve. The Lummi Indian Reservation is located to the south of the Aquatic Reserve.

Relationship to Federal, State, Local and Tribal Management

This plan is promulgated under DNR's proprietary authority to manage state-owned aquatic lands. However, a number of other federal, state, local and tribal authorities regulate activities within the Cherry Point Aquatic Reserve and the watershed that drains into it. The successful management of these activities and resources requires coordination and collaboration with public and private entities as well as local, state, federal, and affected Tribal governments, and non-government organizations. The entities which share management authority for natural resources at Cherry Point are referred to as the 'resource managers.' The following provides information regarding ongoing management interests at Cherry Point Aquatic Reserve.

Tribal Treaty Rights and Interests

Tribes manage cultural and natural resources located on adjacent reservation lands, and those resources related to the right to fish off-reservation at usual and accustomed places. DNR is obligated to conduct government-to-government consultations with all federally recognized tribes, under the 1989 Centennial Accord (www.goia.wa.gov/Government-to- Government/Data/CentennialAccord.htm), DNR Tribal Relations Commissioner's Order # 201029. In addition, pursuant to numerous court rulings and Presidential Executive Orders, all federal agencies are required to consult with affected Indian tribes in a government-to-government manner and ensure that impacts to tribal treaty rights are avoided and/or minimized and any unavoidable impacts are mitigated to the satisfaction of the affected tribal governments.

DNR will continue to engage in a government-to-government dialog with the affected tribes to help ensure this plan's conformance with treaty rights, and that tribal historical and cultural ties to the Cherry Point Aquatic Reserve are maintained. DNR will work cooperatively with the tribes to protect fisheries, archaeological sites, and allow access to cultural sites; and allow for treaty-protected hunting and gathering of resources in a manner that fosters the sustainability of those resources.
Tribes and the State of Washington have developed a cooperative framework which provides for fisheries management and habitat protection.

This plan recognizes the policy statement developed by the Northwest Indian Fisheries Commission on

behalf of member Northwest Tribes discussing the importance of considering the impacts conservation measures can have on tribal economics, subsistence and culture. Under this, Northwest Tribes highly recommend that the creation of any Marine Protected Area (local, state, federal or otherwise) not occur in the absence of any demonstrated need. In the face of such demonstrated need, Northwest Tribes do recognize that Marine Protected Areas may be useful tools for protecting or sustaining resources (NWIFC memo 2003). In line with this policy, one of the primary goals of this management plan is to help demonstrate where there is a need for protecting and sustaining resources.

Cherry Point is located within the usual and accustomed areas of several federally recognized tribes, including the Lummi, Nooksack, Swinomish, Suquamish, and Tulalip Tribes. The cultural resources department of each Tribe has specific interests in the long-term cultural resource protection and management of this area. Cherry Point is within the homeland of the aboriginal Lummi Tribe whose sole successor is the present-day Lummi Nation. Cherry Point contains homelands of the Lummi Tribe that were ceded to the United States in the Point Elliot Treaty for considerations, including the right to fish in common with the citizens of the territory at the Tribe's usual and accustomed fishing grounds and stations. Tribes exercise their interest based on the specific location and particular impacts associated with local planning processes and project proposals. The federal government is obligated to protect the long-term interests of tribes by limiting permits that impact cultural objectives of tribes. All projects and plans for this area shall require government-to-government consultation with appropriate tribal governments under the State Centennial Accord. Local entities are strongly advised to consult regarding permitted activities and local plans. It is essential that conservation goals and management standards be established in cooperation with these Tribes.
Regular discussions should be planned with affected tribes to ensure that this plan remains consistent with cultural resource goals and Treaty rights of the Tribes.

U.S. Coast Guard

The U.S. Coast Guard manages vessel activity and responds to pollution reports within Puget Sound through the Marine Safety Office. The Coast Guard also helps ensure the safety of vessels during transit and while in port. The U.S. Coast Guard (USCG) manages commercial vessel traffic throughout Washington's waters, including at Cherry Point, and is responsible for reviewing designated anchorage sites. The Coast Guard is the lead response agency for spills in coastal waters and deepwater ports, implements federal ballast water laws, and discharge of onboard sewage in federal waters.

U.S. Army Corps of Engineers

Under Section 10 of the Rivers and Harbors Act, the U.S. Corps of Engineers (Corps) oversees any in-water construction in navigable waters. Additionally, the Corps has been delegated authority under the Clean Water Act for the issuance of Section 404 permits. The Corps supports navigation by maintaining and improving channels; develops projects to reduce flood damage, and regulates dredging and filling activities in wetlands and waterways including the construction of any structures such as bulkheads or piers. Like all federal agencies, the Corps of Engineers must ensure that tribal trust resources are protected prior to taking any action that could potentially affect treaty-protected resources, including fishing and cultural or traditional cultural properties.

U.S. Environmental Protection Agency

The Environmental Protection Agency (EPA) is the lead federal response agency for oil spills occurring in inland waters and jointly administers Section 404 of the Clean Water Act (CWA) with the Corps of Engineers. The EPA has delegated the administration of other sections of the Clean Water Act (e.g., Section 401, Section 402) to the Washington State Department of Ecology and the Lummi Nation but

still retains the responsibility to ensure that those sections of the CWA are effectively administered and that their trust responsibilities to tribal governments are upheld.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service is charged with protecting those species listed under the Endangered Species Act and the Migratory Bird Treaty Act and the habitats those species rely upon.

NOAA Fisheries

NOAA Fisheries is responsible for protection of marine and freshwater species under the Endangered Species Act and the Marine Mammal Protection Act. NOAA Fisheries also is responsible for consultation under the Magnuson-Stevens Fishery Conservation and Management Act and the designation of critical fish habitat.

Washington State Department of Health

The state Department of Health regulates opening and closing of recreational and commercial shellfish zones and advises the public as to the healthy recreational harvest of shellfish.

Washington State Department of Ecology

The Washington State Department of Ecology (Ecology) contributes to resource protection through the Spill Prevention, Preparedness and Response Program; Air Quality; Water Quality; Toxics Cleanup; Shorelands Assistance; Water Resources; Solid Waste (Industrial Section – permitting); Hazardous Waste and Toxic Reduction. Ecology has a Spill Prevention, Preparedness and Response Program that focuses on prevention of oil spills to Washington waters and land, as well as planning for an effective response to any oil and hazardous substance spills that may occur. Vessel traffic in Washington State is tracked by Ecology's spill program and published in Vessel Entries and Transits (VEAT) for Washington Reports (see Appendix B for recent tracking information). Ecology reviews and must approve local Shoreline Master Plans and all plans for major substantial development permits involving construction in waters of the state.

Ecology also works to maintain water and sediment quality standards, such that listing of waterbodies or segments as impaired under section 303(d) of the Clean Water Act is unnecessary. They are responsible for developing and approving National Pollutant Discharge Elimination System (NPDES) permits for industrial and municipal discharges. Nonpoint source pollution is managed through a variety of state and local programs; Ecology has developed a nonpoint pollution plan that focuses on local land use activities. Finally, Ecology issues water quality consistency certifications under Section 401 of the Clean Water Act, which help ensure compliance with the law's Antidegradation Policy (Ecology website 2008).

Washington State Department of Fish and Wildlife

The Washington Department of Fish and Wildlife (WDFW) has authority over the management of the non-tribal commercial and recreational shellfish harvesting and fisheries. WDFW are co- managers with tribal governments and collaborates on the management of commercial and recreational finfish and shellfish harvesting. WDFW also plays an important role in oil spill response, ballast water monitoring and Natural Resources Damage Assessments. The agency also protects natural resources from development through its Hydraulic Project Approval (HPA) process.

The State Legislature gave WDFW the responsibility of preserving, protecting, and perpetuating all

fish and shellfish resources of the State. To assist in achieving that goal, the State Legislature in 1949 passed a state law now known as the "Hydraulic Code" (Chapter 77.55 RCW). The law requires that any person, organization, or government agency wishing to conduct any construction activity that will use, divert, obstruct, or change the bed or flow of State waters must do so under the terms of a permit (called the *Hydraulic Project Approval-HPA*) issued by WDFW. The purpose of the permit is to address any damage or loss of fish and shellfish habitat which is considered to result in direct loss of fish and shellfish production (WDFW website 2008).

Washington State Parks and Recreation Commission

The State Parks and Recreation Commission plays a vital role in educating the public regarding appropriate recreation. Washington State Parks manages the Birch Bay State Park to the north of Cherry Point Aquatic Reserve, and has an existing lease for aquatic lands offshore of the state park. Birch Bay State Park is a 194-acre camping park with 8,255 feet of saltwater shoreline on Birch Bay and 14,923 feet of freshwater shoreline on Terrell Creek. The park is rich in archeological significance and offers panoramic views of the Cascade Mountains and Canadian Gulf Islands. Birch Bay State Park is one of the largest recreational shellfish areas in the State. Birch Bay State Park is located just outside of the Reserve boundary.

Puget Sound Partnership

In 2007, the Legislature established the Puget Sound Partnership. The Partnership is charged with developing an action agenda to restore the environmental health of Puget Sound by the year 2020. DNR is a member of the Ecosystem Coordination Board that advises the Partnership's Leadership Council. In December 2008, the Partnership released the final Action Agenda. The Action Agenda includes the following recommendations related to the Cherry Point Aquatic Reserve:

- Complete the management plan for the Cherry Point Aquatic Reserve.
- Coordinate the plan with Whatcom County Cherry Point Management Area policies.
- Protect high value habitat by developing a strategy to protect large intact marine and nearshore habitat.
- Quantify impacts and strategically remove derelict fishing gear, starting with Cherry Point.
- Continue efforts to manage industry at Cherry Point to minimize pollution.
- Integrate and coordinate nearshore and marine protection and restoration efforts (e.g., pollution cleanup, Shoreline Master Program, Cherry Point Marine Managed Area) with watershed recovery efforts (e.g., Critical Areas Ordinances, Instream Flow Action Plan, Watershed Management Plan, Salmon Recovery Plan, MRC plans, Shellfish District Protection Plans).
- Continue to work cooperatively with Canadian neighbors on transboundary water quality, water quantity, fish habitat, and flooding issues, specifically to recover Cherry Point herring. (PSP, 2008).

Achieving many of the desired future conditions described in Chapter 6 of this plan will depend on funding and implementation of the state's Puget Sound Action Agenda[44]. DNR will continue to work with the Puget Sound Partnership and other cooperating agencies to implement the Action Agenda.

[4] See Puget Sound Partnership Action Agenda: Table 1-1: Ecosystem recovery goals, desired outcomes and provisional indicators, page 14 – 16. Goals 4, 5, and 6 (December 1, 2008)

Whatcom County

Whatcom County regulates upland and shoreline land uses within its jurisdiction. The Whatcom County Comprehensive Plan and the Whatcom County Shoreline Master Program, described on the next pages, are the key tools for managing land use. The county also manages its parks and recreational lands, transportation network, and other facilities. In addition, the county regulates clearing, grading, and construction activities and provides pollution control through their management of stormwater runoff and their regulation and inspection of onsite septic systems.

Local Land Use Designations

Currently, much of Whatcom County maintains a rural character, with large tracts of commercial forest lands and agricultural land used for pasture and commodity crops. Whatcom County population increased by 100 percent between 1950 and 1990 and was 184,300 in 2006. Continuing population increases in the county are projected to result in a transition to more residential, commercial and industrial uses. (Kyte et al 1999; OFM 2006).

Between 1954 and 1971, three industries moved into the Cherry Point vicinity. In 1954, General Petroleum Corporation constructed an oil refinery near Cherry Point, which was subsequently managed as the Ferndale, Mobil, BP, and Tosco refinery. On September 17, 2001, the Tosco Company was bought by Phillips 66. On August 30, 2002, Phillips merged with Conoco, to become ConocoPhillips. In 1966, Intalco Aluminum built an aluminum smelter north of ConocoPhillips. The aluminum smelter now is owned by Alcoa-Intalco Works. In 1971 Atlantic Richfield Company (ARCO) constructed another oil refinery even further north, later selling it to British Petroleum (please see Appendix D: *Existing Encumbrances and Applications,* for further details on these facilities). This is the northernmost pier along the Cherry Point.

Under the latest Comprehensive Growth Management Plan issued by Whatcom County, the uplands adjacent to the Cherry Point Aquatic Reserve are designated as Urban Growth Areas (UGA). An Urban Growth Area is an area that must include cities and other areas characterized by urban growth or adjacent to such areas, and are to be designed to accommodate the projected population growth for twenty years. Any growth that occurs outside these areas cannot be urban in nature. The county has designated two UGAs adjacent to the Reserve. The Cherry Point UGA, containing approximately 7,000 acres, is designated for future industrial development, and the Birch Bay UGA north of it is designated primarily for residential The existing industrial developments occupy about 4,100 acres of the total Cherry Point industrial lands. On the average, land consumption at Cherry Point has been about 1,000 acres per facility, which includes sufficient land to avoid wetlands and provide buffer areas. Based on this consumption figure, Whatcom County concluded in their County Growth Management Plan (p. 2-52, 2008) that there is only sufficient remaining land in the Cherry Point industrial area to support two additional industrial complexes similar to those presently located there.

Whatcom County states that Cherry Point has special characteristics and regional significance for the siting of large industrial facilities. The County predicts that this demand will most likely result in the remaining undeveloped acreage being absorbed by the end of their 20 year planning period (Whatcom County 2005). Characteristics that make Cherry Point attractive include the fact that since the 1960s, it has a history of operating as a major industrial area in Whatcom County. This has developed the infrastructure to support not only these industries, but future industries as well. Other attractive characteristics include:

- **Shipping Access** – Marine deep water access is present for shipping. This was a major consideration for the three major industries currently located at Cherry Point (Whatcom County 2008).

- **Rail Access** – Burlington Northern has long served Whatcom County, and access is available to the Burlington Northern mainline serving western Washington from Blaine to Portland. Rail service is particularly important for many types of water borne commerce; for example, the BP refinery at Cherry Point uses the railroad to ship calcined coke to U.S. markets and to other port facilities for transshipment to foreign markets (Whatcom County 2008).

- **Proximity to Canada, Alaska and Foreign Ports** – Cherry Point occupies a unique location for the siting of industry because of its close proximity to Canada and because of its shorter travel distance than other regional port facilities for shipping to Alaska and to other Pacific Rim locations. The Cherry Point industrial area benefits from proximity to Canada, as trade between the U.S. and Canada grows in response to the lifting of trade barriers under the Free Trade Agreement of 1989. An increase in vessel traffic is being noted through the Strait of Juan de Fuca, as vessels move towards Vancouver (VEAT 2008). Marine terminals at Cherry Point could serve a portion of the potential growth in Canadian marine cargo (Whatcom County 2008).

Whatcom County considers these industries a substantial part of the economic base of Whatcom County, with the region and the economic welfare of the county strongly tied to the health of these industries and their ability to flourish and expand as opportunities present themselves. The County has designated the area as "Heavy Impact Industrial" to support the requirements of heavy manufacturing uses that require water deep enough to accommodate large vessels (Kyte et al. 1999; Whatcom County 2006). This protects the area from incompatible uses that would prevent their ability to expand, particularly residential development (see Whatcom County Code Chapter 20.74, revised March 2008).

County Shoreline Master Program

For purposes of local shoreline planning, Whatcom County places Cherry Point in the Birch Bay Watershed Management Unit (WMU), a 31 square mile coastal watershed between Drayton Harbor and Lummi Bay. It includes the marine shoreline from the north end of Semiahmoo Peninsula, and includes Birch Point, Neptune Beach, Birch Bay State Park, Point Whitehorn, and Cherry Point. The WMU extends inland to the City of Ferndale, and includes Lake Terrell and Terrell Creek. The Birch Bay and Cherry Point UGA make up a significant percentage of the watershed.

Shorelines of the state include the marine shoreline, the lower 3.1 miles of Terrell Creek and Lake Terrell. The marine shoreline from Birch Point to Point Whitehorn is also shoreline of statewide significance. To plan for and manage these shorelines, Whatcom County submitted their updated SMP in 2007, and under Whatcom County Code (WCC) 23.100.17, zoned and adopted the Cherry Point Management Area. Whatcom County's authority under the SMP includes protecting critical areas located within shorelines, such as riparian vegetation, saltmarsh, eelgrass beds, salmon migratory corridors, and pocket estuaries. This plan has been accepted by the Department of Ecology.

According to Whatcom County (WCC 23.100.17.A.1) the Cherry Point Management Area can be described as follows:

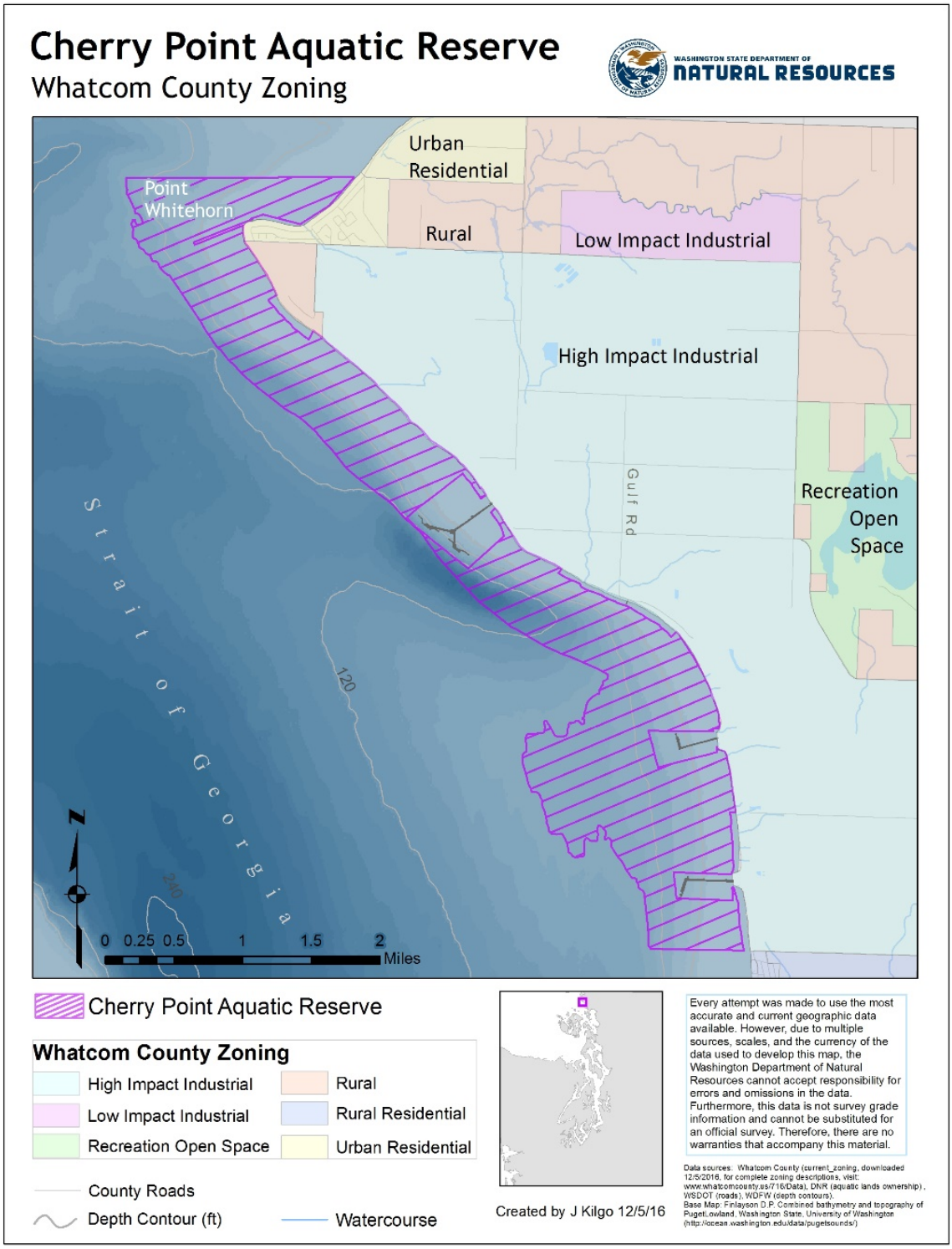
> The purpose of the Cherry Point Management Area is to provide a regulatory framework which recognizes and balances the special port, industrial and natural resource needs associated with the development of this marine resource…Washington State natural resource agencies and Whatcom County have identified certain portions of the Cherry Point Management Area as providing herring spawning habitat that warrant special consideration due to their importance to regional fisheries and other elements of the aquatic environment…Development of the Cherry Point Major Port/Industrial Area will accommodate uses that require marine access for marine cargo transfer, including oil and other materials. For this reason, water-dependent terminal facilities are encouraged as the preferred use in the Cherry Point Management Area.

Paragraph (d) of WCC.23.100.100.17.A.1 describes how Whatcom County:

> "…should consider participation with local, state, and federal agencies, tribal governments and other stakeholders in the development of a plan to address integrated management of the uplands and public aquatic lands within the Cherry Point Management Area. The development of such a plan could provide a forum and process for addressing aquatic resources by all stakeholders. Elements of the plan could be adopted as future amendments to this Program as appropriate."

The facilities located at Cherry Point have already provided important resource monitoring data and will play an important role in plan implementation. Maintaining partnerships with existing facilities will be important for implementing many potential management activities.

Figure 3: Whatcom County Zoning



Point Whitehorn Park

Opened to the public in the summer of 2008, the 51-acre Point Whitehorn Park focuses on the site's abundant natural attributes comprised of wildlife, forests, bluffs, natural shoreline and magnificent views of the San Juan Islands. A joint project between the Whatcom Land Trust and Whatcom County, the site provides parking and walking trails to wetlands, overlooks and over one third of a

mile of beach along the Strait of Georgia. Point Whitehorn Marine Park is envisioned to be the first phase of a larger regional park at this site (Whatcom County, personal communication, 2008).

History of Land Use at Cherry Point

The following timeline provides a chronological summary of major construction events, land use decisions and proposals, fisheries management decisions, and selected dates of laws and rules with specific importance at Cherry Point.

Table 1 Timeline of Major Events at Cherry Point

Date	Event	Type
Time Imme	Ceremonial, subsistence, and commercial harvest of finfish and shellfish and other commerce by Native American Indians	Tribal Law
1855	Treaty of Point Elliot signed	Federal/Tribal Law
1889	Washington Statehood	Federal/State Law
1954	The General Petroleum Corporation begins operation of the Ferndale refinery, pier, and outfall.	Major construction
1966	The Intalco Aluminum Corporation builds a second pier and outfall at Cherry Point.	Major construction
1971	The ARCO refinery constructs a third pier and outfall at Cherry Point now owned by British Petroleum.	Major construction
1971	Washington's Shoreline Management Act was enacted.	State law
1972	Federal Water Pollution Control Act is enacted.	Federal law
1974	State herring sac roe fishery is opened.	Fishery management
1975	Whatcom County Water District Number Eight constructs a secondary wastewater effluent outfall at Point Whitehorn.[5]	Major construction
1976	First Shoreline Management Program adopted designating Cherry Point uplands as a "conservancy," shoreline allowing water-dependent industrial use of the shoreline as an outright permitted use and recognizing the state and local importance of such uses at Cherry Point.	Land use
1976	Final Decision of *United States v. Washington* (384 F. Supp. 312, 377 [W.D. Wash. 1974], aff'd, 520 F.2d 676 [9th Cir. 1975], cert. Denied, 423 U.S. 1086 [1976])	Federal/State/Tribal Law
1976	Chicago Bridge and Iron (CBI) proposes to build offshore oil drilling rigs at Cherry Point.	Land use
1977	Whatcom County "Interim Zoning" adopted identifying Cherry Point as an industrial area.	Land use
1977	Federal Clean Water Act is enacted, by amending the 1972 Water Pollution Control Act.	Federal law
1979	Cherry Point-Ferndale Subarea Plan adopted by Whatcom County designating Cherry Point for industrial use.	Land use
1981	Whatcom County updates the "Official Zoning Map" re-affirming Cherry Point as an industrial area. Ordinance No. 81-99	Land use
1982	State herring sac roe fishery permanently closed.	Fishery management
1982	CBI's proposal to build oil drilling rigs is ended by governor's veto of legislation that would have exempted CBI from provisions of the Shoreline Management Act.	Land use
1983	Kiewit proposes to build offshore oil drilling rigs on the Cherry Point uplands	Land use
1984	Kiewit's permits denied by Ecology and DFW	Land use
1987	State herring spawn-on-kelp fishery are opened.	Fishery management
1992	Joseph Schecter proposes to build the Cherry Point Industrial Park (CPIP), including a shipping pier.	Land use
1992	SSA proposes to build the Gateway Pacific Terminal (GPT) pier at Cherry Point.	Land use
1995	Letter from Commissioner of Public Lands states that DNR will consider at most one additional pier at Cherry Point.[6]	Land use
1996	State herring spawn-on-kelp fishery is closed.	Fishery management
1996	State sediment management standards become effective.[7]	State rule
1996	*Northwest Sea Farms v. U.S. Army Corps of Engineers,* 931 F.Supp. 1515 (WD	Federal Law

[5] The operator of this outfall is now the Birch Bay Water and Sewer District.

[6] The letter, dated October 5, 1995, was written by then-commissioner Jennifer Belcher to Tim Winn, District Engineer, US Army Corps of Engineers. Copies filed in CPIP Negotiations with DNR file.

[7] State sediment management standards are codified at WAC 173-204. They are administered by Ecology.

Date	Event	Type
	WA 1996)	
1998	The 1992 CPIP proposal is abandoned; legally they have a shoreline permit until the county rescinds the permit.	Land use
1998	Executive Order 13084 issued by the White House, Consultation and Coordination with Indian Tribal Governments	Federal Law
1998	Whatcom County and Washington State adopt the 1998 Shoreline Program Update designating the Cherry Point Management Area – re-affirming the use of the reach for water-dependent industrial uses.	Land use
1999	NMFS accepts petition to list 18 species of marine fish under ESA, including all Puget Sound Herring.	Legal
2000	Second wing is added to the ARCO pier.	Major construction
2000	National Marine Fisheries Service (NMFS) decides Cherry Point herring do not merit listing under the federal Endangered Species Act.[8]	Fishery management, federal law
2000	Ocean Advocates et al sues Corps for granting ARCO/BP permit for refinery dock expansion w/o EIS or consideration of Magnuson restrictions	Legal
2000	Commissioner's Order establishes Cherry Point as an aquatic reserve	Land Use/Order
2001	Washington Department of Health re-opened 1.5 miles of beaches around Pt. Whitehorn previously closed to recreational shellfishing, reducing the closure zone from 2,640 feet to 1,380 feet.	Land Use
2001	DNR applies Interim Guidance to Cherry Point Aquatic Reserve	Land Use
2002	New leases are issued for Intalco/Alcoa pier and wastewater outfall.	Land use
2002	Birch Bay Water and Sewer District withdraws its proposal for wholesale service to Blaine, who has chosen to construct reclaimed water plant instead.	Land use
2003	Williams Pipeline (also known as Georgia Strait Crossing) proposes placement of a natural gas pipeline across the Cherry Point Withdrawn Area. Proposal later withdrawn.	Land use
2003	The Cherry Point Withdrawn Area scheduled for review, determining whether the area will remain an aquatic reserve.	Land use
2005	The authorization for the Birch Bay Water and Sewer District outfall expires. DNR postpones the application.	Land use
2006	ConocoPhillips lease is renewed with DNR	Land use
2007	Cherry Point BP lease is modified by DNR to accommodate required spill control structures	Land use
2007	Whatcom County adopts updated Shoreline Master Program including protection of shoreline critical areas	Land use
2008	Trillium sells large parcel west of BP facility to BP	Land use
2008	Whatcom County Parks purchase of Trust lands	Land use
2009	Birch Bay Water and Sewer District receives a 30-year easement for the Birch Bay outfall	Land Use

[8] The notice, Endangered and Threatened Species: Puget Sound Populations of Copper Rockfish, Quillback Rockfish, Brown Rockfish, and Pacific Herring, Notice of determination of status review was published in the Federal Register, Volume 66, Number 64, April 3, 2001, pp. 17659 – 17668.

3. Resource Characterization

Site Characterization

This section provides an overview of the environmental and natural resource characteristics for the Cherry Point Aquatic Reserve and adjacent areas. Understanding the processes and functions at Cherry Point and their relationship to the larger ecosystem and species interactions provides a foundation for development of management actions. A more detailed analysis is found in Appendix A.

Geographic Description

Cherry Point is located on the western shores of Whatcom County, located on the Strait of Georgia (see Figure 4, page 96). Washington's marine ecosystems can be divided into three primary systems - the Columbia River Littoral Cell, the Olympic Coast, and the Puget Sound. The Cherry Point Aquatic Reserve is located within the Puget Sound biogeographic region, a region delineated as the marine waters of Washington to the east entrance to the Strait of Juan de Fuca. This biogeographic region can be further subdivided into nine subregions or basins; the reserve is in the southeastern portion of the Georgia Strait Basin (Georgia Basin).

Ecosystem Description

Geomorphic characteristics of the Whatcom County shoreline include glacial sediments, limited sea level rise, moderate tidal range, considerable wave exposure, rock strewn cobble beaches with moderate to high backshore bluffs. Because of its combination of exposure, fetch, and glacial makeup, Cherry Point has a unique beach type of large cobble/boulders with lower areas of mixed sand and pebble infill. Seasonal changes in wave energy create a highly diverse and productive nearshore (Mumford, personal communication). The proximity of Cherry Point to Georgia Strait sets it apart from many other locations in the Northwest corner of Washington. The Strait of Georgia is distinctly different from Puget Sound, influenced to a higher degree by the Pacific Ocean and the Fraser River, resulting in different biodiversity. Many oceanic species are relatively common in the Strait of Georgia, compared to the Puget Sound estuary (Whatcom County 2006). The site is also distinctive for its bathymetry with water depths reaching more than 70 feet just offshore (see Figure 5, page 97).

Diverse habitats found at the Cherry Point Aquatic Reserve include: the cobble-boulder beaches, mixed fine to sandy intertidal areas that steeply slope to deepwater, mixed macroalgae, kelp and eelgrass beds. The shoreline provides critical rearing and migratory habitat for juvenile salmonids. A salt marsh and two small streams discharge into the reserve. Terrell Creek discharges just north of the reserve into a pocket estuary that supports juvenile salmonids (Whatcom County Shoreline Characterization Inventory 2006). The Birch Bay Great Blue Heron colony is located on the creek upland of the reserve. The shoreline above the reserve contains a relatively high amount of intact riparian vegetation that supports the health of the reserve, including: contributing large woody debris, nutrients and insects; providing slope stability, moderating temperature, and protecting water quality. Moderate to tall, eroding bluffs above the reserve feed sand and gravel to the beaches. The Fraser River and Nooksack River (located outside the reserve) also provide sources of fine sediment to the reserve, creating a habitat conducive to supporting submerged vegetation and forage fish, including Pacific herring (Center for Biological Diversity et al. 2004). Drift cells, which describe the movement of beach sediment by wind-driven wave forces along the shoreline, are an important shoreline component at the reserve. Three drift cells characterize the net shore-drift at

Cherry Point; they are shown in Figure 6.

Flora and Fauna

The reserve contains a high diversity of algal species which are an important component of nearshore primary production rates (Nybakken 2001). Submerged aquatic vegetation at Cherry Point is shown in Figure 7. Marine algae supports salmon, forage fish, groundfish, Dungeness crab, and other invertebrates important to the food web that supports many wildlife species, such as resident and migratory birds, and marine mammals. Eelgrass beds include both native and non-native species.

Bladed kelps, such as *Saccharina latissima* and *Costaria costata,* filamentous brown algae such as *Desmarestia* spp., and a variety of red foliose and filamentous algae dominate the macroalgae community. Mixed eelgrass and *Sargassum* extend along much of the shoreline, with sparse kelp (*Nereocystis*) beds beginning to appear near Point Whitehorn. *Sargassum* is a non-native lower intertidal/subtidal floating brown alga (not a kelp), that herring often spawn upon (Pentilla 2001). It is notable that the distribution of *Sargassum* along the reserve and Birch Bay is restricted primarily to the lower intertidal zone, while elsewhere in Puget Sound its distribution is mostly within the subtidal zone.

Numerous species of salmon and trout have historically been, or are currently found in the nearshore environment at Cherry Point and Birch Bay, including: pink salmon (Onchorynchus gorbuscha); chum (*O. keta*), coho (*O. kisutch*), Chinook (*O. tshawytsha*), and sockeye (*O. nerka*). The nearshore is designated as habitat for the following salmon species listed under the federal Endangered Species Act: Puget Sound Chinook salmon, Nooksack Coastal Cutthroat, and Puget Sound Bull Trout, and Puget Sound Steelhead. The Cherry Point nearshore is also used by char and cutthroat tagged in British Columbia (Ptlomey, R, personal communication).

The Puget Sound Evolutionary Significant Unit (ESU) for Chinook salmon includes the Cherry Point site and major waterbodies (see Figure 8, page 108). The Puget Sound Chinook ESU was listed as federally threatened in March of 1999 and includes runs from the North Fork Nooksack River in northeast Puget Sound to the southern Puget Sound watersheds, Hood Canal and the Strait of Juan de Fuca. The Puget Sound Chinook is estimated to be at only ten percent of historic numbers. There are two independent populations of Puget Sound Chinook salmon in the Nooksack basin: North Fork Nooksack River (including Middle Fork), and South Fork Nooksack River. These salmon are distinctive from Chinook salmon in the rest of Puget Sound in their genetic attributes, life history, and habitat characteristics. They are the only populations in the Strait of Georgia region, and they are two of only six Chinook runs left in Puget Sound that return to their rivers in spring (as opposed to fall spawners). For these reasons, the Nooksack populations are considered to be essential to the recovery of the Puget Sound Chinook ESU (Puget Sound TRT 2006). Georgia Strait/Puget Sound coho are also in decline, listed as a federal species of concern.

Three species of forage fish use the Cherry Point Aquatic Reserve: surf smelt (*Hypomesus pretiosus*), northern anchovy (*Engraulis mordax*), and Pacific herring (*Clupea pallasii*). See Figure 9, page 109 depicting known spawning locations. Surf smelt spawn in the upper intertidal zones of the aquatic reserve during the summer months. They are an important food source for seabirds and a variety of fish, including salmon. Northern anchovy spawn from May to September; spawning has been documented from Semiahmoo Bay to Bellingham Bay, including within the reserve.

The area between the south shore of Birch Bay south to Neptune Beach, which is included in the

reserve, is one of the most important Pacific herring areas in Washington State. This area serves as the "core" region of spawn deposition for the largest single herring spawning stock in Washington waters, a stock that historically provided spawning habitat for more than 50 percent of the entire herring population of Puget Sound and the Strait of Juan de Fuca. The Cherry Point herring stock was estimated at a peak of 15,000 tons in the early 1970's. This population has been declining since the late 1970s and although recent surveys suggest the population may have stabilized at approximately 1,000 tons of escapement, the stock status has been downgraded to 'critical' meaning that permanent damage to the stock is likely or has already occurred (Stick, personal communication). Figure 10, page 111, graphs Cherry Point herring spring biomass and fishery landings between 1973 -2008. The Cherry Point stock has historically spawned from the Canadian border to Hale Passage (see Figure 11, page 113), but in recent years the primary spawning grounds has been substantially smaller (EVS 1999). Despite continuing declines in the stock, spawn deposition intensity and frequency in the Cherry Point area has been maintained and spawn surveys encounter 'medium' or 'heavy' spawn deposits more commonly in the Cherry Point area than anywhere else in Puget Sound (Penttilla 1994).

Herring spawn is deposited on eelgrass and more than 25 species of rock-dwelling marine algae found between about +3 feet MLLW to the lower limit of algal growth at around –10 ft (Penttila 1994). Spawn is most frequently found on *Zostera marina* (native eelgrass), *Gracilaria, Laminaria, Saccharina, Sargassum,* and *Botryoglossum* (Penttila, personal communication). Eelgrass beds are found along the sand bars in southern Birch Bay and are then interspersed with a diverse algal community from Point Whitehorn to Neptune Beach. Pacific herring that lay demersal eggs upon the vegetation during the winter and spring months have used these habitats extensively. In addition to suitable spawning grounds, herring also need pre-spawn holding areas, which allow adults to congregate approximately three to four weeks prior to spawning. The pre-spawn holding area for Cherry Point herring is located along the Whatcom County shoreline between Birch Bay and Sandy Point, and includes the aquatic reserve (see Figure 11, page 113).

Recent studies have suggested that the Cherry Point Pacific herring stock is genetically distinct from other Washington and British Columbia stocks (Beacham et al. 2002; Small et al. 2005; Mitchell 2006). Unlike other Pacific herring populations found in Puget Sound, the Cherry Point herring spawn in open, high energy shoreline areas (O'Toole et al. 2000). Furthermore, while other stocks spawn between early January and early April, the Cherry Point herring spawn from early April through June (see Figure 12, page 113 documented and peak spawning times). Research provides a preliminary indication that the Cherry Point herring may have evolved a tolerance for warmer water than other regional herring due to their late spawning time (Dinnel 2008). If so, these genes would be important to ensuring species resilience and adaptation to climate change. Conservation of herring spawning habitat and minimizing disturbance in the pre-spawning holding areas is key to the preservation of the herring stocks inside Puget Sound (WDFW 2009).

Groundfish that utilize Cherry Point include: Dover sole (*Microstomus pacificus*), English sole (*Parophrys vetulus*), rock soles (*Lepidopsetta bilineata*), starry flounder (*Platychythus stellatus*), and Pacific and speckled sanddabs (*Citharichthys sordidus* and *C. stigmaeus, respectively*) (Palsson, personal communication). Occasionally adult butter sole (*Isopsetta isolepsis*) have been found, along with lingcod (*Ophiodon elongatus*) (Whatcom County MRC 2009). During the juvenile phase of their lives, many species of groundfish, such as lingcod and rockfish, use submerged aquatic vegetation for feeding, refuge from predators, and nursery grounds (Mumford 2007). Many rockfish species in Puget Sound are in decline due to such factors as overfishing, derelict gear, water quality degradation, and food web interactions (Washington State Department of Fish and Wildlife, 2009).

NOAA's Fisheries Service recently listed three populations of rockfish in Washington's Georgia Basin for protection under the Endangered Species Act. The populations of two of the rockfish species – canary and yelloweye –have been designated as "threatened" and a third rockfish species – bocaccio – as "endangered."

Cherry Point is considered one of 18 significant bird habitats in the Strait of Juan de Fuca and Georgia Strait (Wahl et al. 1981), attracting Surf Scoters, grebes, loons, and other fish-eating birds and migratory waterfowl. The area between Sandy Point and Point Whitehorn provides year-round habitat for high numbers of fish-eating loons, grebes, alcids, and diving ducks. It is an important wintering ground for migratory birds, including Brant, Harlequin Duck, loons, and Surf Scoters. Marbled Murrelet, listed as threatened under the ESA, have been documented at Cherry Point, likely foraging on herring.The site also supports Peregrine Falcon, Bald Eagle, and Great Blue Heron. Historically, birders observed flocks of up to 25,000 scoters, Pacific Loons, gulls, murres and other species that come to feed on forage fish and eggs (Audubon 2009). Surveys conducted in the last several years indicate that more than 14 of the 37 most common over-wintering species in the Strait of Georgia are experiencing significant declines. For Cherry Point, a 79 percent decline in species was documented. Studies of the role of herring spawn in movements and energetics of scoters have resulted in the finding that spawn at Cherry Point is used by Surf Scoters to acquire reserves for migration and breeding (Anderson et al. 2009). Concurrent with declines in spawning herring biomass, numbers of scoters foraging on spawn at Cherry Point have declined from about 60,000 to 6,000 for the period 1980-1999 (Nysewander, unpublished data). During spring migration of Surf Scoters in late April to May, no feeding opportunities equivalent to historical levels of spawn at Cherry Point are known to exist in the Puget Sound-Georgia Basin.

One of the Pacific Northwest's largest Great Blue Heron rookeries is located north of the aquatic reserve, along Terrell Creek; it supports more than 300 breeding pairs. Heron forage along marine shorelines, the intertidal zone, wetlands and riparian areas of the aquatic reserve. Migratory and wintering eagles are found in seasonally high numbers along the Reserve's shoreline (Eissinger 1994). Peregrine Falcons are also thought to use Cherry Point for foraging habitat (Hayes and Buchanan 2002).

Marine mammals that may use the Reserve based on their presence in the southeast Strait of Georgia include: harbor seals, Pacific harbor porpoise, Dall's porpoise, Stellar sea lions, California sea lions, Gray whales, the Southern Resident Killer Whale, and humpback whale (Calambokidis and Baird 1994; Falcone et al. 2005). Seals use the Cherry Point shoreline for foraging and haulout. (See Figures 13 -15 for additional information on marine mammal distribution). The Southern Resident Killer Whale is listed endangered under the Endangered Species Act. Prey availability, environmental contaminants, impacts from vessels, noise, oil spills, and disease are the key stressors for Southern Resident Killer Whales. Salmon, groundfish, and herring are key prey for Southern Resident Killer Whales.

A number of benthic invertebrates, clams, cockles, crabs, shrimp, snails and marine worms are found in the Cherry Point Aquatic Reserve, many serve as prey for birds, fish and mammals. Dungeness crabs are found at Cherry Point and are important recreationally and commercially. Dungeness crabs are an important predator and prey organism at all life stages, their pelagic larvae are preyed upon by copper rockfish, coho and Chinook salmon, halibut, dogfish, hake, and lingcod. Many invertebrate species observed at Cherry Point include species that rely partially upon herring in their diet. Examples include, amphipod (*Anisogammarus pugetensis*), the ochre sea star (*Pisaster ochraceus*), and unspecified sea anemones.

Non-native Fauna and Flora

The composition of non-native organisms established at Cherry Point has not been adequately characterized. Two species of non-native marine vegetation were identified at Cherry Point as part of an inventory of submerged aquatic vegetation: the Japanese brown alga, *Sargassum muticum*, which has widespread distribution along Cherry Point, and the eelgrass *Zostera japonica*, which has been documented in numerous patches from Birch Bay to south of Gulf Road (Fairbanks et al. 2005).

As a major shipping port, the Cherry Point industries receive most of their vessel traffic from ports in Alaska, and California with additional vessel visits from Pacific Northwest ports, as well as, some Asian and Australian ports. Ballast and fouling organisms arriving with visiting vessels represent a potential invasion vector for numerous species. The EPA has identified ballast water as one of the most "universal and ubiquitous vectors" for the transport and discharge of non-native species in marine and coastal areas (2008).

Current Conditions

A number of species that occur within the Cherry Point Aquatic Reserve have shown signs of decline in the past, or are still in decline. Cherry Point herring stocks have been vastly reduced, which is likely affecting the health of other species at Cherry Point, such as birds and salmon. Non-indigenous submerged aquatic vegetation has found a foothold in the nearshore and is displacing certain types of native algae. The causes of species decline in and around the Cherry Point Aquatic Reserve have not been well studied or understood. Know threats to Reserve resources are described in the next section. Addressing uncertainties related to species decline is a priority within the plan.

The water quality and ecological conditions at the Cherry Point Aquatic Reserve are affected by immediate and adjacent land use and in-water activities, the Georgia Strait, the Fraser and Nooksack Rivers, and the general climatic conditions of northwest Washington. In-water development directly adjacent or abutting the Cherry Point Aquatic Reserve includes three large piers supporting major industrial facilities (EVS 1999) and one municipal outfall. The majority of the adjacent shorelines are undeveloped and unarmored with intact riparian vegetation (Figure 16, page 133). There are no recreational overwater structures or mooring buoys located within the Aquatic Reserve. A small amount of fill located on private tidelands provides footings for the two southern piers. The footings extend into the intertidal and are heavily armored with rip rap and likely intercept sediment within the drift cell during high tide cycles (DNR 2001). Armoring also occurs along the shoreline at Gulf Road, as well as, residential bulkheads located at Point Whitehorn. Loss of submerged aquatic vegetation has likely occurred from overwater structures, and may be limited to the vicinity of such stuctures, but this has not been well studied at the site. A study of the Arco pier found that shading from the pier appears to limit the growth of marine vegetation (Shapiro & Associates 1994). The extent of the impacts of the three facilities would depend on the height of the structure and its orientation, bathymetry of the site, as well as the substrate below them.

Impervious surfaces are overall relatively low in the watershed that drains into the Reserve (Figure 20, page 151). Stormwater runoff is generated from industrial piers, buildings, roads, and upland residential development located directly adjacent to the Reserve. Some residential properties use tightlines to pipe stormwater over bluffs onto the beach. All industrial facilities at Cherry Point have National Pollutant Discharge Elimination System (NPDES) permits to discharge effluents into the

Reserve. Another facility permitted to discharge into the reserve is the Birch Bay Sewage Treatment Plant. Together, these outfalls contribute millions of gallons of water and runoff into this part of Georgia Strait. While initial testing indicated presence of certain potentially historical contaminants at the Alcoa Intalco site, current work by state agencies, as addressed in recent NPDES permits, indicate improvements (Ecology 2007). In general, chemical concentrations in receiving waters and sediment at Cherry Point are relatively low, compared with other locations. Sediment studies performed in the last decade detected contaminants at all three industrial facilities, but levels were not at concentrations sufficient for listing under Ecology's 303(d) list or the imposition of "sediment impact zones". Contaminants include Polyaromatic Hydrocarbons around discharge locations, contaminants were also detected in sediment adjacent to creosote pilings. Contaminated sediment in the area of the Alcoa pier has been traced to historical spills or releases from the aluminum smelter.

Legacy sources of contamination from historic, unregulated industrial waste disposal are likely to exist on uplands adjacent to the Reserve. Ecology is concerned about the TreOil Industries Limited site at 4242 Aldergrove Road; contaminants such as pulp and paper manufacturing by-products have leached into the groundwater which later discharge into Puget Sound (see Figure 20, 151). Ecology has identified the site as potentially hazardous to human health and the environment, and it is ranked number two on their list of hazardous sites awaiting cleanup (Ecology 2008). Ecology notes the potential of this site to be contributing to herring mortality through groundwater transport to the nearshore (Marshall, personal communication).

Marine vessel traffic is extensive in the Strait of Georgia in the vicinity of the Reserve. Cherry Point contains the largest refineries in Washington State; over half of all the crude and refined oil and petroleum products are loaded and offloaded here. Also present is the Alcoa-Intalco aluminum facility. Numbers are not available regarding current vessel traffic into the Reserve. This information will be collected during plan implementation to inform management actions related to dock operations and traffic risk mitigation strategies. Vessel traffic patterns in Puget Sound are tracked by Ecology (see Appendix B). Ecology has also begun tracking oil spills over 150 gallons at Cherry Point. Between December 1997 and June 2008, there have been seven spills (see Appendix B).

Airborne pollution at Cherry Point is considerable, but the potential effect of atmospheric deposition on aquatic ecosystems is unknown. The primary sources of emissions affecting the proposal are vessel traffic and stationary sources. In the larger Georgia Basin (where the Cherry Point Aquatic Reserve is located), marine vessels account for 22 percent of nitrogen dioxide emissions, with light-duty vehicles responsible for 23 percent. Marine vessels are the largest single source of sulfur dioxide in the airshed, emitting 33 percent of emissions. Agriculture is the dominant source of particulate matter, along with space heating. Whatcom County has just 7 percent of the entire population in the Georgia Basin, but also has several major industries, contributing 29 percent of the smog-forming emissions.

The Northwest Clean Air Agency (NWCAA) monitors Whatcom, Skagit and Island counties and produces annual emission inventories from large stationary industrial facilities within its jurisdiction, including facilities located within the Cherry Point site. The NWCAA reports that for Whatcom County in 2004 and 2005, the primary stationary sources of particulate matter, sulfur dioxide, nitrogen dioxide, volatile organic compounds, and carbon monoxide were the industrial facilities located at Cherry Point: Alcoa Primary Metals (Intalco), BP West Coast Products, and ConocoPhillips (NWCAA 2006).

These facilities at Cherry Point contributed an average of 92 percent of all monitored industrial air pollutants from stationary sources in Whatcom County in 2005 and 2006. Results of monitoring showed that four of the five monitored pollutants decreased between 2004 and 2006 (NWCAA, 2004, 2005, and 2006). The county is currently in attainment (meeting requirements) under EPA standards set forward by the Clean Air Act and administered by the NWCAA.

Public recreational activities such as boating, fishing, shellfish harvesting, swimming, and beach walking are popular at Cherry Point. Disturbance to the beach by recreational shellfish digging is altering the ecosystem in several areas of the Cherry Point Aquatic Reserve (Kyte 2007). Public and private property has been impacted, including the shoreline from Point Whitehorn to south of Gulf Road. Area scientists believe the direct and indirect impacts from shellfish digging activity are significant to herring and shellfish reproduction. The impact is primarily in boulder and cobble substrates where a relatively small number of recreational shellfish harvesters do not refill holes as required by WDFW regulations. The mounded material dug from the hole is not typically restored by tidal and wave action, resulting in permanent alteration to beach and intertidal habitat.

Other recreational activities that may impact habitat and wildlife in the area include disturbance of birds and marine mammals by dogs and human activities. Beach fires are reducing habitat and threaten riparian areas. Trampling of sensitive vegetation can result in impacts to sea grasses and algae. As public access increases, these issues could be amplified. There is a need for public education and outreach regarding the sensitive nature of many of the systems and resources along Cherry Point.

Offshore areas have traditionally been used for tribal commercial, ceremonial, and subsistence harvest of numerous species including salmon, herring, Dungeness crab, and bottomfish using a variety of methods, including gillnets, setlines, trawl, and purse seine and crab pots. Valuable natural resources continue to play an important role in the local and tribal communities. Docks and other hardened structures may impact currents and tidal action and preclude and/or interfere with the exercise of tribal treaty rights to fish in this area.

Potential Future Impacts

The Cherry Point Workgroup identified the following known and potential threats to Cherry Point natural resources: shoreline modification, including overwater structures, loss of riparian vegetation, armoring, and derelict gear; pollution from groundwater contamination, stormwater runoff, point discharges, and air deposition; disturbance from recreational activities; artificial light and excessive intermittent sound; vessel traffic, including oil spills; ballast water and invasive species; and habitat impacts due to climate change. The Technical Advisory Committee (TAC) earlier identified a number of threats to the aquatic reserve, including impacts of fill and pilings associated with the piers, industries and the expanding threat posed by residential development along the northern and southern boundaries of the reserve. A detailed description of risks to the aquatic habitats and species of the Cherry Point Aquatic Reserve is provided in Appendix B.

Shoreline Modifications

Construction of a new overwater structure or expansion of existing overwater structures could degrade shoreline ecological processes, habitats and species proposed for conservation. Depending on the location, design, level of use, and management, overwater structures may have a significant impact on ecosystems and species. Of particular concern are the potential impacts of additional shoreline modifications, such as, how a new overwater structure will affect juvenile salmon

rearing, migration corridors, herring spawning and pre-spawn holding habitat. Construction of new recreational overwater structures is unlikely, given the severe weather conditions in the area.

Shading is a primary concern, as the reduction of light available for photosynthesis for aquatic vegetation can impact habitat structure, complexity, and the surrounding food web. Nighttime attraction to artificial lighting by certain fish species, including salmon, and congregations of salmon predators, is of particular concern. Wave shading from pilings and other in-water structures may disrupt water flow patterns, energy and sediment flow. Propeller wash could result in physical habitat alterations. Impacts to water quality from increased impervious surface runoff, ballast water and waste discharges, fuel spills, hydraulic fluid spills, material spills, and other activities associated with overwater structures may directly and indirectly impact aquatic flora and fauna (Nightingale and Simenstad 2001). The potential adverse impacts of light, noise, shading, and vessel traffic on Cherry Point herring spawning, pre-spawn holding behavior, and preferred migratory corridors have not been well studied; research on these issues is a priority and is addressed further in the management actions.

Additional shoreline armoring, fill, land clearing associated with industrial, residential, recreational land use and activities have the potential to adversely impact riparian and submerged vegetation and bluff habitats, leading to loss of habitat functions. Removal of native riparian vegetation can impair water quality, reduce recruitment of large woody material and terrestrial insects that serve as salmon prey, affect sediment transport processes by either accelerating or limiting input, and increase erosion. Construction of new hard shoreline armoring in residential areas, or to support a new pier could result in similar impacts, such as, interrupting sediment transport processes that sustain habitats, modifying intertidal slopes and substrates, and removing aquatic and riparian vegetation. As a result, degradation of habitats used by forage fish, salmon, Dungeness crabs, groundfish and other fish and wildlife species could occur. Figure 16, page 133, shows the current shoreline armoring at Cherry Point.

Water and Sediment Quality

Increases in stormwater runoff from impervious surfaces can alter biotic communities that have adapted to the salinity regime, as well as, carry pollutants into the reserve. Increases in contaminants could include: excess fertilizers, herbicides, and insecticides from residential areas; oil, grease, metals, and toxic chemicals from road and commercial facilities; soil from erosion on construction sites and eroding bluffs due to drainage problems on residential properties; bacteria and nutrients from pet wastes, and faulty septic systems. Unless the Treoil site is cleaned up, it will likely continue to contaminate groundwater that may be entering the reserve and contributing to herring mortality.

Buildout of residential and industrial uses at Cherry Point are likely to increase stormwater and municipal wastewater discharges. Increases in industrial, municipal, and stormwater outfalls can alter salinity regimes and increase ambient temperatures and pollutants in receiving waters and sediment at Cherry Point. Increases in both nonpoint and point sources at Cherry Point, including sediment and groundwater legacy sources, could contribute endocrine disrupting compounds, persistent organics, or other toxic compounds that may affect the health of fish and wildlife species. Contaminants may also increase due to airborne emissions associated with increases in vessel traffic. The cumulative impacts of increased temperature and pollutants could be significant. Temperature increases could increase invasions of non-native species, or affect herring spawning times. Climate change may worsen the impacts of contaminants due to increased water temperature and photo enhanced toxicity. Herring, groundfish, marine mammals, crab larvae and seabirds are

particularly at risk due to chemical contamination. For herring, PCBs and other persistent organic pollutants with the ability to alter immune function may make the fish more susceptible to infection. Studies show chemical contamination is also a moderate risk to groundfish reproduction (WDFW 2009). Killer whales are candidates for accumulating high concentrations of pollutants because of their position atop the food web and long life expectancy (NMFS 2008).

Other potential impacts to the aquatic reserve from climate change and global warming include ocean acidification, sea level rise, and increased storm severity. Nearshore resources that are temperature sensitive, such as crab larvae and herring spawning, may be affected by increases in water temperatures. Projections vary, but range from a 7- to- 23 inch rise in global average sea level by 2090-2099. Climate change could result in increased coastal erosion, all or some of which may result in changes to species abundance and distribution. Sea level rise and increased erosion can increase pressure to install hard shoreline armoring structures. A reduction in the availability of tidal marsh/tidal flat habitats could occur, as sea levels rise combined with increased river flow increases the salinity of the nearshore area while decreasing the availability of tidal marsh areas. Commercial shellfish communities (e.g., oysters and clams) and migratory shorebird populations that utilize these flats for habitat and feeding may also decline.

Recreational Activities

Population growth in the region is likely to increase demand for recreation opportunities and harvesting of renewable resources. Habitat degradation due to unfilled shellfish holes, trampling of sensitive vegetation, wildlife disturbance by dogs and human activities, and beach fires is likely to continue or worsen. Impacts to aquatic vegetation and water quality impacts could likely occur from increased recreational boat traffic and overwater structures. Derelict gear from recreational and commercial activities can continue to catch crabs, groundfish and other species.

Vessel Traffic

Vessel traffic within the Cherry Point region is predicted to increase within the next 10 to 20 years. In general, increased vessel traffic can increase the risk of spills, discharges, potential impacts from fugitive dust and noise, introductions of invasive (non-native) species from ballast water, and wildlife strikes. Major expansions at the Port of Vancouver will likely increase vessel traffic density in the approaches to and from Cherry Point. The area is also frequently used by commercial and recreational crab-fishing vessels, commercial trawlers and by seasonal whale-watching tours. Large vessels load and unload raw materials and products at the three current facilities located in the Cherry Point area. These facilities have shown a steady increase in productivity, expansion, and commercial growth which could result in a significant increase in regional and international vessel traffic transporting raw material and finished products. The refineries have necessary procedures and technologies in place to significantly reduce the likelihood of oil spills or minimize spill volumes, such as the Oil Spill Prevention Plan, the Oil Spill Response Plan, the Spill Prevention, Control, and Countermeasure Plan, the Integrated Contingency Plan, and Oil Handling Personnel Training. However, the possibility exists for future spills, which could be particularly catastrophic to Cherry Point herring, Southern Resident Killer Whales and diving bird populations.

The rising levels of maritime shipping increase the risk of invasion by non-native species in Puget Sound and the Strait of Georgia. Un-exchanged ballast water discharges from commercial ships are a primary vector for introducing non-indigenous species. As commercial shipping has been increasing at Cherry Point, this is an area that has been monitored over the years. The risk of invasive (non-native) aquatic plant and animal species being introduced through ballast water is a serious one. Non-

native aquatic plant and animal species can displace, disturb, consume, and compete with native species (CRS 2007). Non-native organisms may also be attached to the hulls of commercial vessels. This is an identified problem at Cherry Point (Markiewicz et al. 2005). Other introductions result from recreational boaters, commercial aquaculture, indirect Canadian maritime sources, and some natural sources. European Green Crab (*Carcinus maenas*) is a potential threat to Cherry Point, having been captured along Vancouver Island.

Increased vessel traffic also increases the possibility of "strike" to wildlife in the vicinity of the vessel. Species may include fish, diving birds, seals, and dolphins, but the most commonly followed example is that of ships or vessels striking whales.

Noise from vessel traffic is expected to increase over time. Noise has been identified as a potential stressor on Pacific Herring (EVS 1999; Schwartz and Greer 1984). Most commercial fish react to loud noise; these reactions are most pronounced in migratory schooling fish which rely on hearing to detect environmental cues, such as approaching predators. Physical impacts have been documented with construction project noise, such as pile driving (Laughlin 2005). It is unclear how vessels frequenting herring spawning grounds or industry pier operations affect herring spawning success, feeding behavior, or individual health (Settlement 1999). Further study is needed to comprehensively assess the impacts.

4. Management Goals and Objectives

Desired Future Conditions

The Cherry Point Aquatic Reserve was designated to conserve (preserve, restore, and/or enhance) the aquatic habitats and species that make the site unique. This section of the plan provides goals and objectives to help ensure that these desired conditions can be met. The proposed goals are broad statements of desired future condition, formulated to conserve the sites natural aquatic communities, habitats, ecosystems, and processes, and the ecological services, uses and values they provide to current and future generations.

Achieving the desired future conditions of this plan will require partnerships between regulatory and proprietary agencies, tribes, businesses, non-government, property owners, resource users and the public. Several desired future conditions require actions to be taken on a broader scale, such as implementation of the state's Puget Sound Action Agenda.[9]

Goal One: **Identify, protect, restore and enhance the functions and natural processes of aquatic nearshore and subtidal ecosystems that support endangered, threatened and sensitive species and aquatic resources identified for conservation.**

Objectives

1.1 Protect and restore naturally functioning environmental processes (nearshore drift and high energy intertidal environment) through application of standards for new and expanded uses and activities. Support voluntary efforts to reduce impacts of shoreline modification and carry out restoration.

1.2 Prevent non-indigenous organisms from invading or disrupting the ecosystem through implementation of management actions.

1.4 Consider climate change when planning restoration projects and future development.

1.5 Ensure future land use and permit decisions do not alter natural system forming processes, degrade habitat or result in impacts to key species.

Goal Two: **Improve and protect water quality to protect public health, support fish and wildlife species and healthy functioning habitats.**

Objectives

2.1 Work cooperatively to identify and minimize existing and potential future water quality impacts on the nearshore environment resulting from outfalls, runoff, groundwater contamination, ballast, airborne sources, and other discharges to the Reserve. Monitor nearshore water quality and temperature and support local efforts to reduce adverse impacts over time.

2.2 Protect the reserve from new sources of water pollution, including airborne sources.

2.3 Reduce the risk of oil and toxic spills and increase regional capacity to respond.

2.4 Coordinate with resource agencies to continue to maintain state and federal standards for water and sediment quality.

[9] See Puget Sound Partnership Action Agenda: Table 1-1: Ecosystem recovery goals, desired outcomes and provisional indicators, page 14 – 16. Goals 4, 5, and 6 (December 1, 2008)

Goal Three: Protect and help recover indicator fish and wildlife species and habitats, with primary focus on Cherry Point herring, Nooksack Chinook salmon, groundfish, marine mammals, seabird/duck and shorebird communities, Dungeness crab, and submerged aquatic vegetation.

Objectives

3.1 Protect, restore and enhance habitat that supports breeding, nesting, feeding habitat and migratory corridors for fish and wildlife.

3.2 Prevent impacts of new structures, shoreline modification, intakes and outfalls on aquatic vegetation, forage fish spawning, and fish migration, and minimize risks of environmental impacts from existing industrial, residential, and recreational uses.

3.3 Remove and reduce the impact from derelict fishing gear, debris and structures.

3.4 Support the recovery and protection efforts for federal and state threatened and endangered species, species of special concern and those that are the primary focus of this plan, and their habitats. Support efforts to increase Cherry Point herring biomass to 3,200 tons by year 5 and 5,000 tons by year 10 of the plan.

3.5 Carry out research and monitoring on the causes of species decline within the Reserve in order to develop actions that will be effective in helping with species recovery.

3.6 Encourage the removal or redesign of shoreline modifications to minimize or eliminate impacts on aquatic vegetation, forage fish spawning, and fish migration, particularly where the modifications are not necessary for the owners' use and enjoyment of the land.

Goal Four: Facilitate stewardship of habitats and species by working in cooperation with lessees, tribes, recreational users and resource agencies to minimize and reduce identified impacts of human activities on the species and habitats of the Reserve.

Objectives

4.1 Work with lessees to promote responsible management of existing uses in a manner consistent with Reserve goals. Support research efforts, monitoring, and adaptive management approaches that will assist lessees in reducing site-specific impacts over time.

4.2 Provide education and outreach opportunities and support others in efforts to educate homeowners abutting the shoreline and site users regarding the importance of managing runoff, riparian vegetation protection and other habitat values.

4.2 Make information and results readily available to the public, regulatory agencies, tribes and educational institutions.

4.3 Support regulatory agencies in using best available science, technology and management practices in permits for new development and activities to prevent harm to key habitats and species in the Reserve.

4.4 Coordinate with resource agencies and others to ensure recreational users will be informed and follow existing laws so that impacts to habitats and species are avoided or minimized.

4.5 Support and carry out research and monitoring to identify actions to increase resilience of habitats in the face of climate change, provide a greater understanding of the ecosystem, and reduce uncertainty about habitat and species interactions and threats.

4.6 Work with Whatcom County, State Parks and others to preserve and enhance existing opportunities for public access and environmental education.

4.7 Coordinate with lessees, US Coast Guard, and other cooperators to minimize conflicts between different sectors of commercial and other vessel traffic, and prevent impacts to marine mammals and other species.

Goal Five: **Identify, respect, and protect archaeological, cultural, and historical resources on state-owned aquatic lands.**

Objectives

5.1 Ensure that authorized activities in or directly adjacent to the Reserve cause no harm to the archaeological, cultural or historical resources in or adjacent to the Reserve.

5.2 Ensure significant historical findings are documented as a condition of any new or expanded use authorizations.

5.3 Support cultural uses at the site through responsible management of natural resources that are part of their tradition and are required to sustain and enhance the quality of life of the tribes are protected and preserved for sustainable use.

5. Management Actions

Management actions have been developed to address the potential threats identified in Chapter 3 and the goals and objectives identified in Chapter 4. These management actions should be carried out over the first 10 years after plan adoption. The actions should maintain or improve the ecological condition of the Reserve and will assist in the adaptive management process that will occur after the first 10 years of plan implementation. Because the management actions in this plan will take several years to implement, actions have been prioritized to identify those that should be completed sooner versus those that may be completed in late as time and resources permit. Actions that should be initially undertaken, preferably within the first five years, are identified as tier one, and actions that may be initiated as time and resources permit, are identified as tier two. DNR actions related to use authorizations are considered tier one and should be implemented throughout the 90-year period or until amended through adaptive management processes. This prioritization is based upon the analysis of risks and the future desired conditions of the plan, and should be periodically revisited as our understanding of the relationship between ecological processes, anthropogenic stressors, and species or habitat conditions decline at the Reserve improves.

DNR will use this plan to guide decisions regarding authorizations for uses of state-owned aquatic lands within and directly adjacent to the aquatic reserve. The management emphasis for new authorizations on state-owned lands will place protection of native aquatic habitats above all other management actions. For existing uses located on state-owned aquatic lands directly adjacent to the reserve, the focus will be to reduce their existing impacts over the 90-year time frame of the reserve. Since impacts to sensitive habitats and species within the reserve may also be attributed to activities that DNR does not have explicit authority to manage, such as upland uses, DNR will seek management cooperation and collaboration from others resource management agencies. DNR will work with regulatory agencies, tribes and others to ensure that existing, future uses and activities contribute to the management goals of this plan.

The management actions for the Cherry Point Aquatic Reserve focus on protection and restoration of sensitive aquatic resources in the context of planning for existing, future industrial, recreational, stewardship, and cultural uses of state-owned lands. The actions are grouped under six categories:

- Conservation of Ecosystems, Habitats and Species
- Restoration and Enhancement
- Outreach and Education
- Monitoring, Data Collection, and Research
- Allowed Uses
- Prohibited Uses.

Conservation of Ecosystems, Habitats and Species

Tier 1

DNR will protect ecosystems, habitats and species at the site through appropriate limits on use authorizations. DNR will:

- Manage existing and future activities on state-owned aquatic lands with an emphasis on protection of the aquatic habitat and species identified in this plan over other actions. (See the allowed uses section for specific standards).

- Ensure through use authorizations that structures, uses, and operations are designed to avoid impacts to wave energy, nearshore sediment drift, aquatic and riparian vegetation, fish and wildlife species and their habitats. Development and operation of any new overwater structure and modification or expansion of existing structures must be designed to avoid and or minimize noise, light, wave shading, and artificial light based on required studies, scientific research and monitoring, and knowledge of the ecosystem characteristics. Prior to approval, the required studies listed in the 'allowed uses' section must be completed. *Meets objectives 1.1, 1.4, 3.1, 3.2, 3.4, 5.3.*

- Facilitate the development of site-specific habitat protection plans when appropriate. Habitat protection efforts may include: placement of important habitat on adjacent lands into conservation easements, or acquisition of tidelands, wetlands, and shoreline property through gifts. *Meets objectives 1.4, 2.2, 3.1, 3.2, 3.4, 4.6, 5.3.*

  Support recovery efforts for Cherry Point herring. Work with WDFW, the Tribes, and other agencies to reverse the decline and bring the population to a spawning herring biomass of 3500 tons by the end of 5 years and 5000 tons at the end of 10 years. *Meets objectives 1.4, 2.2, 3.1, 3.2, 3.4, 4.6, 5.3.*

- Prohibit new "hard" structured shoreline armoring on state-owned aquatic lands. . Habitat-friendly alternatives may be authorized if designed to avoid and minimize impacts (as recommended by the Integrated Streambank Protection Guidelines, Washington State Aquatic Habitat Guidelines Program, 2002). However, replacement of existing shoreline armoring with hard armoring, when the only alternative to adequately protect existing structures, may be authorized when consistent with the Whatcom County SMP. *Meets objectives 1.1, 1.4, 3.1, 3.2, 3.4, 5.3.*

- Prohibit the following in the reserve: underwater cable or pipeline structures, or new saltwater intakes, except when necessary for the installation and use of firefighting equipment at industrial piers. *Meets objectives 1.1, 1.4, 2.1, 3.2, 3.4*

- Prohibit additional residential docks within the reserve. Mooring buoys may be installed to avoid impacts to marine vegetation and species. *Meets objectives 1.1, 1.4, 3.1, 3.2, 3.4, 5.3.*

- Determine the need for mooring buoys to address interaction between tug and tow operations and crab fisheries. *Meets objectives 1.1, 1.2, 1.4, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.5, 4.6, 5.1, 5.3.*

The following management actions are collaborative and DNR will seek partnerships to facilitate voluntary stewardship activities on private property and public lands adjacent to the aquatic reserve:

- Request that WDFW enforce existing shellfish harvest regulations with emphasis on the ecological impacts of unfilled holes. Promote partnerships with WDFW, Whatcom County, beachwatchers, and others to place informational signs and placards at key beach access points, and provide education and outreach. In the event continued damage to the herring spawning grounds is occurring, despite several years of public outreach efforts, discuss with WDFW whether seasonal or complete closures are warranted. *Meets objectives 3.1, 3.4, 4.4, 5.3.*

- Maintain natural slope stability characteristics through vegetation management requirements. *Meets objectives 1.1, 1.3, 1.4, 2.2, 3.1, 3.2, 3.4, 5.3.*

- Where opportunities arise, partner with state and local government, tribes, non-profit organizations, businesses, and adjacent landowners to identify and implement protection of adjacent aquatic areas and uplands. Special consideration should be given to protection of the salt marsh at Gulf Road. *Meets objectives 1.4, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.4, 4.1, 5.3.*

- Support public education, outreach and incentive programs for the protection of existing native vegetation to maintain wooded buffers within the setbacks landward of the top of the bluff. DNR will support development of a plan addressing maintenance and restoration of bluff vegetation. *Meets objectives 1.1, 1.4, 3.1, 3.2, 3.4, 4.2, 5.3.*

- Encourage Whatcom County to implement the following restrictions and/or recommendations on the public beaches accessible from the new park at Point Whitehorn:

- No dogs should be allowed on the beach. They cause disturbance and harassment of birds and wildlife. A seal haul-out area is near the park access.

- Education should be provided regarding the sensitivity of the Cherry Point ecosystem. Visitors should be advised to "stay on bare rock and sand" to avoid trampling of sensitive aquatic plants and organisms. This could be accomplished through the placement of informational signs and placards at key beach access points.

- No beach fires should be allowed.

- Visitors should be advised to avoid illegal removal of marine organisms (see WDFW regulations), wood and substrate. *Meets objectives 1.1, 1.4, 2.2, 3.1, 3.2, 3.4, 4.2, 4.4, 4.6, 5.3.*

- Encourage Whatcom County to coordinate with the owner of the beach in the area of Gulf Road so that public access may be improved and developed in the future, and strive for the same levels of protection provided at the Point Whitehorn Park. *Meets objectives 1.1, 1.4, 2.2, 3.1, 3.2, 3.4, 4.3, 4.6, 5.3.*

- Review and comment on proposed Coast Guard vessel traffic risk mitigation efforts. Consider vessel traffic studies conducted for BP and Gateway Pacific Terminal and other available vessel traffic information in environmental review and determinations related to the permitting of dock operations and potential impacts on herring, marine mammals, and other species. Data from these studies and future studies may also be used to develop vessel traffic risk mitigation strategies, as appropriate, in coordination with: Coast Guard, WDFW, Ecology, Whatcom County, Cherry Point industries, pilot associations (Puget Sound Pilots) and affected tribes and public interest groups. *Meets objectives 1.1, 1.4, 2.3, 3.1, 3.2, 3.4, 4.1, 4.3, 4.7, 5.3.*

- Review and comment on federal and state rules proposed to mitigate impacts to natural resources from any future changes or increases in risk from vessel traffic along Cherry Point to include vessel anchorage options. In coordination with Coast Guard, WDFW, Ecology, DNR, Whatcom County, Cherry Point industries, pilot associations (Puget Sound Pilots), industries, affected tribes and public interest groups.

- In coordination with Coast Guard, industries, pilot associations (Puget Sound Pilots), commercial and tribal fishermen, analyze vessel interference and evaluate options for reducing impacts from anchoring and barge in tow on habitat and loss of fishing gear. Consider viability of open water mooring systems. *Meets objectives 3.1, 3.2, 3.3, 3.4, 4.1, 4.7, 5.3.*

- Provide input regarding future additional Geographic Response Plan updates focusing on protecting heavily used herring spawning areas. *Meets objectives 2.2, 2.3, 3.1, 3.4, 5.3, 4.7, 5.3.*

Water and Sediment Quality Protection and Ballast Management

Tier 1

- DNR will protect the reserve from pollution through appropriate limits on use authorizations. Specifically, DNR will: Require lessees to demonstrate that new point source discharge outfalls for stormwater, or industrial wastewater, and increases in discharges from existing DNR authorized facilities are designed to avoid or minimize individual and cumulative adverse impacts to Cherry Point herring stock, other aquatic habitat, and water quality (see allowed uses section). *Meets objectives 1.4, 2.1, 2.2, 3.1, 3.2, 3.4, 5.3.*

- For modification of existing point source discharge outfalls or stormwater conveyance pipes, lessee must demonstrate that the water does not exceed water quality standards. Monitoring reports demonstrating compliance with standards must be submitted to DNR prior to completion of modification.

- Require that construction of a new overwater structure or modification and expansion of existing overwater structures be designed and installed in a manner that avoids or minimizes impacts on the water quality of the Cherry Point Reserve, including avoiding or minimizing runoff impacts and removing treated wood from below the water line to the maximum extent practical to eliminate leaching.

- Work with dischargers to reduce impacts of existing discharges, exploring opportunities for treatment, reuse, and other methods.

The following management actions are collaborative and DNR will work cooperatively with others to formulate and implement strategies to address point and non-point source impacts. DNR will:

Tier 1

- Encourage Ecology to fund and implement the Treoil Site Emergency Interim Actions (March 2000) to characterize and stabilize waste and releases at the site. Ecology should raise this site to a higher priority on their Contaminated Sites List for remedial action because of questions for potential contamination of the reserve and clean-up plan for groundwater contamination from the Treoil site, if warranted. *Meets objectives 2.1, 2.2, 2.4, 3.1, 3.4, 5.3.*

- Work with resource agencies to increase the rates of ballast water exchange monitoring for vessels that dock with the Cherry Point Reserve. *Meets objectives 1.2, 2.2, 3.1, 3.2, 4.1, 4.5, 5.3.*

- Work with WDFW, Ecology, and leaseholders to develop strategies for dealing with ballast water from ships that call at Cherry Point terminals consistent with Chapter 77.120 RCW, WDFW ballast water management, the interim ballast water management laws, and upcoming recommendations of the Ballast Water Working Group. *Meets objectives 2.1, 2.2, 2.4, 3.1, 3.4, 4.1, 4.3, 5.3.*

- Work with Whatcom County, Ecology, and industries to minimize or prevent any new sources of nonpoint pollution to the Cherry Point Aquatic Reserve. Special emphasis should be placed on limiting impacts from stormwater runoff. *Meets objectives 2.1, 2.2, 2.4, 3.1, 3.4, 5.3.*

- Work with Ecology and dischargers to address any known permit or regulatory violations to ensure ongoing compliance with State Water Quality Standards and Sediment Management Standards**.** *Meets objectives 2.1, 2.2, 2.4, 3.1, 3.2, 4.1.*

- Encourage Ecology to require sediment quality studies as a part of all NPDES permits. *Meets objectives 1.5, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 5.3.*

- Support Whatcom County in implementing the programmatic solutions identified as recommendations in the Birch Bay Comprehensive Stormwater Plan (2006), including low impact development designs where appropriate. *Meets objectives 2.1, 2.2, 2.4, 3.1, 4.1, 4.3.*

- Encourage Ecology to establish proposals for water quality treatment system upgrades to the existing discharges where needed, ensuring that they will minimize impacts to habitats and species. *Meets objectives 2.1, 2.2, 2.4, 3.1, 3.2, 4.1, 5.3.*

- Work with Whatcom County, Whatcom Public Utility District (PUD), Birch Bay Water and Sewer District, Ecology, and dischargers in support of proposals for the treatment and re-use of stormwater, re-use of treated wastewater and re-claimed water, and water

conservation programs in order to reduce discharges. Assist existing dischargers with alternatives for water re-use, designs, permits, and information on applicable grant funds. *Meets objectives 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 5.3.*

- Support Whatcom County and Birch Bay Water and Sewer District in designing and implementing strategies to reduce onsite wastewater systems that contribute pollution to the reserve. Seek funding alternatives to encourage landowner participation. *Meets objectives 2.1, 2.2, 2.4, 3.1.*

- Review and comment on ballast water treatment/management methods to reduce the possibility of introducing invasive species from tankers and other cargo vessels. Work with WDFW, Ecology, Coast Guard, EPA, leaseholders, the Invasive Species Council, U.W. Sea Grant, and others to limit testing of unproven treatment methods that have the potential to negatively impact native habitat and species. *Meets objectives 1.2, 2.1, 2.2, 2.4, 3.1, 4.7.*

- Work with WDFW, Ecology, Coast Guard, EPA, leaseholders, the Invasive Species Council, U.W. Sea Grant and others to develop and implement a management plan, including monitoring and adaptive management plans, to reduce the risks of non-native species to the valued ecological resources at Cherry Point. Strategies should include controlling the introduction of non-native plant and animal species and their management and eradication to protect native plant and animal communities. Ensure that protocols and monitoring efforts are expanded to address increased threats of non-native species from increased vessel traffic. *Meets objectives 2.1, 2.2, 2.4, 3.1, 3.4, 4.1, 4.3, 4.7, 5.3.*

- Review and comment on Ecology's five-year review of Oil Spill Contingency Plans and stay apprised of changes that occur to plans in the interim. Coordinate with WDFW, affected tribes, ship, tug and barge companies, and Puget Sound Pilots. *Meets objectives 2.2, 2.3, 2.4, 3.1, 3.4, 5.3.*

- Review and comment on Ecology's five-year review of Oil Handling Facility Operations Manuals and stay apprised of changes that occur in the interim. Coordinate with WDFW, affected tribes, ship, tug and barge companies, and Puget Sound Pilots. *Meets objectives 1.4, 2.1, 2.2, 2.3, 2.4, 4.3, 5.3.*

- Request that Whatcom County and Ecology ensure that new shoreline related development does not cause erosion and nonpoint source pollution from upland activities. *Meets objectives 1.1, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.3, 5.3.*

- Review and comment on any proposed changes to tug escort requirements. Coordinate with WDFW, affected tribes, non-profit organizations, and Puget Sound Pilots. *Meets objectives 3.3, 4.7, 5.1.*

- Support the Coast Guard, NOAA and industries in updating the ballast water harbor care safety plan. *Meets objectives 2.2 2.3.*

Tier 2

- Encourage Whatcom County to provide technical assistance and incentives to property owners to retrofit existing tightline drains. Many are inadequate, resulting in erosion due to

leaks and breaks. *Meets objectives 1.1, 2.1, 2.2, 2.4, 3.1, 3.4, 5.3.*

Support Whatcom County in encouraging homeowners to intercept increased surface water and shallow groundwater resulting from alterations of the natural hydrology of upland portions of bluff properties to maintain and restore natural rates of erosion from Point Whitehorn to Birch Bay State Park, specifically the Holeman, Birch Bay Drive Bluffs, and high berm segments (identified in Johannessen 2003). *Meets objectives 1.1, 2.1, 2.2, 3.1,3.4, 3.4, 5.3.*

- Work with the Coast Guard to ensure compliance with all state and federal regulations for the discharge of onboard sewage while transiting the Cherry Point Aquatic Reserve and while berthed at industry piers. *Meets objectives 1.4, 2.1, 2.2, 2.4, 3.1, 3.4, 4.3, 5.3.*

The following management actions are collaborative and DNR will work cooperatively with others to formulate and implement strategies related to atmospheric deposition:

- Assist participating industries with implementation of applicable measures from the Northwest Ports Clean Air Strategy, in coordination with EPA, Ecology, the Northwest Clean Air Agency, and participating industries. *Meets objectives 2.2, 2.4, 4.1.*

- When reviewing project proposals, DNR will consider information collected on Georgia Strait climate, microclimate, and sea level rise collected by the Office of the Washington State Climatologist (OWSC) and the Climate Impacts Group. *Meets objectives 1.1, 1.3,1.4, 3.1, 3.4., 4, 5.3.*

Protection of Cultural Resources

Tier 1

- DNR will ensure that existing and proposed restoration and development activities on state-owned aquatic lands comply with all applicable mandated federal, state, and tribal cultural protection laws prior to any construction commencing along the Cherry Point shoreline, including, but not limited to: Archaeological Resource Preservation Act; National Historic Preservation Act; Clean Water Act; River and Harbors Act; Resource Conservation and Recovery Act; Safe Water Drinking Act; Clean Air Act; Endangered Species Act, National Environmental Policy Act; and Coastal Zone Management Act. *Meets objectives 3.4, 5.1, 5.2, 5.3.*

- DNR will ensure consistency of plan implementation with protection of tribal culture and values, treaty rights, and is consistent with the Northwest Tribes policy on Marine Protected Areas (NWIFC, 2003). *Meets objectives 5.1, 5.2, 5.3.*

- DNR will work with tribes, in coordination with the applicant, and the State Historic Preservation Office, the U.S. Army Corps of Engineers, and WDFW, to develop a 'Cultural Resources Protection Protocol' for activities on state-owned aquatic lands within or adjacent to the reserve. The protocol would include, but not limited to, requirements for appropriate pre-construction surveying, procedures for addressing inadvertent discoveries during clean-up and construction, and procedures for repatriation or re-interment. *Meets objectives 5.1, 5.2, 5.3.*

Restoration and Enhancement

Tier 1

DNR will develop restoration plans for specific areas and species within the reserve, partnering with state and local governments, tribes, non-profit organizations and adjacent landowners where possible. DNR will partner with various entities to identify restoration needs, develop and implement restoration plans within the reserve and seek funding for their completion. DNR will approve new proposals for restoration projects within the reserve when those proposals are determined to be consistent with the management goals and objectives of the reserve.

Specific areas where restoration efforts are being considered and/or pursued either by DNR or others include:

- Inventory and removal of harmful debris and derelict fishing gear in the Cherry Point Aquatic Reserve. *Meets objectives 3.1, 3.3, 3.4.*

- Mapping and removal of rogue creosote logs along the beach at Cherry Point in coordination with City of Bellingham, Ecology, Beachwatchers, industrial landowners and the Whatcom Marine Resources Committee. *Meets objectives 2.2, 3.1, 3.2, 3.3.*

- Ensure that protection and restoration plans address the need to mitigate the effects of climate change upon the valued ecological resources described in this plan. Using likely scenarios of climate change developed through careful monitoring, data collection and vulnerability assessment, working in coordination with the Climate Impact Group of the University of Washington, Whatcom County, and others. *Meets objectives 1.3, 2.2, 3.1, 4.5, 5.3.*

DNR will support the following restoration projects through technical and funding assistance, or other support as appropriate:

- Annual marine debris beach cleanups conducted by industries, Beachwatchers, and Whatcom Marine Resources Committee. *Meets objectives 2.1, 3.1, 3.2, 3.3.*

- Whatcom County proposal to restore areas impacted by recreational shellfish digging activities to natural beach contours and documentation of the impacts/effects of restoration. *Meets objectives 1.1, 3.1, 3.2, 3.4, 4.4.*

- Voluntary landowner removal of the derelict gravel conveyor at Gulf Road to eliminate creosote pilings and allow recolonization of marine vegetation in the footprint of the structure. *Meets objectives 1.1, 2.1, 2.2, 3.1, 3.2, 3.3.*

- Whatcom County and Marine Resources Committee proposals for restoration of native plant species most adapted to the local conditions in areas of freshwater or marine shorelines where riparian habitat has been either removed or eliminated as a result of past human activities. *Meets objectives 1.1, 1.2, 3.1, 3.2, 3.4.*
- Whatcom County projects with various entities to encourage enhancement of native vegetation along shoreline, particularly along county-designated setback zones landward of the tops of bluffs. *Meets objectives 1.1, 1.2, 3.1, 3.2, 3.4.*

- Whatcom County, WDFW, and Ecology efforts to provide technical assistance and incentives to shoreline property owners to assist with removal of bulkheads or their replacement with soft bank or other alternatives to shore forms that promote natural processes. Sites include north side of Point Whitehorn and armoring at Gulf Rd. *Meets objectives 1.1, 1.3, 1.4, 3.1, 3.2, 3.4, 4.2, 4.3.*

- WDFW, Whatcom County, Ecology, and industrial pier owner proposals to evaluate and encourage options for restoring natural transport processes of sediment across impediments at the Cherry Point Aquatic Reserve, such as the pier aprons at Alcoa-Intalco Works and ConocoPhillips marine facilities, to help reduce impacts from existing structures and associated fill. *Meets objectives 1.1, 2.1, 3.1, 3.2, 3.4, 4.1, 5.3.*

- Cooperative efforts by Ecology, WDFW, affected tribes, and owners of overwater structures to encourage voluntary retrofitting improvements on older facilities with wave and light shading impacts. *Meets objectives 1.1, 3.1, 3.2, 3.4, 4.1, 5.3.*

- Efforts to identify and remediate unauthorized dump sites that may contribute contaminated runoff or groundwater into the reserve. *Meets objectives 2.1, 2.2, 2.4, 3.1, 5.3.*

Education and Outreach

DNR will work with resource agencies, tribes, user groups, local environmental groups, local clubs, and other interested citizens to implement the following education and outreach actions:

Tier 1

- Increase outreach to shellfish harvesters, fishing and crabbing industry, and recreational boaters about location of forage fish habitat.

- Outreach to the Puget Sound Pilot about efforts they could take to prevent impacts to forage fish habitat during spawning season.

- Provide signage at appropriate locations specifying regulations and interpretive education information related to impacts of recreational shellfish harvest.

- Education regarding the sensitivities of the Cherry Point ecosystem with emphasis on trampling of aquatic vegetation and disturbance of birds and seals (in haulout areas).

- Efforts targeting recreational boaters to reduce the introduction of non-indigenous species. Education and outreach on the use of eco-friendly fertilizers, herbicides, pesticides and riparian vegetation. *Meets objectives 1.1, 1.2, 2.2, 3.1, 3.2, 3.4, 4.2, 4.4.*

- Provide outreach to the public regarding issues and progress on the reserve. Develop a listserv, webpage, or email list to send updates. Work with interested parties to co-sponsor periodic conferences on Cherry Point reserve science, progress, and other issue of interest to the public.

Monitoring, Data Collection and Research

There are four components of research and monitoring within the reserve:

- Data gap analysis
- Establishing baseline conditions
- Trend monitoring to determine the effectiveness of management activities and document natural variation; and
- Research to better understand observed changes and the interactions between management activities and natural resource conditions.

Data gap analysis will help managers determine baseline conditions that represent the current quality of the Cherry Point ecosystem. These conditions set the baseline for monitoring ecosystem health to which future conditions will be compared in order to judge progress and effectiveness. Baseline monitoring will document current conditions by combining existing data with new characterizations of resources and ecological processes proposed in this plan.

After baseline conditions have been identified, continued monitoring for trends in habitat and species conditions should be conducted. Trend monitoring will be used to assess the success of management actions in attaining or exceeding the goals identified previously in this management plan. Trend monitoring is necessary in order to assess the need for course corrections related to improving the management actions. Research can complement trend monitoring by providing possible answers for why species and habitats may be declining or improving.
Because there are many management actions related to data collection, monitoring and research, the following actions are a high priority over the first five years of plan implementation: 1) monitoring the effectiveness of protection actions that address existing and proposed use authorizations, and 2) research to reduce uncertainties about the decline of species targeted for conservation that can directly improve the effectiveness of management actions.

Data Gap Analysis

Participants in the development of this plan have identified the need for the following data. DNR will seek to partner with local, state and federal governments, tribes, research institutions, industrial users, and nonprofits to help reduce data gaps.

Tier 1

- Identify and catalog habitat protection, enhancement, and restoration opportunities with special emphasis on native submerged aquatic vegetation. *Meets objectives 1.2, 3.1, 3.4,3.5.*

- Identify any additional necessary and immediate protections for forage fish spawning habitats, marine and terrestrial bird habitat, and submerged vegetation. *Meets objectives 2.2, 3.1, 3.2, 3.3, 3.4.*
- Monitor toxicity in the nearshore to assess potential impacts of contaminated groundwater discharges.

- Evaluate relationship of the Treoil site on groundwater and intertidal water quality. *Meets objectives 2.1, 2.2, 3.1, 3.2, 4.5*

Tier 2

Prepare a quarterly tabulation or annual summary reports of the following vessel traffic and spill data within the Cherry Point Aquatic Reserve:

- Seasonal vessel traffic and anchorage use
- Ecology boom reporting form submissions

- Quarterly summaries of the Cherry Point PORTS data
- Spill history and reporting
- Fuel/oil transfer interruptions due to weather conditions
- Near miss/incident data for vessels
- Recreational boating data, as available
- Changes to vessel traffic bound to and from the Cherry Point Aquatic Reserve area relative to existing and proposed regional commercial, recreational and port operations. e.g., DeltaPort Phase 3, Roberts Bank T-2 expansion, etc. *Meets objectives 2.3, 3.1, 3.3, 4.7.*
- The impact on the Cherry Point Reserve for atmospheric deposition is unknown and currently not being researched. Investigate the potential impacts of vessel and other emission sources and global transport of air pollutants on water quality and sediment in the reserve. Support ongoing efforts to monitor deposition from air pollution and evaluation of its impacts in the vicinity of Cherry Point. *Meets objectives 2.1, 2.2.*

Baseline Monitoring

While a substantial amount of information has been collected for the Cherry Point Aquatic Reserve, gaps in characterizing the baseline still exist. DNR will seek to partner with local, state and federal governments, tribes, research institutions, industrial users, and nonprofits to conduct baseline monitoring. The following needs for baseline monitoring have been identified:

Tier 1

- Complete validation of the herring larval survival and growth test in a commercial lab to finalize protocol for use by regulated community. This action is a high priority because lessees are required to carry out studies as a condition of any lease authorizations associated with increases in stormwater or wastewater discharges (see Allowed Uses section). *Meets objectives 3.1, 3.2, 4.5.*

- Conduct detailed seafloor mapping and analyze habitat characteristics within the management area. *Meets objectives 3.5, 4.5.*

- Conduct detailed survey for derelict fishing gear. *Meets objectives 3.1, 3.3, 3.4.*

- Identify the location, extent and quality of other forage fish (e.g., surf smelt, sand lance) spawning habitat. *Meets objectives 3.1, 3.4, 3.5.*

- Measure the diversity, distribution, and abundance of intertidal species adjacent to and within the Cherry Point Aquatic Reserve. Work with WFDW to assess ballast water exchanges to inform methods of reducing invasive species transport. *Meets objectives 1.2, 3.4, 3.5.*

- Conduct research on the seasonal occurrence of larval organisms present along the Cherry Point Aquatic Reserve to help inform dispersant use decision-making by Incident Command in the event of a spill. *Meets objectives 1.2, 2.1, 2.2.*

- Coordinate with NOAA, WDFW, Industries, pilot associations (Puget Sound Pilots), USCG, Whale Network, commercial and tribal fishermen, scientists and researchers to collect and maintain a tabulation of presence/absence of marine mammals, including the following data to improve advice to mariners on when and where whales are most likely to

occur:

- Proximity to vessel or ship if seen
- Behavior (feeding, breaching, other
- Species (if known)
- Habitat use (if known)
- Date/time, tide and season *Meets objectives 3.1, 3.4, 3.5, 4.5, 4.7.*

Tier 2

- Reduce potential for vessel interference with marine mammals by identifying migratory pathways and habitat preferences; develop collision risk plan for ships and vessels in the area. *Meets objectives 3.1, 3.2, 3.4, 3.5, 4.1, 4.7.*

Trend Monitoring

DNR will partner with local, state and federal governments, tribes, research institutions, businesses, and nonprofits to identify and conduct trend monitoring for ecological conditions in and around Cherry Point Aquatic Reserve. If funding is available, monitoring plans will be developed to establish ecological trends and conditions at the site. Current and future trend analysis data identified to help guide management of the reserve include:

Tier 1

- Surveys to determine abundance, distribution, and population trends of nearshore and riparian bird species, such as ongoing studies including Western Washington University (WWU) and Puget Sound Assessment and Monitoring (PSAMP) programs. All avian studies should be conducted throughout the year for a complete understanding of the use and trends in the Cherry Point Aquatic Reserve. *Meets objectives 3.1, 3.4, 3.5, 4.5.*

- Inventory and characterization of existing riparian condition, monitor condition at regular intervals, and evaluate trends and environmental effects of management. *Meets objectives 1.1, 3.2, 3.5.*

- Support and encourage partner agencies to undertake fish and wildlife surveys along the reach and increase surveys of herring spawn timing and behavior in response to light and noise. *Meets objectives 3.1, 3.2, 3.4, 3.5, 4.1, 4.5, 4.7, 5.3.*

- Continue monitoring of local fish (salmon, flatfishes, forage fish) and shellfish (Dungeness) populations to evaluate trends and effectiveness of management. *Meets objectives 3.1, 3.2, 3.4, 3.5, 4.1, 4.5, 5.3.*

- Continue the mapping of submerged aquatic vegetation within the reserve at five-year intervals to provide a dynamic inventory. Evaluate trends and environmental effects of management. Methodologies should be comparable with previous inventories. *Meets objectives 1.2, 3.1, 3.2, 3.4, 3.5, 4.1, 5.3.*

- Continued monitoring of the Cherry Point herring stock population and spawning events to evaluate trends and effectiveness of management. Track changes in the timing and location of

herring or other species that use the Cherry Point area as a spawning ground. These may be altered by changes in currents, temperature or other clues used by the Cherry Point Pacific herring to set spawning time and location. *Meets objectives 3.1, 3.2, 3.4, 3.5, 4.1, 4.3, 4.5, 5.3.*

- Track changes in species composition and the sensitivity of the community to shading effects and other factors. *Meets objectives 1.2, 3.1, 3.4, 3.5, 4.5.*

Tier 2

- Prepare summary reports of discharge data to evaluate long term trends. *Meets objectives 2.1, 2.2, 2.4, 2.4, 3.2, 4.1, 4.5.*

Track and report on facilities' efforts to reduce air pollution, the regional and global investigations, and look at new technology to address potential impacts. *Meets objectives* 2.2, 3.2, 4.1.

- Track changes in sedimentation and fill due to changes in currents or storm frequencies. Current and storm frequency and energy can be altered compared to historical conditions. Rates and direction of sediment transport may be altered as a result. *Meets objectives 1.1, 1.3, 3.1, 3.5, 4.5.*

- Develop a comprehensive monitoring strategy for climate change, considering the following:

- How alterations in climate will also change the patterns of occurrence of invasive species already established in the region. *Meets objectives 1.2, 2.2, 3.1, 3.5, 4.5.*

- Monitor temperature and currents entering the reserve, and map changes in species location, density of sea grasses, location of shellfish and other variables that may indicate long-term changes due to climate alterations or other factors. *Meets objectives 3.1, 3.4, 3.5, 4.5*

- Examine the effect of increased phototoxicity and temperature on PAHs and other key chemicals as the climate changes. It is already known that exposure to sunlight can lead to enhanced toxicity effects from PAHs. *Meets objectives 1.3, 2.1, 2.2, 3.1, 3.2, 3.4, 4.1, 4.5*
.
- Track the type and extent of habitat within the management area using models to predict likely outcomes. Habitat patterns will shift due to change in sea and air temperature, the type of disturbance regime and the colonization of the region by species adapted to warmer temperatures. There may be a tendency for some types of habitats to move in a north-south direction depending upon temperature and other habitat variables. It may prove necessary to create new habitats able to support species that can exist in a transformed region. *Meets objectives 1.3, 3.1, 3.4, 4.5.*

- Assess major changes in Fraser River and Nooksack River annual flow regime and water quality on local habitat and species. *Meets objectives 1.4, 3.4, 3.5.*

- DNR will support efforts to establish a consensus on sea level rise estimates statewide and coast-wide, through the National Academy of Sciences. *Meets objectives 1.3, 4.5.*

- Coordinate with WDFW and Whatcom County to measure and mitigate climate change among other management questions in the document. Since climate change is an all-

encompassing aspect of the Cherry Point Aquatic Reserve, coordination should take place to ensure that a mitigation plan for one area does not impact another area of management. An example would be protection against sea level rise by altering a shoreline; or providing protection against an increase in invasive species, which would be able to colonize the region because of an increase in water temperature. *Meets objectives 1.1, 1.2, 1.3, 2.1, 2.2, 2.4, 3.2, 3.4, 4.5.*

Research

DNR will seek to partner with local, state and federal governments, tribes, research institutions, industrial users and nonprofits to identify and develop research projects within the reserve. Any research activities that occur within the reserve must not result in damage to the ecosystem and must meet the goals and objectives of the reserve. Research opportunities may include, but are not limited to:

Tier 1

- Determine causes for small size, low hatch rate, and the high rate of abnormal development in Cherry Point herring stock both as an assessment of the intrinsic health of the stock and in regards to the geographical pattern of abnormalities seen in outplants along the shoreline in the 1990s. *Meets objectives 1.4, 3.1, 3.2, 3.4, 4.1, 4.5, 5.3.*

- Research ways to reduce shading of herring and forage fish habitat where necessary, and reduce evening illumination during spawning season. *Meets objectives 3.1, 3.2, 4.1, 4.3, 4.5, 5.3.*

- Assess effects of sound from commercial vessel traffic and dock operations on the spawning behavior of herring. *Meets objectives 3.1, 3.2, 3.4, 3.5, 4.1, 4.5, 4.7, 5.3. .*

- Evaluate recreational harvest impacts on the Cherry Point Aquatic Reserve nearshore marine environment to inform management strategies. *Meets objectives 1.1, 3.1, 3.2, 3.5, 4.4, 4.5.*

- Repeat and expand on the herring embryo temperature tolerance study. This is a requirement of lease authorizations involving expansion of discharge outfalls; see the 'Allowed Uses' section. *Meets objectives 2.2, 3.1, 3.2, 4.5*

- Develop monitoring protocols to track likely vectors (sources for introduction) of non-native organisms and support methods of treatment that reduce risks and avoid impacts to the Cherry Point Aquatic Reserve. Where non-native species have become established, characterize the occurrence and dynamics of non-native species at Cherry Point and study measures to safely eradicate the invaders and/or mitigate impacts. *Meets objectives 1.2, 2.2, 3.1, 3.2, 3.5, 4.1, 4.5.*

- Repeat and expand on the ambient water toxicity study to evaluate cumulative effects of industrial and municipal wastewater outfalls using protocols accepted by EPA and Ecology. Consider and/or evaluate the use of caged mussel, harbor seal blood chemistry, sediment monitoring, and other biological impact assessments for monitoring indicators of potential problems. (This is a requirement of lease authorizations involving increases in stormwater or wastewater discharges. See 'Allowed Uses' section). *Meets objectives 2.1, 2.2, 3.2, 4.1, 4.5.*

- Provide ongoing groundwater characterization with specific focus on nearshore contamination. *Meets objectives 2.1, 2.2, 3.1, 4.5.*

- Observe and review lessons learned from oil or other hazardous material spill preparedness drills and from spills. *Meets objectives 2.2, 2.3, 3.2.*

Tier 2

- Characterize sediment chemistry throughout the reserve. Areas outside *sediment impact zones* should be evaluated with particular attention to the intertidal and upper subtidal zones. *Meets objectives 2.1, 2.2, 2.4, 3.1, 3.4, 4.5.*

- Characterize sediment, groundwater, and surface water sources and quality within the depositional zone of the surface water runoff at Unick Road. *Meets objectives 2.1, 2.2, 2.4, 3.1, 3.4, 4.5.*

- Examine changes in runoff frequency, volume and the fate of contaminants. The physical characteristics of the receiving water can change due to alterations in temperature, pH and other factors that alter the fate of the contaminants and the sensitivity of organisms. Patterns of stormwater quantity and timing are also susceptible to change as the climate is altered. Ambient toxicity testing should also take into account changes in receiving water temperature and changes in species composition of the appropriate receiving waters. Locate freshwater seeps and describe groundwater movement patterns from upland areas to nearshore. Describe volume of flows and effects on the marine ecosystem. *Meets objectives 2.1, 2.2, 3.1, 4.5.*

- Assess the impact of shore armoring near Point Whitehorn and Gulf Road. *Meets objectives 1.1, 3.1, 3.2, 3.5, 4.5.*

- Characterize the occurrence and dynamics of non-native species at Cherry Point and sources of non-native species that can immigrate to the region. The study would also evaluate the probability of invasive species by vector. *Meets objectives 1.2, 2.2, 3.1, 3.2, 3.5, 4.1, 4.5.*

- Examine the pathways and threat of additional invasions and changes in the patterns of *Sargassum*. The change in physical parameters (currents, pH, oxygen, temperature) and the change in the composition in local community structure will alter the likelihood of invasion by organisms being transported by ballast water, currents or other vectors. *Meets objectives 1.2, 2.2, 3.1, 3.5, 4.5.*

- Collect and summarize data on natural climate change (El Nino, PDO) and human induced climate change *(field research, models)* that may affect the Cherry Point Aquatic Reserve. This effort should include change in ocean currents, migration of species, changes in ocean acidity on the pH of the receiving water, and the toxicity of the wastewater streams and temperature regimen at the reserve. A contingency plan should cover what ecological resources are likely to be affected by climate change and which can be preserved given reasonable model outputs. *Meets objectives 1.3, 4.5.*
  Re-examine dilution models if currents change due to climate induced factors, including output volumes. There are uncertainties regarding how a changing climate might affect

water quality in the reserve. Examine the need to adjust dilution ratios for temperature mixing zones in facility discharge permits as ocean temperatures rise. *Meets objectives 2.2, 4.5.*

Assess changes in Fraser River annual flow regime and water quality on Cherry Point habitat and species. *Meets objectives 4.5,*

Allowable Uses

DNR will consider the following new uses for state-owned aquatic lands within or directly adjacent to (abutting) the aquatic reserve:

- Easement for Birch Bay Water and Sewer District outfall (see below for specific guidance)
- Existing industrial piers and associated outfalls (see below for specific guidance)
- Sustainable recreational activities, including shellfish harvesting (see below for specific guidance)
- Environmental education where consistent with reserve objectives and appropriate public access
- Ecological monitoring if conducted under a monitoring plan approved by DNR
- Research in support of the reserve's goals and objectives
- Restoration projects that are consistent with the management of the reserve
- Commercial and recreational fisheries will be managed by WDFW, responsible tribal governments, and DNR shellfish section staff.
- Authorize mooring buoys if determined to be appropriate to address interaction between tug and tow operations and crab fisheries. *Meets objectives 1.1, 1.2, 1.4, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.5, 4.6, 5.1, 5.3.*

Existing Use Authorizations

As described in Chapter 1, there are no existing use authorizations on state-owned aquatic lands within the Cherry Point Aquatic Reserve. The existing use authorizations are located in the "cutouts" directly adjacent to or abutting the reserve. DNR cannot alter the terms and conditions of an existing lease, easement, or other use authorization without consent of the tenant or grantee.

This management plan does not alter existing contractual rights and obligations. Existing tenants or grantees may continue to conduct their activities in conformance with their current use authorization and in compliance with other local, state and federal regulations. DNR will encourage voluntary and cooperative efforts of existing lessees to implement the elements of this plan.

Water-dependent, industrial uses that require marine access are the preferred use of the Cherry Point Management Unit in the Whatcom County SMP. The SMP also recognizes the importance of the areas as herring spawning habitat and other key habitat characteristics that warrant special consideration. Similarly, DNR recognizes the

Cherry Point reach to be of both great economic and ecological importance to the region. This plan provides guidance for DNR to facilitate modifications or renewals to existing leases at Cherry Point, while ensuring environmental protection and promoting species recovery.

The existing industrial uses at Cherry Point are not incompatible with goals for the long-term protection of the aquatic resources within and adjacent to the aquatic reserve. Therefore, the existing industrial uses do not conflict with aquatic reserve status at Cherry Point. The uses can further serve the objectives of the reserve if the facilities are managed according to this plan and lessees actively take steps to enhance compatibility of their facilities with reserve goals. Decisions for reauthorization for existing uses will be made by DNR, based on the facts and circumstances at the time of request for approval.

Reauthorization of Existing Uses

DNR will achieve the desired future outcomes for the Cherry Point Aquatic Reserve by integrating contemporary knowledge, research findings, and recommendations for action identified in this management plan into future lease and use agreements. DNR will also work with lessees to find ways to assure that their future use authorizations serve the reserve's long-term management objectives.

Consistent with statutory authority and agency policy for all applications to use any state-owned aquatic land, DNR will consider an application to reauthorize existing uses at Cherry Point when existing agreements expire. At the time of application for reauthorization, DNR will evaluate whether the proposal by the applicant conforms to this management plan based on the criteria specified below. As needed, DNR will work with the applicant to develop plans to reduce, over the term of the new agreement, any environmental impacts that may arise from existing facilities and uses. Such plans will be based on best available science, research and monitoring findings at the time of reauthorization. The content of such plans may vary between leaseholds depending on the extent to which a lessee had addressed environmental impacts during the term of the expiring agreement.

Consistent with DNR proprietary authority, reauthorizations may include terms requiring monitoring to help identify or reduce uncertainty regarding environmental impacts. This will allow DNR to determine conditions to include in subsequent future use authorizations in order to successfully provide environmental protection for the Cherry Point Aquatic Reserve, while also fostering water-dependent uses. If DNR adopts a habitat conservation plan for all state-owned aquatic lands, the agency will also integrate the habitat conservation plan's programmatic measures with the requirements of the Management Plan to address endangered species protection.

DNR will consider the following questions when evaluating applications from existing Cherry Point lessees and to determine consistency with this plan:

- Is the lessee in good financial and contractual standing with DNR?
- Is the lessee in compliance with conditions of federal, state and local laws and permits?
- Is the use managed in accordance with this plan and consistent with the objectives of the aquatic reserve, the Desired Future Conditions of this Plan, and, if the application for reauthorization includes a discharge outfall, have the additional reauthorization requirements related to discharge outfalls been met?
- Has the lessee submitted a plan proposing actions to reduce existing site-specific impacts to specific habitats and species identified for conservation?

While there is no environmental baseline for Cherry Point at present (developing a quantitative baseline is a goal of this plan), enough is known about many resources to make informed decisions about use authorizations. DNR will work with other resource management authorities to identify regulatory and proprietary actions necessary to protect resources.

Additionally, DNR will expect cooperation from lessees and the support of other interested parties to enhance the quality of habitat and provide long-term protection to the Reserve. If Cherry Point herring continue to decline at a statistically significant level, DNR will discuss approval of any future use authorizations at the site with WDFW, to determine how to reauthorize a use in a way to ensure protection of herring. *Meets objectives 1.1, 1.2, 1.4, 2.1, 2.2, 2.3, 3.1, 3.2, 3.4, 4.1, 5.1, 5.2, 5.3.*

Additional Reauthorization Requirements Related to Discharge Outfalls

Consistent with RCW 79.105.210, RCW 90.48.386 and WAC 332-30-122(2)(a) DNR may reauthorize, or approve lease modifications for existing discharge outfalls, or allow new discharge outfalls serving existing authorized uses under the following conditions:

- The outfalls must meet all current local, state and federal regulatory requirements, and water quality standards.
- The applicant must take all appropriate steps to avoid or minimize substantial or irreversible damage to the environment.
- The applicant must complete the following studies to determine potential impacts of the proposed activities on habitats and species, and identify appropriate measures for impact avoidance and minimization. DNR will use the results of such studies to ensure that leases include conditions to avoid or minimize damage to the environment. Studies include:
    - Herring larval survival and growth test protocol validation by commercial laboratories, to determine the relative sensitivities to the effluent from approved outfalls, as per Herring Agreed Order # 3192.
    - Completion of herring embryo temperature tolerance study, as per Herring Agreed Order #3192.
    - Repeat and expand testing to investigate the cause of herring embryo abnormalities as described by Hershberger and Kocan 1999.
    - For municipal outfall, assess cumulative impacts of wastewater to the waters of the Cherry Point Aquatic Reserve, including pharmaceuticals and other endocrine disrupters using analytical methods as described in Lubliner et al. (2010). *Meets objectives 2.1, 2.2, 3.1, 3.2, 4.1, 4.5.*
    - Repeat and expand on the ambient water toxicity study including water temperature changes, as required by Herring Agreed Order # 3192, using protocols accepted by EPA and Ecology to evaluate cumulative effects of industrial wastewater outfalls and groundwater seeps on nearshore species survival and water quality.
- Reassess bioaccumulation of PAH, PCB, and heavy metals in caged mussels as described by Applied Biomonitoring, 2002. For stormwater outfalls discharging to Birch Bay, implement the solutions recommended in the Birch Bay Comprehensive Stormwater Plan (2006) for the Birch Bay watershed. Completion of proposals that investigate treatment and re-use of

stormwater, treated wastewater (currently discharged at Cherry Point) and re-claimed water, and water conservation programs in order to reduce discharges. *Meets objectives 1.1, 1.4, 2.1, 2.2, 3.1, 3.2, 3.4, 5.3.*

Approvals for Changes to Existing Uses and Facilities

Under certain conditions, this Management Plan allows for new uses of existing facilities, as well as expansion and significant modification of existing facilities (the type of work that under DNR's standard lease agreement would be considered new work rather than routine maintenance and repair). The proposal for such modifications must meet certain standards described below for alterations to existing facilities. Additionally, any structural modifications or operational changes to existing facilities that would result in increased artificial light, noise, wave or light shading, runoff, pollution, or other discharges must meet the standards below for alterations to existing facilities.

Alterations to Existing Facilities: Overwater Structures

DNR will not authorize alterations to the overwater footprint of existing facilities until the following conditions are met or studies complete. The purpose of these conditions is to assess potential adverse impacts of the proposed alteration on species and habitats to inform development of measures for impact avoidance and minimization that can be incorporated into lease agreements.

- Proposed changes to DNR authorized uses at Cherry Point shall avoid or minimize noise and artificial light impacts based on the recommendations formulated in existing studies, future research and monitoring.

- Modification to existing structures must be designed to avoid disruption of herring migratory patterns from deep water to the nearshore and along the nearshore.

- Proposed alteration of existing overwater structures must minimize wave and light shading to the maximum extent feasible and avoid adverse impacts to areas with significant biological aquatic resource value, such as sediment transport processes, aquatic vegetation, spawning areas, pre-spawn holding areas and migratory corridors. This should be accomplished through managing location, orientation, design, materials, construction best management practices, operation of structures and activities contributing to shading.

Approval of Authorizations for New Uses

To determine if a proposal is consistent with this plan and serves the objectives of the reserve, DNR will consider the following when reviewing applications for new uses.

New Discharge Outfalls

Consistent with RCW 79.105.210, RCW 90.48.386, and WAC 332-30-122(2)(a) DNR may issue new leases for outfalls. As a condition of a potential lease authorization, DNR will require studies to be completed to determine the potential impacts of the proposed activities on habitats and species and identify appropriate measures for impact avoidance and minimization. DNR will use the results of such studies to ensure the leases are conditioned to avoid or minimize damage to the environment. The conditions and studies required for authorization consideration include:

- The outfalls meet all local, state and federal regulatory requirements, and water quality standards.

- Appropriate steps are taken to avoid or minimize substantial or irreversible damage to the environment.

- Conduct ambient water toxicity study using protocols accepted by EPA and Ecology to evaluate cumulative effects of existing industrial wastewater outfalls and groundwater seeps on nearshore species survival and water quality. Caged mussel studies and/or harbor seal bioassays may be used as biological indicators of toxicity. Study design may be based on similar study required by Herring Agreed Order # 3192. Project proponent may coordinate study with existing authorized uses that are also required to conduct ambient water toxicity study, as identified in Additional Reauthorization Requirements Related to Discharge Outfalls section above.

- Assess bioaccumulation of PAH, PCB, and heavy metals in caged mussels as described by Applied Biomonitoring, 2002.

Shoreline modification along Cherry Point

New structures or proposed modifications to existing structures must be designed to avoid impacts to wave energy, nearshore sediment drift, and aquatic and riparian vegetation. Only aquatic habitat-friendly methods of shoreline armoring (as recommended by the Integrated Stream bank Protection Guidelines, Washington State Aquatic Habitat Guidelines Program, 2002) will be authorized on state-owned aquatic lands. Exceptions will be made for replacement of existing shoreline armoring to protect existing structures, as long as consistent with the Whatcom County SMP. *Meets objectives 1.1, 1.4, 3.1, 3.2, 3.4, 5.3.*

Prohibited Uses

Saltwater Intake Structures

DNR will not authorize saltwater intake structures within or directly adjacent to the reserve, except in those cases when it is necessary for the installation and use of firefighting equipment at the industrial piers.
Meets objectives 1.1, 1.4, 2.1, 3.2, 3.4.

Cable or Pipeline Installations

DNR will not authorize cross-channel cable or pipeline installations within or directly adjacent to the reserve. *Meets objectives 1.1, 1.4, 2.1, 2.2, 3.1, 3.2, 3.4.*

Other Uses

DNR will not consider authorizing any uses in the reserve other than those identified above, unless the use is consistent with the purpose of the reserve management objectives of this plan. Any uses proposed on state owned aquatic lands directly abutting the reserve must not conflict with the purpose of the reserve designation or with the protection of habitat and species identified for conservation within the reserve.
Meets objectives 1.1, 1.2, 1.4, 2.2, 2.3, 3.1, 3.2, 3.4, 5.1, 5.2, 5.3.

6. Plan Implementation

The successful management of the Cherry Point Aquatic Reserve will require coordination and collaboration with public and private entities as well as local, state, federal, and tribal government, and non-government organizations. Review and evaluation of sound scientific and management information by resource managers should guide the future development, restoration and protection decisions. To increase collaboration in decision making, resource managers should consider forming a permanent workgroup whose purpose would be to guide the implementation of this plan and coordinate decisions that will affect the long-term health of resources and ecosystems of the Cherry Point Aquatic Reserve.

To enhance coordination and cooperation the resource managers are encouraged to jointly develop a Memorandum of Understanding (MOA) to address issues of mutual interest in the Cherry Point area. The MOA should describe how these entities will coordinate the discharge of their authorities and responsibilities, and state how they intend to work together to achieve desired outcomes for resource protection as presented in this plan for the Cherry Point Aquatic Reserve. The resource managers and their entities should seek information and review recommendations for action from this plan and other locally developed plans, the Puget Sound Partnership, the scientific community, local industry, Whatcom County Marine Resources Committee, environmental stakeholders, and other local interest groups in making decisions.

The resource managers may choose to establish advisory committees to enhance review and input on specific research, protection or restoration efforts. The resource managers should rely on existing regulatory and governmental decision processes as the basis for managing activities of the regulated community including general land use. Decisions by the resource managers should support the long-term objectives as stated in this plan and the MOA.

In addition to coordinating with each other, the resource managers should coordinate decisions and activities related to the maintenance of navigation, water quality and habitat protection with U.S. Corps of Engineers, U.S. Fish and Wildlife Service, NOAA Fisheries and U.S. Environmental Protection Agency. Decisions and activities related to vessel traffic management, spill prevention, and clean-up should be coordinated with U.S. Coast Guard, Ecology, Northwest Area Committee, interested tribes, and the fishing industry. Under the MOA, significant decisions and documents should be shared and discussed with resource managers prior to implementation.

Coordination with Community Groups

Many actions will require the assistance of nongovernmental entities. Such as, monitoring, research, restoration and environmental education. These largely non-regulatory actions can support plan implementation and will require careful coordination and clear delineation of responsibility and activity. DNR will make sure that group efforts are regularly coordinated with the resource managers and opportunities for discussion are established. Emphasis should be on making information available to the public and community groups for review and feedback on priorities selected by the resource managers.

Funding

Implementation of this plan is anticipated to be a cooperative effort. A coordinated approach to funding for the activities will be a key to successful achievement of the plan's goals. DNR seeks to coordinate

funding efforts to ensure that the plan is implemented based on priorities established in this plan and with input by the resource managers. DNR will seek funding to ensure the completion of all management actions required for approval of new leases, lease modifications, and lease renewals, however, DNR also encourages current and potential future leases to seek funding for these required studies as well. This will ensure that studies are funding and completed consistent with lessee needs Funding will be sought from a variety of sources including grants, agencies and other sources. As obligated by their permits, lessees will fund required regulatory mitigation associated with the ongoing operations of their facilities. DNR will encourage lessees and other governmental agencies to consider proactively participating in cooperative efforts to assist in ensuring the funding of issues identified in this plan.

Adaptive Management

Adaptive management is a key component to success of the Cherry Point Aquatic Reserve Management Plan. Adaptive management is a systematic process for improving management programs by learning from the outcomes of actions taken. Adaptive management requires tracking progress in carrying out the plan, making technical assessments about effectiveness of plan actions, managing and sharing data, evaluating and communicating progress, and determining whether course corrections are needed to make the plan more effective over time. Adaptive Management also allows for science-based approaches to fill data gaps and provides a framework to address uncertainties in the coming years.

The successful management of the Cherry Point Aquatic Reserve will require coordination and collaboration with public and private entities as well as local, state, federal, and tribal government, and non-government organizations. Review and evaluation of sound scientific and management information by resource managers should guide the future development, restoration and protection decisions.

This plan contains numerous actions that will be implemented by DNR and others. DNR will be responsible for tracking implementation of actions, research, and monitoring for the reserve. DNR will also assist with management of data collected through research, monitoring and other sources. DNR will develop a monitoring database to coordinate and compile the data collected by DNR and other entities during ongoing monitoring activities within and adjacent to the reserve. This will require the cooperation of agencies, affected tribes, industry, community groups and research institutions.

Because the management actions in this plan will take several years to implement, actions have been prioritized to identify those actions that should be completed in the first five years. Considerable gaps exist in our understanding of ecological processes and the relationship of the risk factors to the decline of targeted species within the aquatic reserve. Therefore, actions in the first five years will focus on establishing priorities for research to reduce uncertainties about the cause of species decline that can directly improve the effectiveness of actions, and on effectiveness monitoring. The purpose of effectiveness monitoring is to assess the success of management actions in attaining the future desired conditions. With increased understanding of the relative role various risk factors play in species decline, and the effectiveness of proposed management actions, management activities can be further refined and targeted. Quantifiable management goals and actions will be developed and adjusted over time based upon the established baseline conditions to aid in attaining the desired long-term future conditions for the resources of the aquatic reserve.

Through the adaptive management process, the resource managers will need to focus on the achievement of the desired future outcomes. An evaluation process shall be established early in the

implementation process that will provide the basis for determination if implementation of actions in this plan is achieving outcomes in all areas. Adaptive management of the reserve will integrate changes in scientific knowledge concerning the site, conditions of habitats and species, and existing uses of state-owned aquatic lands. Data and reports generated from research and monitoring activities will also be used to guide DNR in determining if management actions are meeting the goals and objectives of the reserve. If management actions are not successfully contributing to the goals and objectives for the reserve, then they will be modified, monitored, and evaluated during the following 10-year review process in accordance with adaptive management strategies.

DNR will review and update this management plan at least every 10 years, or more frequently if deemed appropriate. Among other things, changes in scientific knowledge concerning the site, conditions habitats and species, and existing encumbrances will be included in the updates. Additionally, data and reports generated from research and monitoring activities will be evaluated in attempts to determine if management actions are meeting the goal and objectives of this plan.

Glossary

Antidegradation Policy

The Clean Water Act's (CWA) antidegradation policy is found in section 303(d) (and further detailed in federal regulations) and its goals are to 1) ensure that no activity will lower water quality to support existing uses, and 2) to maintain and protect high quality waters.
States must adopt an antidegradation policy and methods for implementation.

Aquatic Lands

All state-owned tidelands and bedlands. "Aquatic lands" means all state-owned tidelands, shorelands, harbor areas, and the beds of navigable waters (RCW 79.105.060(1)). Aquatic lands are part of the public lands of the state of Washington and include many public places, waterways, bar islands, avulsively abandoned beds and channels of navigable bodies of water, managed by the department of natural resources directly, or indirectly through management agreements with other governmental entities.

Aquatic Reserve Program

The Aquatic Reserve Program is an ecosystem-based program created to establish aquatic reserves on selected state-owned aquatic lands to protect identified important native aquatic ecosystems. Aquatic reserves are lands of special educational or scientific interest, or of special environmental importance (WAC 332-30-151).

Authorization instrument

A lease, material purchase, easement, permit, or other document authorizing use of state-owned aquatic lands and/or materials.

Ballast water:

Ballast water is held in tanks and/or cargo holds of ships to provide stability and maneuverability during a voyage when ships are not carrying cargo, are not carrying heavy enough cargo, or require more stability due to rough seas.8 Ballast water may be either fresh or saline. Ballast water may also be carried so that a ship rides low enough in the water to pass under bridges and other structures.

Beach:

The zone of unconsolidated material that extends landward from the low water line to the place where there is marked change in material or physiographic form, or to the line of permanent vegetation (usually the effective limit of storm waves). The seaward limit of a

beach is the extreme low water line. A beach includes a foreshore and a backshore.

Bedlands, Beds of navigable waters: Those submerged lands lying waterward of the line of extreme low tide in navigable tidal waters and waterward of the line of navigability in navigable lakes, rivers and streams.

Benthic Zone: The benthic zone is the lowest level of a body of water, such as in an ocean or a lake. It is inhabited by organisms that live in close relationship with (if not physically attached to) the ground, called benthos or benthic organisms.

Biological Diversity: The various plant and animal species representative of and native to a site. "Regional biological diversity" is protected when habitat is provided to species that are becoming locally rare due to loss of habitat.

Biotoxin (marine): Marine biotoxins are poisons caused by microscopic toxin-

producing algae (a type of phytoplankton) that naturally occur in marine waters, normally in amounts too small to be harmful. However, a combination of warm temperatures, sunlight, and nutrient-rich waters can cause rapid plankton reproduction, or "blooms."

Bluff: An unvegetated high bank composed largely of unconsolidated deposits with a near-vertical face overlooking a body of water.

Cliff: A high, very steep to perpendicular or overhanging face of rock rising above the shore.

Coastal Zone: The sea-land fringe area bordering the shoreline where to coastal waters and adjacent lands exert a measurable influence on each other.

Commerce: The exchange or buying and selling of goods and services. As it applies to aquatic land, commerce usually involves transport and a land/water interface.

Critical Habitat: Those areas necessary for the survival of threatened, endangered, sensitive species, as designated under the Federal Endangered Species Act and Washington State Forest Practices Rules.

Cultural Resources: Archeological and historic sites and artifacts, whether

	previously recorded or still unrecognized, as administered by Department of Archaeology and Historic Preservation (DAHP) and protected under Title 27 RCW.
Dredging:	The enlarging or cleaning out a river channel, harbor, etc.
Ecosystem:	An ecological community consisting of all the living and non-living components of the physical environment.
Endangered, Threatened & Sensitive Species (ET&S):	Plants and animals protected under the federal Endangered Species Act or state designation.
Enhance:	To intentionally re-create elements that existed on site before disturbance, or introduce new functions or characteristics to a site.
Epibenthic:	Living on the bottom of the ocean.
Extreme low tide:	The line as estimated by the federal government below which it might reasonably be expected that the tide would not ebb. Varies by location.
Habitat:	The components of the ecosystem upon which a plant or animal species relies for its life cycle.
Hydraulic Project Approval:	Permit issued by the Washington State Department of Fish and Wildlife, the purpose of which is to address any damage or loss of fish and shellfish habitat which is considered to result in a direct loss of fish and shellfish production.
Intertidal:	The intertidal zone is also known as the foreshore and is that area exposed to the air at low tide and submerged at high tide, for example, the area between tide marks. This area can include many different types of habitats, including steep rocky cliffs, sandy beaches or vast mudflats.
Littoral zone:	The littoral zone of the coast is also called the foreshore, or intertidal zone, and is the section of the coast that is periodically covered by high tides and exposed during low tides.
lux:	The **lux** (symbol: **lx**) is the SI unit of illuminance and luminous emittance. It is used in photometry as

a measure of the *apparent* intensity of light hitting or passing through a surface. (

Maintain: To protect natural site characteristics and ecosystem processes, such as wildlife habitat, soil conservation and succession of native plant communities.

Mean Low Water: A tidal datum. The average of all the low water heights observed over the National Tidal Datum Epoch.

Mean Lower Low Water (MLLW): A tidal datum. The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch.

Mean High Water (MHW) - The average height of the highest tidal waters reached during the year over a National Tidal Datum Epoch.

Mean Higher High Water (MHHW): The average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch.

Monitor: To collect and analyze data for the purpose of answering management questions. A baseline is established and periodic measurements are taken to determine the extent and rate of change over time. Topics include: Beneficial and negative impacts of stewardship activities, natural events and public use.

Moorage facility: A marina, open water moorage and anchorage area, pier, dock, mooring buoy, or any other similar fixed moorage site.

Natural Landscape Elements: The natural watercourses, topography, hydrology and vegetation which comprise a particular site.

Natural processes: Phenomena that shape the landscape's appearance and habitat potential.

Non-point source discharge: Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrologic modification. Technically, the term "nonpoint source" is defined to mean any source of water pollution that does

not meet the legal definition of "point source" in section 502(14) of the Clean Water Act (see definition of point source).

Ordinary high tide: The same as mean high tide or the average height of high tide.

In Puget Sound, the mean high tide line varies from 10- to- 13 feet above the datum plane of mean lower low water (0.0).

Ordinary high water: The line of permanent upland vegetation along the shores

of non-tidal navigable waters. In the absence of vegetation, it is the line of mean higher high water.

Open moorage: Moorage slips and mooring floats that have completely open sides and tops.

Open water moorage and anchorage areas: Areas of state-owned aquatic lands leased for moorage

and anchorage that do not abut uplands and do not include a built connection to the uplands. May contain mooring buoys, floating moorage docks, other moorage facilities not connected to the shoreline or anchorage areas in accordance with WAC 332-30-139(5).

Pelagic Zone: The pelagic zone is the part of the open sea or ocean and does not include the seafloor.

Percent Slope - The direct ratio (multiplied by 100) between the vertical and the horizontal distance for a given slope; e.g., a 3-foot rise in a 10-foot horizontal distance would be a 30 percent slope.

Photic zone: The photic zone or euphotic zone is the depth of the water whether in a lake or an ocean that is exposed to sufficient sunlight for photosynthesis to occur. The depth of the euphotic zone can be greatly affected by seasonal turbidity.

Point source discharge: The term "point source" means any discernible, confined

and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or

other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture (taken from section 502(14) of the Clean Water Act).

Polycyclic aromatic hydrocarbons (PAH): A group of chemicals that are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat. There are more than 100 different PAHs. PAHs generally occur as complex mixtures (for example, as part of combustion products such as soot), not as single compounds. PAHs usually occur naturally, but they can be manufactured as individual compound. Can also be found in substances such as crude oil, coal, coal tar pitch, creosote, and roofing tar. They are found throughout the environment in the air, water, and soil. They can occur in the air, either attached to dust particles or as solids in soil or sediment. Health effects vary depending upon compound.

Public lands: Lands belonging to or held in trust by the state, which are not devoted to or reserved for a particular use by law, and include state lands, tidelands, shorelands and harbor areas as herein defined, and the beds of navigable waters belonging to the state (RCW 79.02.010).

Public use: To be made available daily to the general public on a first-come, first-served basis, and may not be leased to private parties on any more than a day use basis.

Public use beach: A state-owned beach available for free public use but which may be leased for other compatible uses.

Restore: To recover natural site features and processes that existed on site prior to disturbance.

Riparian: Relating to or living or located on the bank of a natural water course, such as a stream, lake or tidewater.

Runoff That part of the precipitation from rain, snowmelt or irrigation that is not absorbed into the ground, instead often flowing over impervious surfaces, or directly into streams and other surface waters or

	land depressions.
Saturated	A condition in which the interstices of a material are filled with a liquid, usually water.
Sediment Impact Zone (Ecology)[10]:	A sediment impact zone is an area where the specific sediment quality standards may be exceeded in conjunction with an authorized discharge permit. In authorizing a sediment impact zone, Ecology must find that the discharge is in the public interest and may require that best management practices be employed or that all known, available, and reasonable technology ("AKART") be applied to minimize the adverse impact of the discharge on sediments.
Shore:	That space of land which is alternately covered and left dry by the rising and falling of the water level of a lake, river or tidal area
Shoreline	The intersection of a specified plane of water with beach; it migrates with changes of the tide.
State Environmental Policy Act to	**SEPA;** State law that requires agency decision makers consider the environmental consequences of a proposal prior to making a decision. It includes a procedure, public involvement opportunities, and supplemental authority to require mitigation for identified adverse environmental impacts.
State-owned aquatic lands:	Those aquatic lands and waterways administered by the department of natural resources or managed under department agreement by a port district. State-owned aquatic lands does not include aquatic lands owned in fee by, or withdrawn for the use of, state agencies other than the department of natural resources (RCW 79.105.060(20)).
Subtidal zone:	Also called the sublittoral zone of the coast. The subtidal zone (below low water) is a band that is

[10] WAC Chapter 173-204 establishes sediment standards. Section 173-204-420 specifies sediment quality criteria for Puget Sound that may not be exceeded, and section 173- 204-120 provides that existing beneficial uses (of the benthic environment) must be protected, and no degradation which would interfere with those uses will be allowed (see definition of Antidegradation Policy). The regulations, while requiring adherence to sediment quality criteria, also recognize that goal may not always be attainable. The result of that regulatory conflict is the authorization of sediment impact zones.

affected only during the negative tides which occur periodically throughout the year

Supralittoral zone: Also called the splash zone (above high water), this area of the beach or coast remains exposed the longest and whose inhabitants are only sprayed with water, although during episodic “flooding” it is covered by the tide.

Terminal: A point of interchange between land and water carriers, such as a pier, wharf, or group of such, equipped with facilities for care and handling of cargo and/or passengers (RCW 79.105.060(21)).

Tidelands: Lands between the lines of ordinary high tide and the line of extreme low tide.

Uplands: Lands, including lakes, wetlands and streams, above the line of ordinary high tide.

Vessel: A floating structure that is designed primarily for navigation, is normally capable of self propulsion and use as a means of transportation, and meets all applicable laws and regulations pertaining to navigation and safety equipment on vessels, including, but not limited to, registration as a vessel by an appropriate government agency.**Water-dependent use**: A use which cannot logically exist in any location but on the water RCW 79.105.060(24)).

Wetlands: Lands where saturation with water is the dominant factor determining soil development and the types of plant and animal communities living in the soil and on its surface.

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Appendix A - Cherry Point Aquatic Reserve Resource Characterization

This section provides detailed information regarding the ecological zones, habitats, species and other resources found within or adjacent to the Cherry Point Aquatic Reserve. Understanding the ecological processes and functions at Cherry Point can guide decision-making regarding aquatic land management that influences the Reserve and its associated ecological relationships**.**

Background

The Georgia Basin was created about 150 million years ago when colliding continental plates created the Georgia Depression. The Puget Sound and the Strait of Georgia were created by the repeated advance and scouring of glacial ice-sheets, the most recent of which moved into the area around 15,000 to 13,000 years ago (Easterbrook 1999). This glaciation, referred to as the Fraser, flowed through the Fraser Valley and formed the Strait of Juan de Fuca. The Fraser Glaciation moved as far south as Olympia, with huge glaciers forming the hills and valleys that characterize the Georgia Basin today and depositing the Vashon Till that covers much of the region (Williams et al. 2001).

The Strait of Georgia or the Georgia Strait, is a strait between Vancouver Island (as well as its nearby Gulf Islands) and the British Columbia mainland. The Canada-US border runs through the southern part of the Strait. To the south, Georgia Strait adjoins Puget Sound (which extending to near the bottom of the map) and to the west, it adjoins Haro Strait, then the Strait of Juan de Fuca (bisected by the order). The Strait is approximately 240 kilometers (150 mi) long and varies in width from 18.5 to 55 km (11.5 to 34 mi). Cherry Point Reach lies within the Strait of Georgia – see below.[11]

[11] This image is from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) Project and more than 5 years old. Satellite data captured by the SeaWIFS sensor are released into the **public domain** 5 years after capture.

Figure 4. Strait of Georgia and Pacific Northwest- The Strait of Georgia at center, the Strait of Juan de Fuca below, Puget Sound at the lower right. Sediment from the Fraser River clearly visible.

Nearshore Environment

The nearshore environment includes estuarine and marine shoreline areas representing the interface between freshwater, air, land, and the open marine waters of Puget Sound and Georgia Strait (Fresh et al. 2004). The nearshore includes upland and backshore areas that directly influence conditions along the shoreline, extending seaward to the greatest depth of the water column that encompasses the photic zone (Fresh et al. 2004). Within this area, a complex interplay of biological, geological, and hydrological processes interact across the terrestrial-marine interface to maintain the nearshore environment (Johannessen and MacLennan 2007).

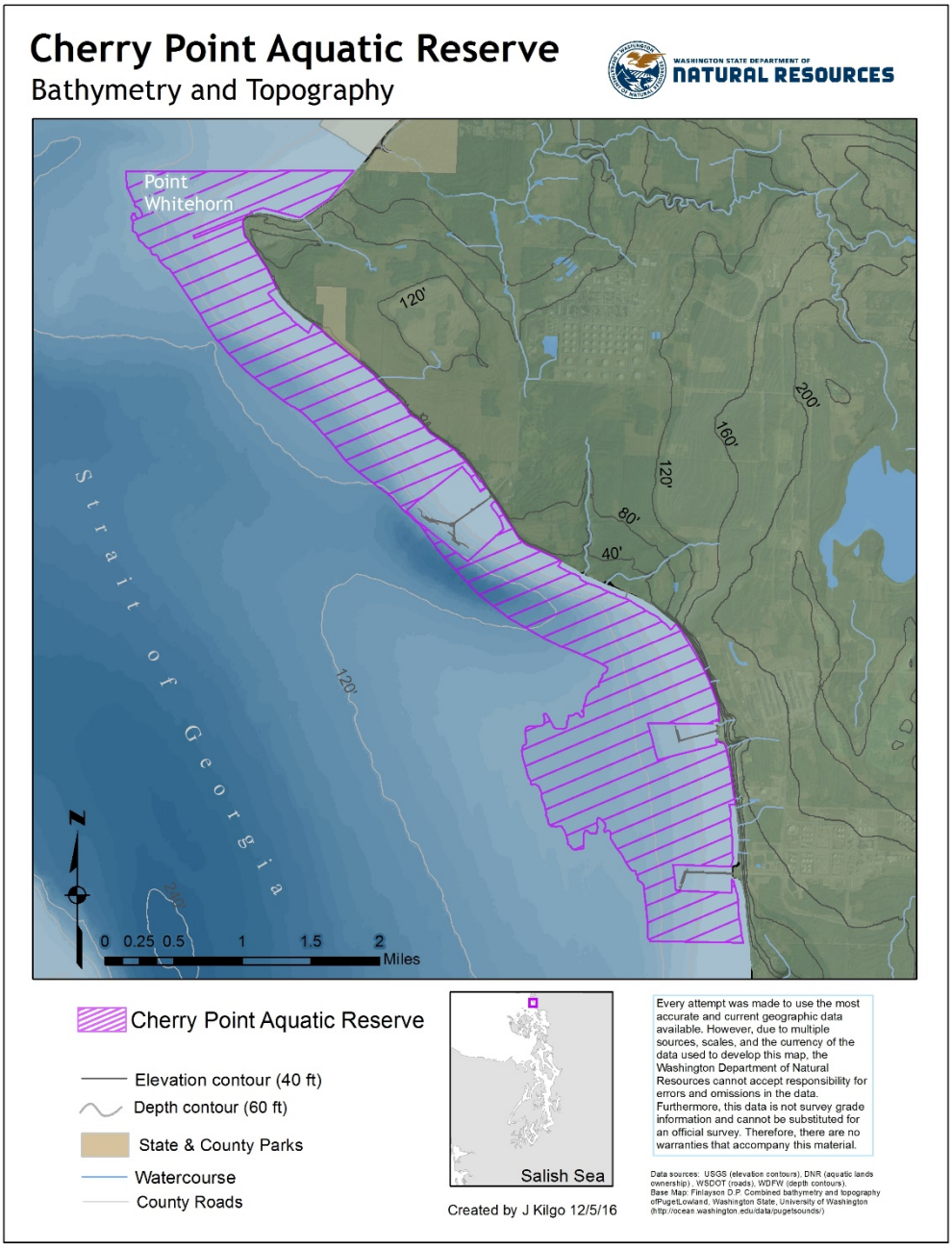
Shoreline Characteristics

Geomorphic characteristics of the Whatcom County Shoreline, including Georgia Strait, include glacial sediment, limited sea level rise, moderate tidal range and considerable wave exposure. These characteristics create geomorphic systems, based upon the availability of and sources of sediment, and the influence of waves, tide and river energy (Shipman 2008).

The character of the beach at Cherry Point is described as consisting of moderate to high feeder bluffs, with broad storm berms, which likely buffer wave erosion. The berm crest is composed of pebble and granula with minor cobble, and the upper foreshore of the beach is dominated by pebble and cobble with substantial amounts of sand in most locations. The lower foreshore/high tide beach is cobble and pebble dominant with sand and boulders. Beach material along the low tide terrace is

typically composed of finer sediment with cobble and boulder lag deposits. Active bluff erosion contributes large woody debris to the upper beach (Whatcom County Shoreline Characterization Inventory 2006). The site is also distinctive for its bathymetry with water depths reaching more than 70 feet just offshore (see Figure 5).

Figure 5. Bathymetry and Topography at Cherry Point



Bluffs and Drift in Whatcom County

Bluffs are present throughout a majority of Whatcom County waterways. Bluffs are relatively recent landforms, created as an after effect of the most recent glaciations (Fraser). A large sheet of ice advanced from British Columbia through Georgia Strait on the tail of advancing outwash composed of sands and gravels, and moved south through Puget Sound to below Olympia. It extended out beyond Cape Flattery. This is called the Vashon Advance, and is response for many of the sediment

in Puget Sound (“Vashon Till”) and beach landforms seen today. It occurred approximately 5,000 years ago (Johannessen, 2006).

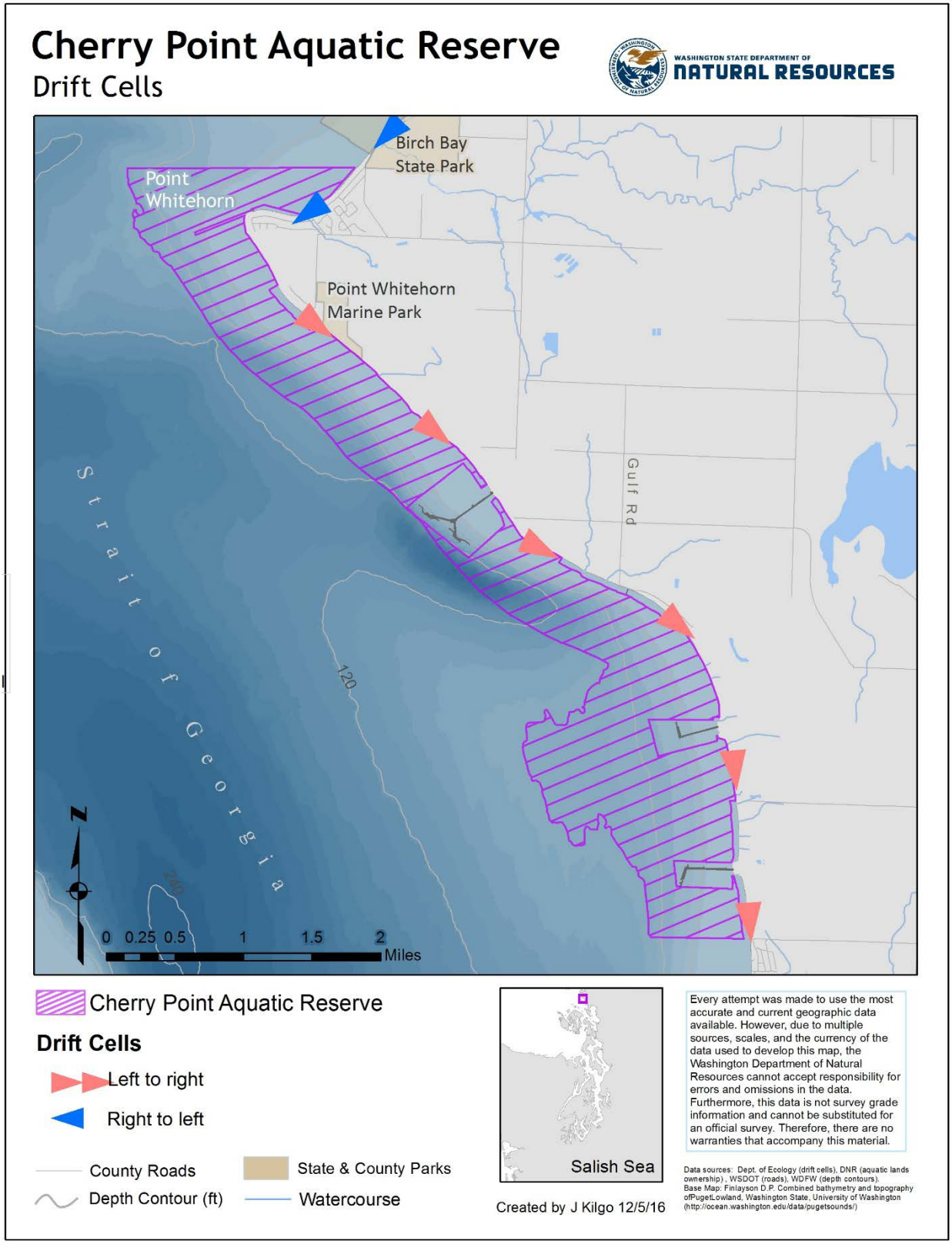
In Whatcom County, the Vashon Advance created bluffs that reach heights reach up to 200 feet. Many of these bluffs actively erode, creating beaches and large areas of accretion, composed of this glacially derived sediment. These bluffs help feed the constant river of sand and gravel that flows along beaches. Shore drift or "littoral drift" can move materials from eroding bluffs and streams to shorelines miles away. Weather and waves pick up particles in one area and drop them off in another area. The direction of shore drift is determined by the prevailing direction of the waves and currents in the drift cell. Drift cells are an important shoreline component at the Cherry Point Aquatic Reserve; there are three within Reserve or the immediate vicinity adding to the areas uniqueness, and these cells will be discussed in detail next.

Drift cells are important because they are the mechanism that supplies nearshore environments with the majority of the sediments they require. Drift cells nourish beaches, and provide fine sediments to flats, and maintain sand spits and other coastal landforms. According to the Whatcom County 2006 Shoreline Characterization and Inventory, there are three drift cells located at or in the immediate vicinity of Cherry Point: (1) Birch Bay, (2) Point Whitehorn, and (3) Cherry Point. Structures such as marinas, docks and groins can erode and damage beach habitat by blocking supplies of sand to downdrift beaches, flats and sand spits (Ecology website 2008). Figure 6 depicts the drift cells at Cherry Point.

Birch Bay Drift

Shore drift moves from Birch Point south and east towards the jetty located at Birch Bay Village Marina. A second drift cell starts east of the Marina and extends to the northeastern corner of Birch Bay (Whatcom County 2006).

Figure 6. Cherry Point Drift Cells



Point Whitehorn Drift

A drift cell originates at Point Whitehorn, drifting northeast to converge with a cell in the northeast corner of Birch Bay. Bluff erosion at Point Whitehorn is substantial and significantly contributes to the drift cell. Visible evidence of this dynamic process at Point Whitehorn includes broad sand flats, spits, and protruding shorelines. Beaches at Point Whitehorn mark the start of a large accretionary beach, which forms around Birch Bay, just to the north. Ninety-four percent of the beaches in this Reach are considered accreting beaches (compared to eroding beaches) (Whatcom County 2006).

Cherry Point Drift

A northwesterly fetch from the Strait of Georgia moves sediment south, through a narrow divergence zone located at Point Whitehorn. This cell includes the Cherry Point area and terminates at the spit at Sandy Point. According to Whatcom County's Shoreline Inventory and Characterization, which examined sediment transport along the coastline, sediment sources are abundant within this drift cell, accounting for approximately 54 percent of the Cherry Point shore reach. Feeder bluffs make up an additional 9 percent. The Cherry Point Aquatic Reserve is also characterized by recent landslides, representing over 18 percent of the shore reach. Toe erosion was identified along 38 percent of the Reserve. Human modifications that directly affected geomorphic processes were identified along 9 percent of the Cherry Point Aquatic Reserve (Whatcom County 2006).

Riparian areas are generally defined as the interface between terrestrial and aquatic ecosystems. As Brennan (2007) explains, riparian areas are part of the transition zone between aquatic and terrestrial systems. The riparian area within the Cherry Point Aquatic Reserve includes forests, meadows, streams, and a brackish wetland. The primary functions and processes within the marine riparian zones include nutrient and sediment input, maintenance of water quality, soil/slope stability, shade/temperature control, and recruitment of large woody material.

Salt Marshes

At Cherry Point, a large brackish marsh habitat complex can be found along Gulf Stream Road. Salt marsh and brackish marsh habitats thrive in areas influenced by tides, often located above mean high high water (MHHW), in locations where sediment accretion or supply is high (Whatcom County 2006; Kyte, personal communication, 2009).

Cherry Point Nearshore Zone

As earlier emphasized, the nearshore environment is a dynamic area. It also provides for a wide range of commercial, navigational, and residential activities such as marinas, ferry docks, and log storage. Due to the ecological sensitivity of the nearshore environment and its value for human activities, protecting nearshore processes and functions is a critical component of this management plan.

The intertidal zone at Cherry Point is rocky, running the length from Point Whitehorn to Sandy Point and containing a wide variety of biological habitats. The most common habitat consists of various sizes of boulders, mixed with, cobble, gravel and sand. Large boulders are prevalent north of Cherry Point, near the Alcoa-Intalco facility, and immediately south of the ConocoPhillips refinery. Boulder habitat has the function of providing substrate shelter for mobile and sessile organisms (ENSR 1992a). Moving from the intertidal towards the low-tide line, the boulders mix with and sandy patches. Many of these sand patches support eelgrass (*Zoestra marina*) and/or assemblages of marine algae (ENSR 1992a).

The sublittoral zone extends from the low-tide line out to 200 meters. The sublittoral refers to areas where sunlight reaches the ocean floor; that is, the water is not deep enough to remove the photic zone. At the Cherry Point Aquatic Reserve, the sublittoral zone is generally depositional, with fines, silt and mud prevailing. Subtidal (sublittoral) mudflats are also abundant below approximately 5 to 10 meters below mean lower water because of the depositional nature of the offshore environments within the Reach (Kyte, personal communication, 2009). Some boulders are present, covered in silt. Sediment in the upper sublittoral zone immediately below the intertidal zone are generally sandy mud (ENSR 1992a). The inner sublittoral extends out to about 160 feet, the boundary of the Cherry Point Aquatic Reserve. However, the actual seaward limit of the sublittoral will vary because it is determined by that depth at which we find no plants growing on the ocean bottom. It is determined to a major extent by the amount of solar radiation that penetrates the surface water, or the end of the photic zone. This could be influenced, in part, by turbidity (Thurman 1990) and any type of spill.

The sublittoral is considered the end of the nearshore environment, with the open ocean (marine) beyond this area. Beyond this, we find open ocean conditions, where local and regional currents, temperature, salinity and water quality become important to consider.

Oceanography

Today, the Strait of Georgia is fed by the 850-mile long Fraser River to the north, which moves large amounts of silt and fresh water long distances. This river drains over one quarter of British Columbia and has the largest salmon runs in North America (Georgia Strait Alliance 2007). The Fraser River has a profound influence on the water flow and quality within the Strait of Georgia. Over 80 percent of the freshwater entering the Strait of Georgia comes from the Fraser River; run-off is driven by glacier melt, occurring during June and July. Other rivers drain into the Strait of Georgia from Vancouver Island during periods of intense precipitation, generally around November (Waldichuck 1957). For comparison, the annual amount of freshwater entering Puget Sound is only 10-20 percent of the amount that enters the Strait of Georgia.

Freshwater

The Strait of Georgia receives freshwater input from rivers and streams, compared to Puget Sound, which receives freshwater runoff from the encircling Olympic Mountains to the west and the Cascade Mountains to the east (Whatcom County 2006). For Cherry Point, one of the major sources of nearby freshwater supports two genetically distinct salmonids – Nooksack Chinook and Nooksack Coastal Cutthroat. This sediment rich river has been heavily modified in the upper and mainstem areas, and currently drains just south of the Reserve. Salmonids migrating to the Nooksack use the Cherry Point nearshore area.

The Fraser River has been the primary source of freshwater for Cherry Point and the Strait of Georgia. The Fraser brings a high level of fine sediment to the Reserve, when combined with the Nooksack input to the south of the Reserve, and constant erosion of feeder bluffs along the shoreline, have created a habitat conducive to supporting submerged vegetation and Pacific herring (Center of Biological Diversity et al. 2004)..

The Nooksack River, located south of the Reserve and its delta has been diverted and reduced in size, due in part to levees and isolating meanders. Historically, until the 1950's, the Nooksack River discharged into the Bellingham Bay. Diversions of the Nooksack occur for irrigated agriculture, industrial uses at the Cherry Point refinery complex and the cities of Lynden and Ferndale. In all these cases flow is reduced from within the Nooksack channel (PSAT 2005).

Smaller freshwater streams discharge in or near the Cherry Point Aquatic Reserve. Terrell Creek discharges just north of Cherry Point through Birch Bay State Park, along with two unnamed freshwater creeks identified as streams "01.0100" and "01.0101". Terrell Creek is 8.7 miles in length and is mapped as a pocket estuary that provides feeding, refuge, and other regulatory functions for juvenile salmonids (Washington State Department of Parks and Recreation 2007; Whatcom County Shoreline Characterization Inventory June 2006). It supports fair to good populations of coho plus some chum utilization. The Birch Bay great blue heron colony is located north of the creek and west of Jackson Road. The Birch Bay great blue heron colony is the third largest in the region, supporting over 300 breeding pairs (U.S. Department of Energy 2004).

Stream 01.0100 is 1.25 miles long and drains 800 acres. The stream is characterized (according to WAC 222-16-030) as a Type 4 water below Henry Johnson Road (water may be intermittent) and a Type 5 above (water is intermittent) (Shapiro and Associates 1994). Field surveys suggest that few fish species use this stream. Based on previous reports the only anadromous fish likely to use the stream are cutthroat (Shapiro and Associates 1994). Based on personal observations made during annual beach walks from 1999 through 2008 that have included the mouths of these two streams in each year, Kyte reports personal observations that stream 01.0100 is ephemeral at its mouth and usually dry in the spring. Kyte concludes that it is very unlikely that this stream supports any finfish, especially anadromous species (Kyte, M. personal communication 2009).

Less is known about stream 01.0101 and its ability to support anadromous fish is unknown. Stream 01.0101 drains through the Cherry Point saltmarsh, a nine-acre Category 1 wetland that includes 3.5 acres of estuarine emergent saltmarsh that is tidally controlled. Based upon observations by Kyte during beach walks, Stream 01.0100 has always had flowing water at the mouth in the attached tidal marsh. In addition, on a number of occasions, coho salmon fry were observed at the mouth of this stream. Kyte states (personal communication via email) that coho may use this stream for spawning and initial rearing citing research by Williams et al. (1975).

Plant Species

Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV) in the marine environment is an important component of the nearshore ecosystem. SAV includes eelgrass (*Zostera marina* and *Z. japonica*) and attached macroalgae such as kelps (brown algae), red algae such as Turkish towel (*Chondracanthus exasperatus*), and green algae such as sea lettuce (*Ulva fenestrate*). SAV functions as rearing and forage habitat for many commercially important species such as juvenile salmon (*Oncorhynchus* spp.), forage fish, and Dungeness crab (*Cancer magister*) (Fairbanks 2005). Eelgrass, *Zostera marina* L., is monitored by the DNR, the Puget Sound Partnership and other resource managers to assess the health of nearshore habitat in Puget Sound. Since 2000, the Submerged Vegetation Monitoring Project (SVMP) monitored the abundance and distribution of *Z. marina* in greater Puget Sound and outlying areas using underwater videography. *Zostera marina* is considered an indicator of ecosystem health and provides valuable nearshore habitat to ecologically and economically important species.

Eelgrass, Kelp and Algae at Cherry Point

Cherry Point Aquatic Reserve is historically known for having an extremely high diversity in both algal species and biomass, which is subject to change. Eelgrass and kelp beds are found at Cherry

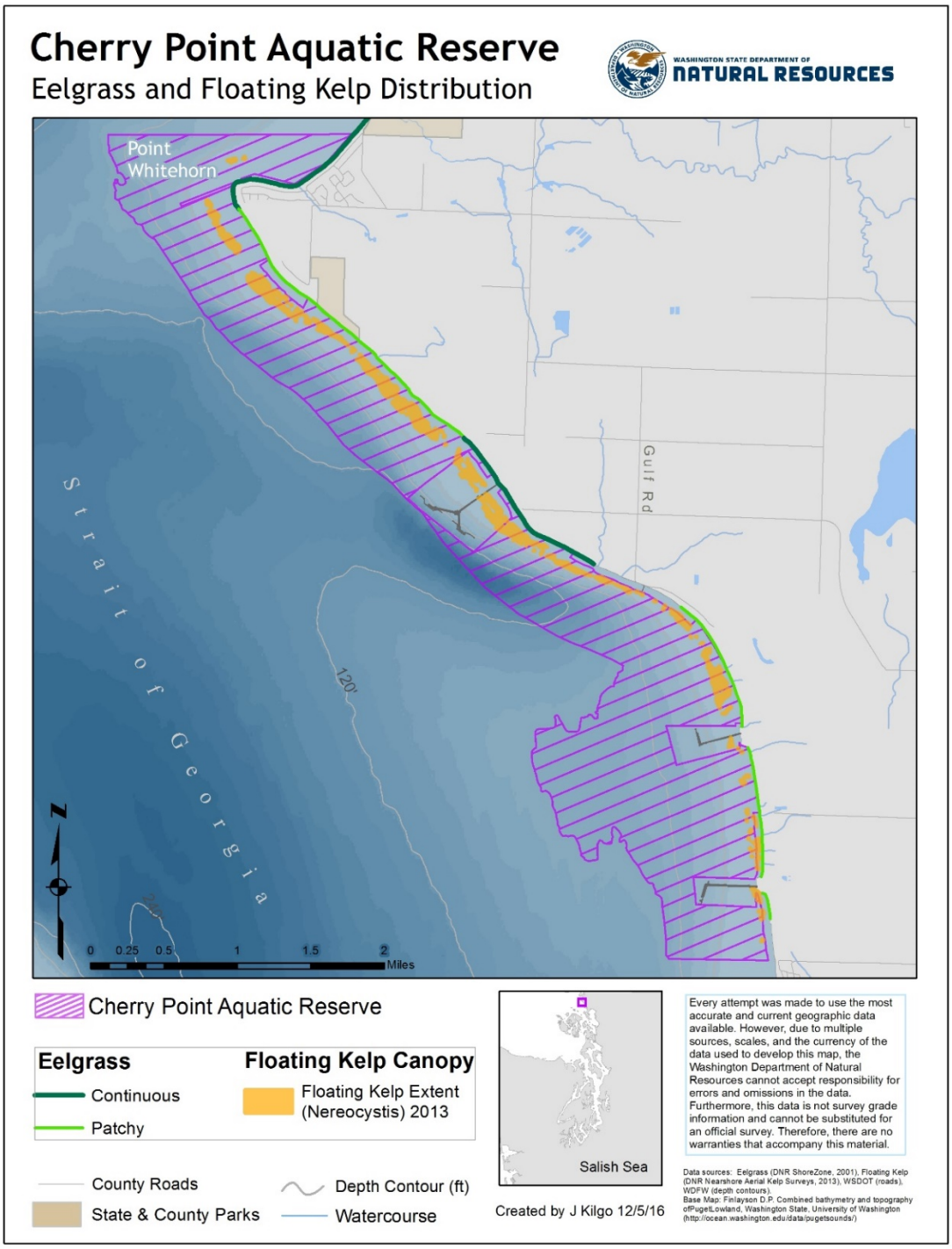
Point, the functions of which include providing food, habitat and shelter for a variety of organisms including salmonids, forage fish, phytoplankton, zooplankton and macroinvertebrates. In addition to being an important component of nearshore primary production rates (Nybakken 2001), kelp beds are critical habitat for a number of organisms including grazers such as snails and sea urchins, filter feeders like barnacles and mollusks, scavengers (i.e. crabs), predators such as rockfish and starfish, and a variety of smaller algae. Out-migrating smolts spend considerable time in nearshore eelgrass and kelp beds feeding and adapting to marine conditions as they mature. As a result, impacts to submerged aquatic vegetation and the communities they support also threaten rearing salmonids. These vegetated communities are an important part of the terrestrial food web and help support a variety of bird and mammal species.

Eelgrass beds of both native and and non-native species (*Zostera marina* and *Z. japonica*) are found along the sand bars in southern Birch Bay and are then interspersed with a diverse algal community from Point Whitehorn to Neptune Beach. These beds provide habitat for forage fish such as herring, and protecting shorelines from wave and current-drive driven erosion. Root systems help to anchor sediments in any shallow subtidal environments during low tides.

Bladed kelps such as *Laminaria saccarhina* and *Costaria costata*, large filamentous brown algae such as a few *Desmarestia spp.*, and a variety of red foliose and filamentous algae dominate the algae community. Mixed eelgrass and *Sargassum* extend along most (94 percent) of the Reserve with sparse kelp (*Nereocystis*) beds beginning to appear near Point Whitehorn. *Sargassum* is a non-native subtidal large brown algae that herring often spawn upon (Pentilla 2001). *Sargassum*'s distribution in most areas outside the Cherry Point Reach is within the lower intertidal to subtidal zone.

However, it is notable that along the Cherry Point shoreline and in Birch Bay, the distribution of *Sargassum* is restricted primarily to the intertidal zone. Eelgrass beds in the Reserve support herring and surf smelt (*Hypomesus pretiosus*) spawning along the beach to the west of Terrell Creek mouth, and provide habitat for Pacific sand lance (*Ammodytes hexapterus*).

Figure 7. Submerged aquatic vegetation at Cherry Point



Submerged Vegetation Monitoring Points (SVMP)

DNR has two sets of data on submerged aquatic vegetation within the Cherry Point Reserve. The data is presented here is not for comparison, as the collection methods were different but simply for informational purposes. Management actions) specify future inventories are needed.

In 1995, the DNR Nearshore Habitat Program surveyed Cherry Point and the following results were

documented:

Table 2.0 DNR Nearshore Survey from 1995

DNR 1995 survey (sq ft of vegetation)		
Brown algae	356,245.2	3.7%
Eelgrass	419,888.1	4.3%
Green algae	209,110.4	2.1%
Kelp	7,719,611.6	79.3%
mixed algae	1,033,752.3	10.6%
Total:	9,738,607.6	100%

Table 3.0 Whatcom County (Fairbanks Environmental Services, 2005) Nearshore Survey from 2004: (see data from Table 4.0):

	Low Density (sq ft)	**High Density (sq ft)**	**Low Density (sq meters)**	**High Density (sq meters)**
Turf Algae	1,894,772.2	1,615,010.8	176,024.3	150,034.5
Canopy Algae	3,142,068.7	1,271,794.0	291,898.2	118,149.7
Bull kelp	2,329,223.2	0.0	216,384.8	0.0
Sargassum	2,089,646.6	0.0	194,128.2	0.0
Eelgrass	2,736,898.9	102,639.6	254,257.9	9,535.2

Table 4.0 Whatcom County Area SAV coverage observed at Cherry Point in August, 2004

Whatcom County (sq. feet of vegetation)		
Sargassum	2,089,646.6	13.8%
Eelgrass	2,839,538.4	18.7%
Bull kelp + canopy algae	6,743,085.9	44.4%
turf algae	3,509,783.1	23.1%
	15,182,054.0	100%

Animal Species
Salmonids
Juvenile salmon rear for a few weeks to several years in freshwater before heading to the estuary, where they may feed and adjust to saltwater (a process called smoltification) for a period of only days to as much as a year before continuing on to the ocean. In estuaries and freshwater, complex, meandering channels provide a network of riffles, pools and side channels for shelter and rearing. Juveniles are dependent upon native riparian vegetation for shading and cooler water temperatures, as well as a source of food from terrestrial insects, and shelter under/in large woody debris. Juvenile salmon experience the highest growth rates of their lives while in these highly productive estuaries and nearshore waters. Stable flows and high dissolved oxygen content (≥ 7.0 milligrams per Liter or mg/L) are also critical for the survival of both returning adults and rearing juveniles.

A large number of salmon and migratory trout species have been historically or currently located along or adjacent to the Reserve, and the area has been designated as habitat for listed species, including Chinook, Nooksack Coastal Cutthroat and bull trout (native char). Out-migrating smolts feed and adapt to marine conditions as they mature in Cherry Point eelgrass and kelp beds and around piers in the spring and summer before leaving the area in the fall (ENSR 1992a). As a result, impacts to submerged aquatic vegetation and the communities they support also threaten rearing salmonids.

Cherry Point and the adjacent areas historically supported a flourishing salmon canning industry. Threats to vegetative communities within Cherry Point from shading, shoreline armoring, increased nutrients loads, and damage from anchors and buoys have combined with natural and anthropogenic stressors outside of Cherry Point to decrease shelter and food supplies for smolts, juveniles, and migrating adults.

Miller, B.S. et al (1977) found large numbers of pink salmon (*Onchorynchus gorbuscha*), chum (*O. keta*), coho (*O. kisutch*), and Chinook (*O. tshawytscha*) in cobble habitat located along the Cherry Point shoreline and in the protected eelgrass beds of Birch Bay. Juvenile sockeye salmon (*O. nerka*) were also found in Birch Bay, but were generally less abundant than other species (Berger/Abam, 2000). Adult Chinook, pink, coho, and chum salmon migrating to the Fraser and Nooksack rivers, Terrell Creek, and natal streams in Drayton Harbor can be expected to transit and feed along the Cherry Point shoreline (Berger/Adam 2000). Terrell Creek provides feeding, refuge, and osmoregulatory functions for juvenile salmonids (Whatcom County Shoreline Inventory 2006). Adults of all these salmon species migrate though the Cherry Point Aquatic Reserve and are harvested for ceremonial, subsistence, and commercial purposes. River biologists in British Columbia state that the area is used by char and cutthroat tagged in British Columbia (Ptlomey, R. personal communication).

The Whatcom County WRIA 1 Salmon Recovery Plan lists Puget Sound bull trout species as "current presumed" and "presumed potential/historic" in waterbodies draining directly to Cherry Point (2007). In freshwater, Washington bull trout forage on salmonid eggs, fry and smolts, whitefish, and sculpin (USFWS 2004). In marine habitat along Cherry Point, native char are often found throughout the nearshore and estuarine habitat, seeking out surf smelt and other schooling fish, such as herring. Native char migrations and life history strategies are closely related to their feeding and foraging strategies. (Michal, H., personal communication, 2009; USFWS 2004). The Cherry Point Aquatic Reserve falls within designated critical habitat for coastal forms of native char

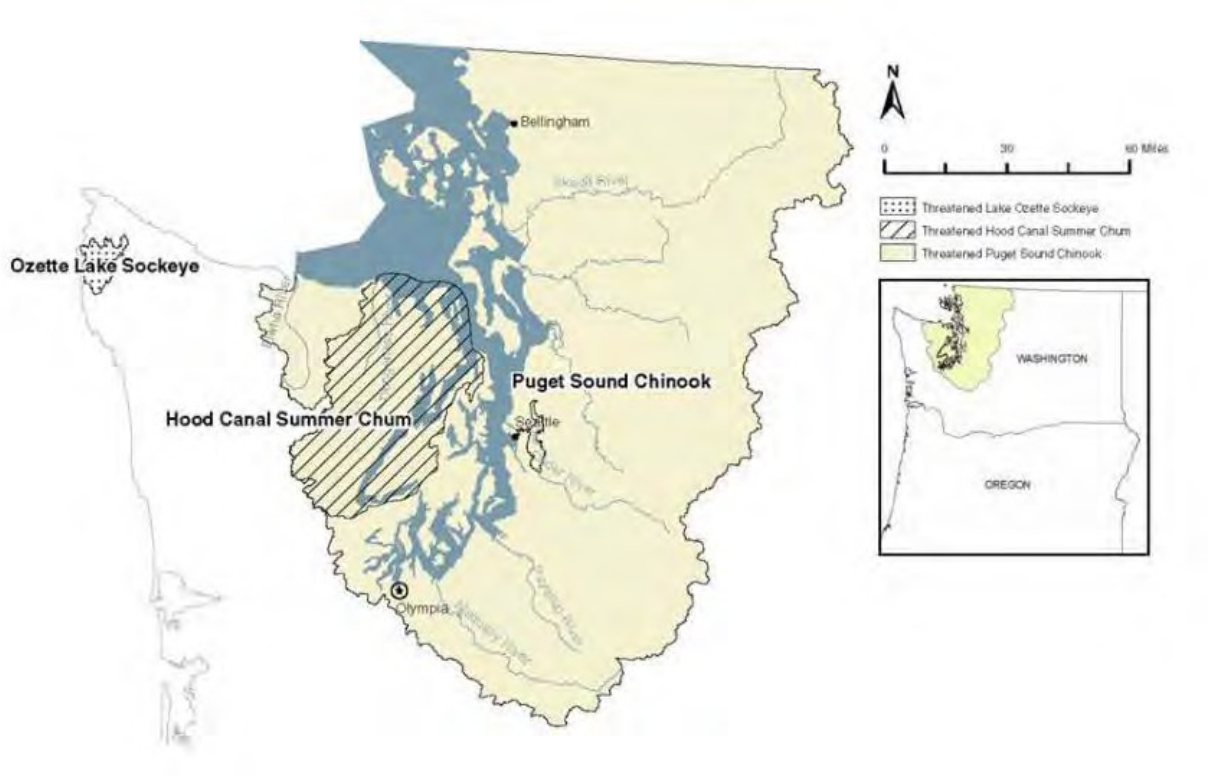
(*Salvelinus confluentus*).

In 1999, Coastal-Puget Sound bull trout populations were listed as threatened by the USFWS and critical habitat was designated in 2005 (September 26) for the lower 48 states. Coastal-Puget Sound bull trout are anadromous forms of the Washington bull trout, overlapping in habitat use with the sea- run Dolly Varden. The 2004 Recovery Plan designates the Nooksack marine habitat area located directly adjacent to Cherry Point Aquatic Reserve as an important core area. Without recovery of the herring population and associated habitat, the food base will remain at risk for the anadromous bull trout in the Northern Puget Sound Region. The maintenance of a healthy estuary and nearshore ecosystem is seen as key to maintaining fluvial and anadromous populations of Coastal-Puget Sound Bull Trout (Michal, H. personal communication, 2009; USFWS 2004). In addition to the protections Coastal-Puget Sound bull trout received under the federal ESA as a threatened species, it is listed as a state candidate species by Washington Department of Fish and Wildlife.

The Puget Sound Evolutionary Significant Unit (ESU) for Chinook salmon includes the Cherry Point site and major waterbodies (see Figure 4). The Puget Sound Chinook ESU was listed as a federally threatened species in March of 1999 and includes runs from the North Fork Nooksack River in northeast Puget Sound to the southern Puget Sound watersheds, Hood Canal and the Strait of Juan de Fuca. Puget Sound Chinook are currently estimated to be at only ten percent of historic numbers.
Over 2,300 miles of nearshore habitat in Puget Sound, including the Cherry Point Aquatic Reserve, has been designated critical habitat for Puget Sound Chinook under the ESA (70 CFR 52630, September 9, 2005.) Chinook salmon in the Nooksack River basin are distinctive from Chinook salmon in the rest of Puget Sound in their genetic attributes, life history, and habitat characteristics, indicating support for the geographical evidence of independence of these fish. Although some Chinook salmon from the Nooksack River basin may sometimes stray into other Puget Sound rivers (based on releases from Kendall Creek Hatchery), the low numbers probably have not had a significant effect on the population dynamics of other populations (Ruckelshaus et al. 2006), and this population remains distinct.

The Puget Sound Technical Recovery Team (TRT) identified two existing independent populations in the Nooksack River basin: (1) North Fork Nooksack River (including Middle Fork Nooksack River) and the (2) South Fork Nooksack River. The TRT found that the South Fork Nooksack stock was one of two populations most at risk, when asked to identify recovery priorities (the other was Cedar River) (Puget Sound TRT, 2006). The Nooksack salmon populations are the only two populations in the Strait of Georgia region of Puget Sound, and they are two of only six Chinook runs remaining in Puget Sound that return to their rivers in the spring (as opposed to fall spawning). For these reasons, the Nooksack populations are considered by the TRT to be essential to recovery of the ESU. Identification of priority estuarine and nearshore areas for protection and restoration is one of seven key recovery strategies towards recovery of the Nooksack salmon. For further information, please see *Independent populations of Chinook salmon in Puget Sound.* NOAA Tech. Memo. NMFS- NWFSC-78, developed by Ruckelsaus, et al. July 2006.

Figure 8. Puget Sound ESA Salmon Recovery Domain, showing Chinook ESU (NOAA, Northwest Regional Office, Accessed June 2009).

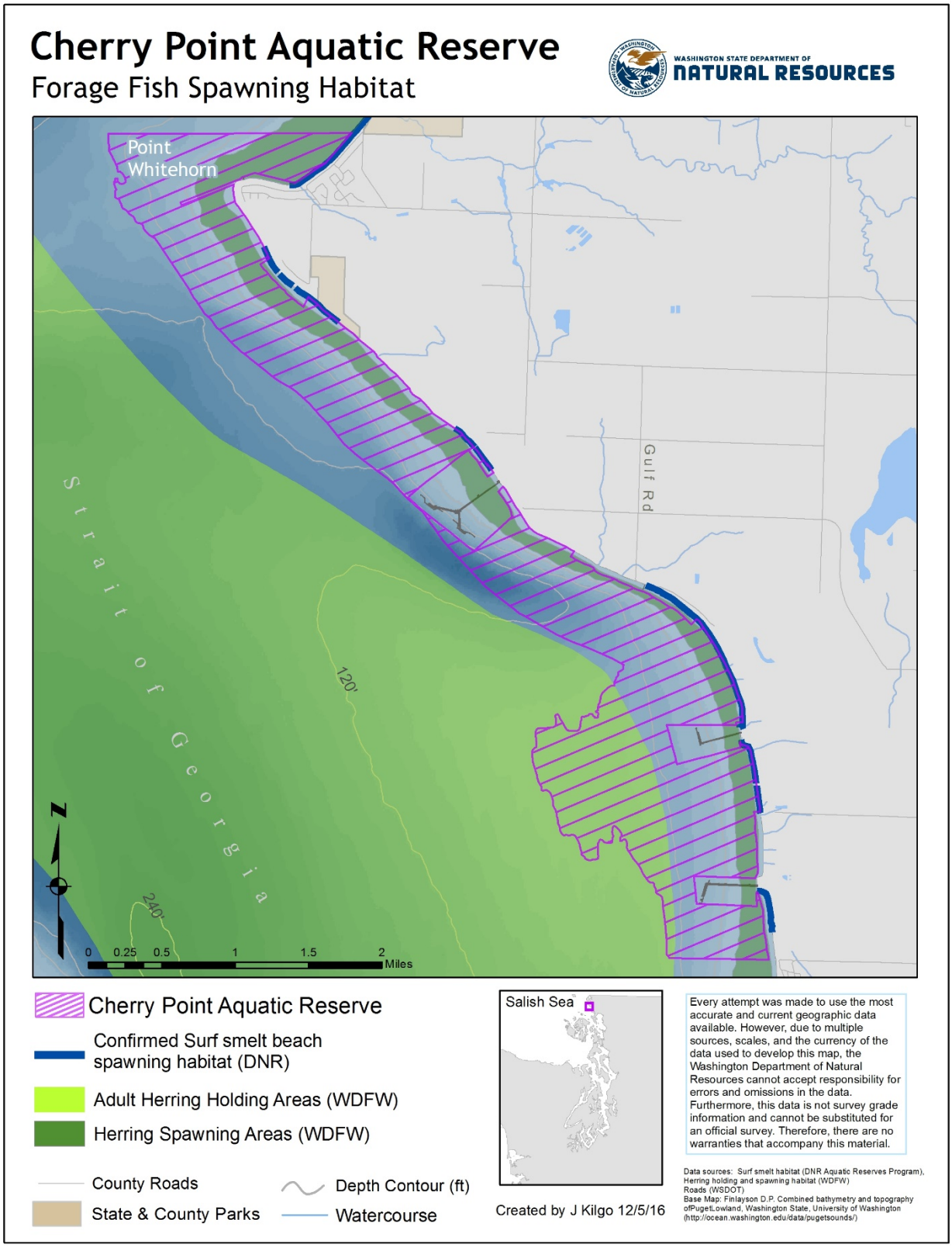


In Puget Sound the majority of steelhead populations are winter-run, meaning adults normally return to freshwater from November to December, and the peak of spawning occurs between March and May of the following year. Puget Sound Steelhead were listed as threatened by NOAA Fisheries in 2007; federal critical habitat has not been designated at the time of this document or Puget Sound Steelhead (Whatcom County 2003; NOAA 2007).

Forage Fish

Forage fish are an important and abundant fish species in Washington. The more common fish species identified as forage fish within Washington include Pacific herring (*Clupea pallasii*), surf smelt (*Hypomesus pretiosus*), Pacific sand lance (*Ammodytes hexapterus*), and northern anchovy (*Engraulis mordax*). All four species are known to use the Reserve. Pacific Herring and surf smelt are known to spawn on the intertidal beaches at Cherry Point (see Figure 9).

Figure 9. Forage fish spawning and holding areas.



Pacific Herring (*Clupea pallasii*)

Pacific herring (*Clupea pallasii*) are widely distributed around the Pacific Rim, with a range that includes northern Baja California to the Bering Sea, north into the seas of the Arctic Ocean and west

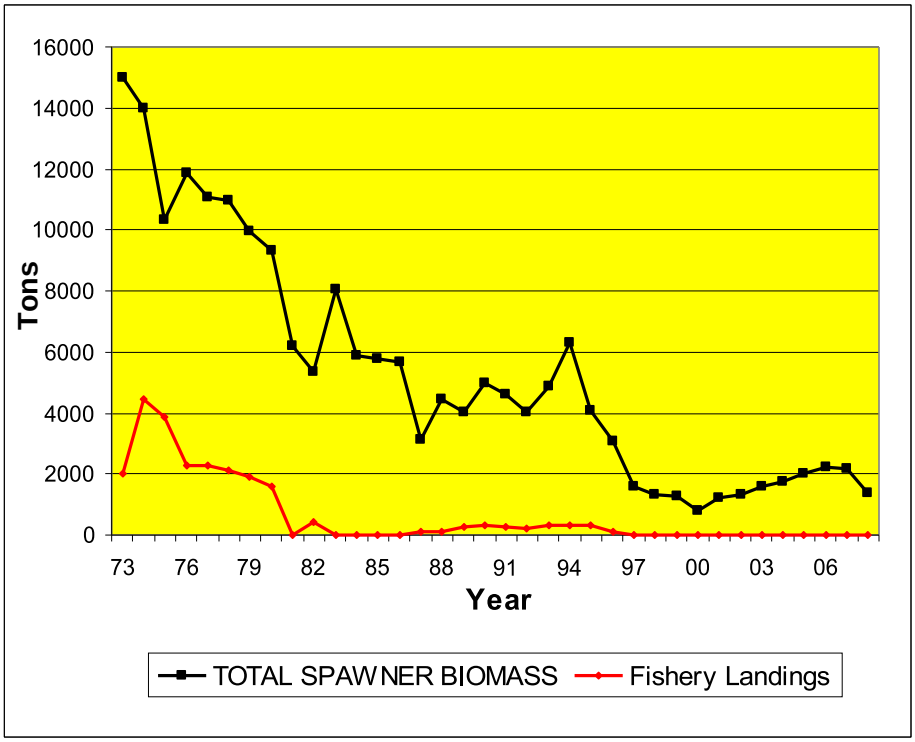
to Japan, Korea, and the Yellow Sea. Major concentrations of herring are found off the coast of British Columbia, the Bering Sea, and the Yellow Sea (Mitchell 2006).

Adult herring stocks are often classified based upon their migratory behavior: migratory populations that move between oceanic feeding grounds in the summer and inshore spawning grounds in the winter, and resident populations that remain in coastal bays and inlets year-round. Cherry Point and Discovery Bay are also believed to be migratory stocks (Stout et al. 2001; Stick et al. 2005), and recent genetic studies have suggested that the Cherry Point herring stock is genetically distinct from other Washington and British Columbia stocks (Beacham et al. 2002; Small et al. 2005; Mitchell 2006).

Pacific herring use the nearshore environment extensively and are often considered an "indicator" species of the overall functioning of a nearshore ecosystem. Pacific herring, including Cherry Point Pacific herring, are centrally located in the food web, acting as a prey species for salmon, marine mammals and birds, and as predators for copepods and larval fish. In its juvenile and adult form, Pacific herring is an important prey for Pacific salmon, Pacific cod, Pacific hake, walleye pollock, lingcod, spiny dogfish, Pacific halibut, rockfishes, common murres, tufted puffins, marbled murrelets, cormorants, gulls, harbor porpoise, California sea lions, harbor seals, and others (West 1997), while spawned eggs and larvae provide a prey base for birds, invertebrates, and fish. Herring are also a commercially valuable species for Washington (Piening et al. 2001). Commonly grouped together with surf smelt and sand lance under the generic terms "forage fish", herring do not utilize beach substrates to deposit their eggs. Instead, they deposit transparent adhesive eggs on intertidal and shallow subtidal sea-grasses and marine algae (Sikes et al. 2002).

In Washington State, Pacific herring consist of 21 isolated spawning stocks that are thought to return to the same area to spawn each year: 2 coastal stocks at Willapa Bay and Grays Harbor, 2 stocks in the Strait of Juan de Fuca, 6 stocks in the southern Strait of Georgia, and 11 stocks in the South and Central Puget Sound (Stick 2005; Mitchell 2006). Herring spawning grounds are very specific in location and the peak of spawning generally does not vary more than 7 days from year-to-year. Within Puget Sound, some herring stocks are highly variable in number from year to year and between locations (WDFW 1998). The Cherry Point herring stock is one that has experienced a drastic decline in abundance while other Washington stocks have maintained or increased abundance. Since the 1970s, the size of the Cherry Point stock has shrunk from a high of approximately 15,000 tons to a low of about 800 tons in the 2000 spawning season to an estimated 2,100 tons for 2007, followed by a decrease to 1,352 tons in 2008 (Figure 10; WDFW unpublished data, 2008).

Figure 10. Cherry Point herring stock spawning biomass and fishery landings (short tons), 1973-2008 (WDFW unpublished data).



Herring require both spawning grounds and a pre-spawning holding area. The purpose of the pre- spawner holding area is for adults to congregate approximately 3- to 4-weeks prior to spawning. Generally this area is located near the spawning habitat. After this time, the adults migrate towards suitable spawning habitat, called spawning ground. For herring, suitable spawning ground for depositing eggs is located primarily on lower intertidal and shallow subtidal areas containing eelgrass and marine algae. In Washington most spawning activity takes place between 0 and -10 feet MLLW (0.0 to 3 meters) in tidal elevation (Stick 2005).

Cherry Point herring spawn from early April to mid-June, with peak spawning activity the first or second weeks of May. Spawn deposition can occur between +3.0 feet tidal elevation to the lower limit of macroalgal growth in this area, around -20 feet, with most occurring between 0 and -10 feet MLLW. Preferred spawning substrate includes eelgrass and more than 25 species of rock-dwelling marine algae (WDFW 2007). Within the boundaries of the Reserve, herring spawn has been found most frequently found on native eelgrass (*Zostera marina)*, as well as *Desmerestia sp., Botryoglossum sp., Laminaria saccarhina, Odonthalia sp., Ulva fenestrata, Nereocystis leutkeana,* and *Sargassum muticum* (WDFW, unpublished data, 2008).

Spawning is followed by a ten to fourteen day incubation period, and then emergence, after which larvae drift on prevailing nearshore currents for 2 to 3 months, followed by metamorphosis into juveniles. Following metamorphosis, herring are thought to spend their first year in Puget Sound. Some stocks of Puget Sound herring spend their entire

lives within Puget Sound while other stocks summer in the coastal areas of Washington and southern British Columbia (Trumble 1983). Little is known about herring movements until they appear as 2 or 3 year olds in pre-spawner holding areas prior to spawning. For current spawning areas compared to escapement data collected between 1973 and 1980, please see Figures 17 and 18 below

Genetics of Cherry Point Herring

Cherry Point herring are distinct in their spawning time. Other Pacific herring stocks in Washington spawn between early January and early April with each stock generally spawning for approximately a two-month period during this time period (Stick 2005). Most spawning in Puget Sound peaks in late February or early March. In contrast, Cherry Point herring spawn between early April and June, peaking in mid-May (Figure 12). Historically, the Cherry Point stock have spawned from the Canadian border to Hale Passage, when the abundance of the stock was much larger and spawning was laterally spread out north and south of the core Cherry Point spawning area (Stout et al, 2001; Meyer and Adair, 1978). See Figures 17 and 18.

Unlike other Pacific herring populations in Washington State, the Cherry Point herring spawn in open, high energy shoreline areas (O'Toole e al. 2000). The question of genetic divergence of Cherry Point herring from other Pacific herring stocks has been addressed in research. Work by Beacham et al. (2002), Small et al. (2005) and Mitchell (2006) have concluded that Cherry Point herring are genetically divergent and isolated from all other sampled Washington and B.C. herring stocks. Relatively unique (late) spawning timing is thought to be the primary cause of the observed genetic divergence of the Cherry Point herring stock. Work by Dinnel et al. (2008) has produced a small dataset providing a preliminary indication that the Cherry Point herring may have evolved a tolerance for warmer water than other regional herring due to their late spawning time. If so, these genes would be important to regional herring in general as our climate warms.

The recent genetic studies previously mentioned indicate the genetic uniqueness of the Cherry Point herring stock, and support the continued management of this stock as a discrete management unit.

Figure 11. Documented spawning grounds and pre-spawner holding area for Cherry Point herring stock.

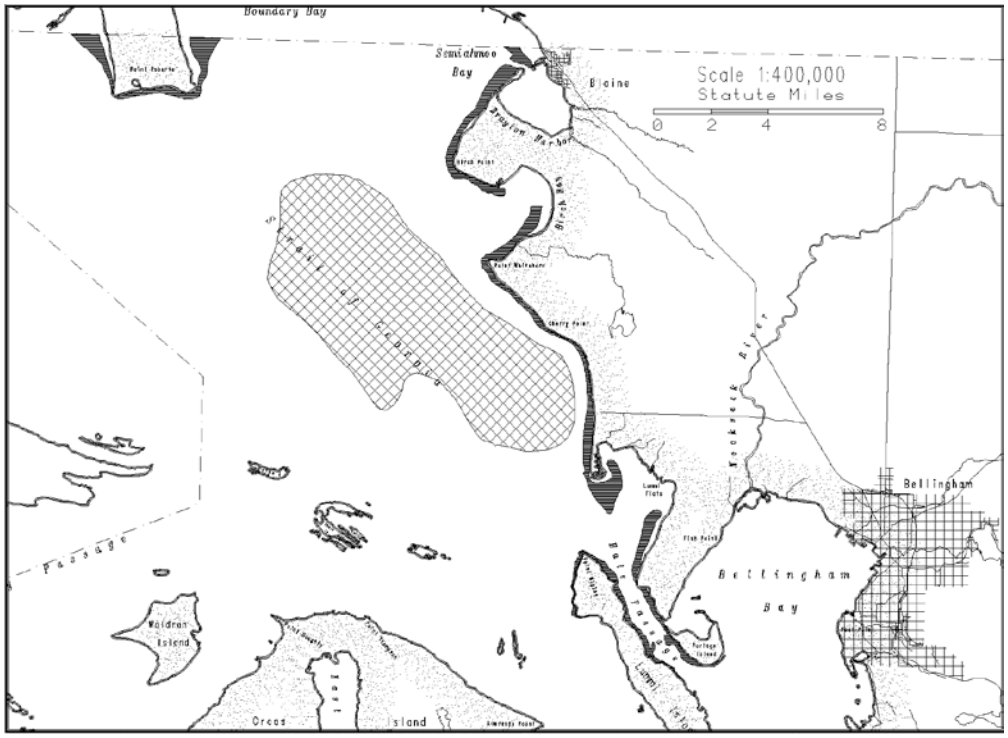
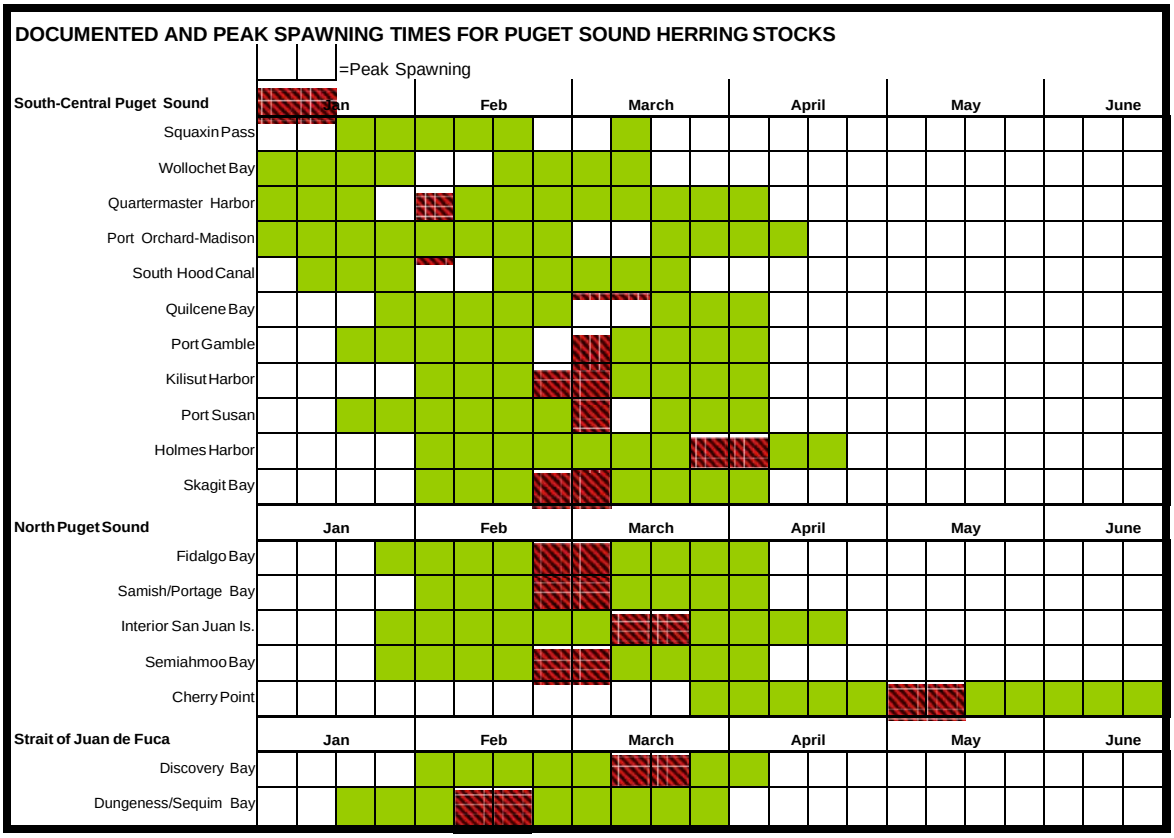


Figure 12. Documented (green) and peak (red) spawning times for herring stocks (WDFW unpublished data).



In 2005, NOAA Fisheries Service completed an updated Endangered Species Act (ESA) status review of Pacific herring, initiated in response to a petition received on May 14, 2004, to list the Cherry Point stock of Pacific herring as a threatened or endangered species. NOAA Fisheries Service determined that the Cherry Point herring stock does not qualify as a "species" for consideration under the ESA. NOAA concluded that the Cherry Point stock is part of the previously defined Georgia Basin distinct population segment (DPS) composed of inshore Pacific herring stocks from Puget Sound (Washington) and the Strait of Georgia (Washington and British Columbia). The Georgia Basin DPS of Pacific herring is not in danger of extinction or likely to become endangered in the foreseeable future throughout all or a significant portion of its range, and therefore does not warrant ESA listing at this time (NOAA 2005).

Surf Smelt (*Hypomesus pretiosus*)

Surf smelt spawning occurs in Whatcom County primarily in the summer months (Point Roberts, Cherry Point, Birch Bay, Bellingham Bay). Surf smelt spawn in the upper intertidal zones of mixed sand and gravel beaches, generally within a few feet of the high tide line. Adhesive and semitransparent eggs are deposited on beaches with this preferred mix of sand and pea gravel, and can occur in areas where there are seeps or shade, which increases the egg survival time in the summer (Wildermuth, D. personal communication, 2008).

The Whatcom County shoreline characterization inventory (2006) found that surf smelt spawning areas are located in the higher intertidal beaches along the west shore of Point Roberts, Semiahmoo Spit to Birch Point and extending east to the northwest corner of Birch Bay. Additional areas include small stretches of shore between the mouth of Terrell Creek and Point Whitehorn, near Cherry Point,

north of Neptune Beach, along the eastern shore of the Lummi Peninsula, along the shoreline near Little Squalicum Creek, north of Padden Creek, and along the beach at Post Point. Shorelines along the Reserve have been documented as surf smelt spawning areas with the area from Gulf Road south to Neptune beach as being the largest contiguous stretch of spawning habitat (Figure 12). Smaller spawning areas have been documented just to the north of the northern BP Pier and just to the south of Birch Bay State Park.

Pacific Sand Lance (*Ammodytes hexapterus*)

Pacific sand lance occur throughout the coastal northern Pacific Ocean from the Sea of Japan to southern California and across Arctic Canada. Populations are widespread within Puget Sound, the Strait of Juan de Fuca and the coastal estuaries of Washington, commonly noted in more localized areas, such as the eastern Strait and Admiralty Inlet. The sand lance is abundant throughout British Columbia and Puget Sound in a variety of habitats (Hart 1973), including the upper intertidal zone along the Cherry Point Aquatic Reserve. In Whatcom County, sand lances are documented to spawn in Bellingham Bay, Gooseberry Point (Hale Passage), around Blaine, and on the eastern shore of Point Roberts, but not within the Planning Area.

Like all forage fish, sand lance are a significant component in the diet of many economically important species in Washington. On average, 35 percent of juvenile salmon diets are comprised of sand lance. Sand lance is particularly important to juvenile Chinook, where 60 percent of their diets are sand lance. Other economically important species, such as Pacific cod (*Gadus macrocephalus)*, Pacific hake (*Merluccius productus*) and dogfish (*Squalus acanthias*) feed heavily on juvenile and adult sand lance (WDFW 2008).

Northern Anchovy (*Engraulis mordax*)

The northern anchovy has resident populations throughout the Puget Sound basin, generally secondary in abundance to those of co-occuring herring. This species releases its distinctly oval eggs directly into the plankton, where they hatch within three days. The anchovy spawning season in Puget Sound is May-September. Anchovy eggs have been found in plankton samples from throughout western Whatcom County, from Semiahmoo Bay to Bellingham Bay, including the Cherry Point area (Stick, personal communication, 2008).

Groundfish

Several groundfish species occur in Whatcom County. Groundfish live mainly on or near the bottom of the water column for most of their adult lives. Key groups of groundfish are: flatfish such as sole and flounder, skate, dogfish and surf perch; pelagic species, such as polluck, whiting and cod, and reef-dwellers including rockfish, lingcod, greenlings and cabezon. During the juvenile phase of their life histories, rockfishes associate with floating kelps, and several species of flatfishes use eelgrass beds for feeding, refuge from predators, and nursery (Mumford 2007). Groundfish contain many links in the food web, connecting nearshore and midwater components to the benthos (PSAT, 2007). They are also economically important. All types are found within Whatcom County, including flounder, sole, lingcod, various rockfish species, cod, hake and pollock.

At Cherry Point, WDFW found that flatfish dominated the catch at a site with Dover (*Solea sole*a), English sole (*Parophrys vetulus*), rock soles (*Lepidopsetta bilineata*), starry flounder (*Platychythyus stellatus*), and Pacific and speckled sanddabs (Palsson, personal communication). This is consistent

with the results of earlier trawls by Kyte (1990), who also found that the majority (more than 90%) of flatfish taken in samples were juveniles less than 100 mm in length.

Occasionally, adult butter sole (*Isopsetta isolepsis*) have been seen along the diving transects or caught in the trawls (Hanson and Van Gaalen 1993). Lingcod (*Ophiodon elongatus*) adults are found in rocky habitats in Bellingham Bay, around the reef at Point Roberts and on Alden Bank, and along the shorelines of Birch Head, Cherry Point, and Lummi Island (Whatcom County MRC 2009).

Table 5. State of Our Bottomfish Report – Funded by the Northwest Straits Initiative

Species	Georgia Strait/ San	North Sound
Pacific Cod	**Depressed**	**Below Average**
Pollock	**Above Average**	**Above Average**
Whiting (Hake)	**Average**	**Unknown**
English Sole	**Above Average**	**Above Average**
Dover Sole	**Critical**	**Depressed**
Starry Flounder	**Above Average**	**Above Average**
Lingcod	**Above Average**	**Below Average**
Rockfish	**Unknown**	**Depressed**

Rockfishes and other groundfish are managed for non-tribal users following the 1998 Puget Sound Groundfish Management Plan and are co-managed with the Treaty Tribes of Washington. (Palsson et al. 2009). The present management plan by the Washington Department of Fish and Wildlife implements a precautionary policy for groundfish management. However, previous management efforts have ranged from targeting recreational and commercial fisheries on rockfish to passive management. As rockfish stocks declined during the past three decades, the Department has progressively restricted the harvest opportunities for rockfish by eliminating targeted commercial fisheries, reducing recreational bag limits, and discouraging or eliminating recreational fisheries targeting rockfish in Puget Sound.

Most adult rockfish are associated with high-relief, rocky habitats, but larval and juvenile stages of some rockfishes make use of open water and nearshore habitats as they grow. Nearshore vegetated habitats are particularly important for common species of rockfish and serve as nursery areas for juveniles and later provide connecting pathways for movement to adult habitats. Rockfishes are prey for a variety of predators including lingcod and other marine fishes, marine mammals, and

marine birds. Rockfishes are very susceptible to barotrauma or being captured and brought to the surface from depth.

Invertebrates

Various Benthic Invertebrates, Bivalves[12] and Malacostracans[13] of Cherry Point

Benthic invertebrate assemblages along the Cherry Point Aquatic Reserve are determined by substrate type. In the uppermost, loose, sand-gravel berms, near the mean high water level, amphipod species are found often inhabiting drift vegetation. Cobble and boulder beds of the intertidal area along Cherry Point provide habitat for species such as barnacles (*Balanus glandula, Chthamalus dalli*), snails (*Nucella lamellosa*, *Littorina scutulata*), chitons (*Mopalia muscosa*), limpets (*Collisella strigatella*), mussels (*Mytilus edulis*), and seastars (*Leptasterias hexactis*, *Pisaster ocbraceus*, *Evasterias trocheli*). Red rock crab (*Cancer productus*) are also present on the surface of cobbles.
Under and between cobble and boulders are found small shore crabs (*Hemigrapsus* spp.), polychaete worms (*Nereis* spp., *Neanthes* spp.,) and shrimp (families *Crangonidae* and *Hippolytidae*) (EVS 1999; Whatcom County 2006).

Invertebrates living in the sediment of the mixed cobble and sandy eelgrass habitats are dominated by annelid worms (capitellid polychaetes and oligochaetes), burrowing anemones (*Anthopleura artemisia*), amphipods, variety of bivalves, including cockles (*Clinocardium nuttallii*), native littleneck clams (*Protothaca staminea*), and butter clams (*Saxidomus giganteus*) (EVS 1999; Whatcom County 2006).

Seastars (*Pisaster brevispius, E. trocheli*), red rock crabs, small shrimp and a wide variety of infauna such as polychaetes and bivalves dominate the subtidal habitat, which contains kelp beds and gravelly substrate. Softer mud subtidal habitat includes the sea pen (*Ptilosarcus guerneyi*), nudibranchs, Dungeness crabs (*Cancer magister*), tanner crabs (*Chinocetes* spp.), sea cucumber (*Eupentacta pseudoquinquesemita*), and small crangonid shrimp. Geoduck clams (*Panope abrupta*) have been identified in the area (EVS 1999).

Dungeness crabs are present throughout the state's waters but in Puget Sound are most abundant in the northern portions. Adults are found primarily in the subtidal zone in soft sediments, but the juveniles rely heavily on intertidal habitats with structural complexity, such as eelgrass beds (Dethier 2006). Their larvae spend long periods (months) in the water column before returning to the nearshore zone to settle. Dungeness crabs are an important predator and prey organism at all life history stages. They have pelagic larvae which are preyed on by many fishes, including copper rockfish, coho, Chinook salmon, halibut, dogfish, hake, and lingcod. Being planktivorous, the larvae may be exposed to pollutants that are present in the water column and plankton. Once they molt into the juvenile stage, they live on the bottom, feeding in the benthic food web. They can readily adjust their diet, but the younger/smaller crabs generally eat mollusks, progressing to shrimp and then to fish as they age and grow. The adults feed on mud-sand substrate, which provides a food-web pathway through which contaminants can move from sediments to humans. Dungeness crabs are

[12] *Bivalves* are a class under the Phylum *Mollusca* characterized by two-part shells secreted by a mantle that extends in a sheet on either side of the body. The class has 30,000 species, including scallops, clams, oysters and mussels.
[13] *Malacostraca* are a large diversified group of crustaceans under the Phylum *Arthropoda*, and include the Order Decapoda - crabs, lobsters and shrimp. Source: Animal Diversity Web, University of Michigan Museum of Zoology; http://animaldiversity.ummz.umich.edu/site/accounts/pictures/Malacostraca.html

relatively short-lived with a maximum lifespan of 8 to 10 years. They move between estuaries and offshore waters seasonally (WDFW 2009).

Dungeness crabs are important to the region recreationally and commercially by the Tribes. Recreational crabbing has been observed at Birch Bay, and off Neptune Beach just north of Lummi Island. Several crabbing methods are employed in the sport fishery, depending on local conditions; they are caught intertidally by hand or subtidally by crabpots, nets, or even hook-and-line. The Cherry Point Aquatic Reserve is located in Marine SubArea 7 North – Bellingham to Pt. Roberts – for recreational harvest of Dungeness and Red Rock Crab. Dungeness crabs support a valuable commercial and sport fishing industry in Whatcom County. Dungeness crabs are the only commercially significant crab harvested in Washington. Cherry Point is important to the commercial fishery operated by the Treaty Tribes. (WDFW website 2009).

The cobble and fine sandy beaches, combined with undeveloped tidal sand and mud flats are important habitat for shellfish. Beaches along Cherry Point are characterized by habitat that could potentially support large numbers of shellfish, particularly bivalves such as manila, native littleneck, horse and butter clams. The nearby Birch Bay State park is classified as a "Land Access Beach with Abundant Clams and Oysters" for public shellfish sites of Puget Sound.
Washington State Department of Health has closed many of these shellfish beds due to water quality problems (Whatcom County 2006). Closed or open, shellfish beds perform a number of important ecological functions including nutrient cycling, substrate stabilization, habitat structure (e.g., oyster reefs), water quality enhancement (filtering and retention), and provide food for a wide variety of marine invertebrates, birds, fish and mammals.

Birds

Cherry Point is considered one of 18 areas of significant bird habitat identified for the Strait of Juan de Fuca and Georgia Strait (Wahl et al. 1981). The area from Sandy Point to Point Whitehorn possesses important habitat during all seasons, supporting high numbers of fish-eating loons, grebes and alcids, along with diving ducks. Among the many terrestrial bird species that are found along the Cherry Point Aquatic Reserve are great blue herons, bald eagles, and peregrine falcons. Peak avian activity levels occur in late winter through early spring, coinciding with herring spawning activities in March through May when huge concentrations of birds, particularly scoters and gulls, feed along the shoreline.

Three large-scale bird surveys have covered Cherry Point. One was the Marine EcoSystems Analysis (MESA) during the late 1970s and early 1980s. MESA was the first comprehensive effort to assess marine bird populations in Puget Sound, funded by the EPA and administered by NOAA. MESA researchers used a number of methods to document density, including transect counts from ferries and aerial surveys. The MESA survey results showed that Cherry Point registered the highest counts of birds per square kilometer in Puget Sound. MESA observers counted more than 13,000 birds per square kilometer at and adjacent to Cherry Point. Herring spawn-related flocks of surf scoters included 22,400 at Pt. Whitehorn (23 April 1978); 22,135 off Lummi Bay (30 April 1978) and 16,037 at Cherry Point on 27 April 1979 (Wahl et al. 1981). Another result of the MESA surveys was the recognition of how important Lummi Bay and Birch Bay were has significant bird habitats; Birch Bay had second highest bird use rating (Wahl et al. 1981).

The Puget Sound Ambient Monitoring Program (PSAMP) conducted surveys between 1992-1999 and continues annually with trend data through 2006 to compare many of these bird counts to the MESA results. Survey transects were designed so that they were nearly identical to 54 transects

flown during the MESA Puget Sound Project, allowing for a statistical analysis of bird species and numbers over a 30-year period (Marine Bird Density Atlas, WDFW, 2006). PSAMP comparisons revealed significant findings for marine birds throughout Puget Sound and the surrounding area. Many populations have decreased - grebes, cormorants, loons, pigeon guillemot, marbled murrelets, scoters, scaup, long-tailed ducks, and brant). Some populations appeared stable or slowly decreasing - rhinoceros auklets, goldeneyes, bufflehead, and gulls species. There may be some degree of increase in harlequin ducks and probably mergansers (Nysewander et al. 2005).

Data on non-breeding birds in the Georgia Strait has been collected again during 2003-2004 and 2004-2005 for comparison to the PSAMP and MESA results. Western Washington University has conducted shore-based and ferry-based counts (Bower, J.L., 2009, unpublished) in the Strait of Georgia. As part of the study, Christmas Bird Counts were considered from 11 sites. The results were then compared to both PSAMP and MESA surveys. This latest survey is called the WWU/MESA comparison (Bower, unpublished, 2009). All three will be discussed in detail next.

There are limitations to comparing PSAMP data to MESA counts. These limitations include but are not limited to how often the transects are flown, how loud the airplane is (may disturb birds), and the difficulty of identifying birds from an airplane. Scientists from Western Washington University (WWU), with funding from Washington Sea Grant and other sources, began conducting shore- and ferry-based marine bird counts that closely replicated the 1970s MESA research. WWU scientists, with help from students and volunteers, conducted monthly land and water surveys between September and May in the inner marine waters of north Puget Sound and south Georgia Straits. Data from Audubon Christmas Bird Counts was also collected. The goal was to provide a more robust count for comparison to the 1978-1979 MESA data.

The result is the WWU/MESA comparison. Results of this comparison showed that 14 of the 37 most common over-wintering species in the Strait of Georgia are experiencing significant declines, including 10 species declining over 50%. Detailed examination of the causes of the changing species abundance was beyond the scope of this study (Bower, J.L., 2009, unpublished). The largest declines were spread across different species, and included the Common murre *Unira aalge* (-92%), Western grebe *Aechmophorus occidentalis* (81%), Red-throated loon *Gavia stellata* (73.9%), and the Bonparte's gull *Larus philadelphia* (72.3%) (Bower, J.L., 2009, unpublished). The observed species trends from the WWU census were similar to those previously reported by PSAMP, with the exception of double-crested cormorant, pigeon guillemot, common loons and harlequin ducks (Puget Sound Update 2007).

For Cherry Point specifically, two sites were monitored. Combined totals for both sites showed a 79.1% decline in species documented when WWU compared data to the MESA study (Bower, J.L., 2009, unpublished). Specific species-level detail can be found below.

Both Lummi, and to a lesser extent Birch Bay, were recognized during these surveys for their importance as shallow bays with extensive eelgrass beds that support wintering populations of diving and surface-feeding ducks, gulls and shorebirds in addition to migrating Black Brant. These adjacent areas should be considered when developing management actions for migratory species that may move from Lummi and Birch Bay into or through the Cherry Point Aquatic Reserve.

Bird species listed as Endangered, Threatened or Sensitive species, as well as other species that rely on Cherry Point aquatic habitats are listed below:

Marbled Murrelet. The Marbled Murrelet is federally and state listed as threatened. It forages within 2 to 5 kilometer of shore in coastal and nearshore waters, and within the top 50 meters of the water. Generally solitary, individuals have been documented where Pacific herring are spawning (USFWS 2006; Speich and Wahl 1989). It is also listed as a federally threatened species. Marbled Murrelets are unlikely to nest in the immediate vicinity of the Cherry Point Aquatic Reserve because most forests are extensively fragmented, small, and of second-growth class. ENSR (1995) documented Marbled Murrelets flying into forests near the Canyon Creek drainage of the North Fork Nooksack River, near the United States-Canadian border and about 37 miles (60 km) from Cherry Point. This was considered to be the nearest known murrelet nesting area to Cherry Point for quite some time (ENSR 1995). Marbled Murrelets have been later documented off of central and southern Cherry Point, approximately 5 to 10 kilometers offshore. The 2005 PSAMP surveys observed 1 – 2 animals off the northern boundary of Cherry Point, in the Point Whitehorn vicinity, during summer surveys (Whatcom County 2006; Nysewander et al. 2005).

Earlier surveys along Cherry Point have consistently noted use of the offshore area for feeding by small numbers (2 to 35 birds) of Marbled Murrelets. The WWU/MESA survey found that the percentage change for the Marbled Murrelet was a statistically significant decrease (-71.0%) compared with the MESA data and a similar statistically significant decline when compared with Christmas Bird Count data (-68.5%) (Bower, J.L., unpublished, 2009).

1) *Common Loon*. Washington State has listed the Common Loon as a Sensitive species. Loons are very reliant on nearshore resources during the winter months, and are flightless during winter, leaving them at a potentially higher risk to a variety of impacts in the marine and nearshore environment. The WWU/MESA survey found that the percentage change for the Common Loon was a statistically significant increase (+48.8%) compared with the MESA data and was not statistically significant when compared with Christmas Bird Count data (Bower, J.L., unpublished, 2009).

2) *Cormorants.* Three species of cormorants inhabit the waters off of Cherry Point, and two are located there year round. Double-crested Cormorants are found on both coastal and inland waters and consider Cherry Point part of their year round habitat. Population numbers declined dramatically in the 1960s and 1970s due to contaminants acquired from fish. Since the ban of DDT, populations have been increasing. The population of Double-crested in Washington along the outer coast increased slightly from 1978 to 1994, but has declined since 1995, most likely because of unfavorable ocean conditions (BirdWeb 2008). Double-crested Cormorants may be increasing. The WWU/MESA survey found that the percentage change for this species was a statistically significant increase (+97.7%) compared with the MESA data and when compared with Christmas Bird Count data (+171.1) (Bower, J.L., unpublished, 2009).

   Brandt's Cormorants (*Phalacrocorax penicillatus*) are listed as state candidate species. The WWU/MESA survey found that the percentage change for this species was not statistically significant (Bower, J.L., unpublished, 2009). The Pelagic Cormorant (*Phalacrocorax pelagicus*) has experienced significant increases in the Washington population between 1976 and 1992 (BirdWeb, 2008), and Pelagic Cormorants may still be increasing. The WWU/MESA survey found that the percentage change for this species was a statistically significant increase (+87.7%) compared with the MESA data; there was no statistically significant change when compared with Christmas Bird Count data (Bower, J.L., unpublished, 2009).

3) *Bald Eagle.* The Bald Eagle is a state sensitive species. Bald Eagles use shorelines for feeding and nesting, often building large stick nests in dominant trees near water. In Washington, Bald Eagle nests are most numerous near marine shorelines, but nests are also found on many of the lakes, reservoirs, and rivers. Fish are usually the most common prey taken by breeding Bald Eagles throughout North America, but Bald Eagles also capture a variety of birds (Stalmaster 1987). Bald Eagles are present in the Georgia Straits, and were documented during the 1992 – 1999 Puget Sound Ambient Monitoring Program (PSAMP) summer marine bird surveys as "Other species observed." (Nysewander et al. 2005). Bald Eagles are sometimes seen disrupting cormorant and heron colonies in marine and nearshore areas. The Washington Department of Fish and Wildlife has identified seven eagle nest locations comprising three distinct territories along Cherry Point.

   Whatcom County references the value of this habitat to Bald Eagles in their Shoreline Characterization and Inventory Plan (see section 3.3: *Terrestrial Wildlife Habitat* - Whatcom County, 2006; Bohannon, J., WDFW, personal communication, 2008). In addition to resident breeding pairs observed nesting along Cherry Point, upland of Lummi Bay, and along Terrell Creek, sub-adult non-breeders occur year-round. Migratory and wintering eagles are found in seasonally higher numbers along the Cherry Point's shoreline where they scavenge along the intertidal areas, fish in open water or hunt ducks and gulls (Eissinger 1994).

   WWU/MESA survey found that the percentage change for this species was a statistically significant increase (+187.0%) compared with the MESA data and there was no statistically significant change when compared with Christmas Bird Count data.

4) *Peregrine Falcon.* Peregrine Falcons are listed as a federal candidate and state sensitive species. It is typically found hunting in open areas, especially along the coast and near other bodies of water that provide habitat for their prey. Whatcom County, and Cherry Point, is located directly along the migratory corridor between Alaska and Washington. Knowledge of the peregrines that use this corridor, often during fall, is somewhat limited (Hayes and Buchanan 2002), but it is thought that the Peregrine Falcon uses the Cherry Point area for foraging. The WWU/MESA survey did not cover this species.

5) *Common Murre*. The Common Murre is a large auk that spends most of its life at sea, coming to land only to breed on rocky cliff shores or islands. It is on the state candidate species list. These birds can be seen outside of breeding areas year round, including deep-water, inland and marine habitats (BirdWeb, 2008). The PSAMP summer marine bird surveys documented the presence of murres off the north shore of Cherry Point, at 10 - 25 Murres/km^2. Along the nearshore birds were counted at 0 – 5 murres/km^2 (Nysewander, D.R. et al. 2005). The WWU/MESA survey found that the percentage change for the common murre was a statistically significant decline compared with the MESA data (- 92.4%) and when compared with Christmas Bird Count data (83.7%) (Bower, J.L., unpublished, 2009).

6) *Surf scoter.* Surf Scoters are often seen diving synchronously to locate small invertebrates such as mollusks, crustaceans, and polychaetes in the nearshore area. At night, they often rest in large flocks outside bays and estuaries in which they feed during the day. Surf Scoters are typically present along Cherry Point in winter; PSAMP winter surveys counted 10 – 50 scoters/km2 in the northern portion of the reach, and upwards of 50 – 250 scoters/km2 in the central to southern portion (Nysewander et al. 2005). Numbers of scoters at Cherry Point increase dramatically when herring spawn is available, although the size of these aggregations of scoters has declined

concurrently with declines in spawning herring at Cherry Point.

Anderson et al. (unpublished manuscript, 2009) studied the role of herring spawn in movements and energetics of scoters, focusing on differences in the value of spawn to Surf Scoters versus White- winged Scoters (*M. fusca*). Their research indicated four main results:

a. Both Surf and White-winged Scoters gain mass by consuming spawn during late winter and spring.
b. The number of each scoter species that aggregates to consume spawn is positively related to the size of the spawning event (i.e., the biomass of spawning herring).
c. Numbers of Surf Scoters are especially abundant at spawning sites that occur later in spring (April to May), because migrating Surf Scoters use these sites as staging areas.
d. Spawn is a preferred food for White-winged Scoters, but appears much more important to Surf Scoters because they often lose fat reserves over winter.

The second and third results are particularly relevant to spawning events at Cherry Point. Specifically, spawning activity occurs later in spring at Cherry Point (late March through May) than at other spawning sites in the Puget Sound-Georgia Basin (January to mid-April). Thus, spawn at Cherry Point is used by surf scoters to acquire reserves for migration and breeding. However, concurrent with declines in the biomass of spawning herring at Cherry Point, numbers of scoters observed foraging on spawn there declined from about 60,000 to 6,000 in the period 1980–1999 (Nysewander, D. R., unpublished data). During spring migration of surf scoters in late-April to May, no feeding opportunities equivalent to historical levels of spawn at Cherry Point are known to exist in the Puget Sound-Georgia Basin.

Herring spawn is profitable to scoters for two main reasons: (1) it is highly aggregated and thus reduces foraging effort (Lewis et al. 2007), and (2) spawn has no shell matter, which likely increases nutrient and energy gain relative to some foods scoters consume earlier in winter[14] (Anderson, E.M. et al., unpublished manuscript, 2009).

Although less well studied than scoters, predators ranging from invertebrates, to marine birds, fish, and whales likely benefit from spawning events of herring (Wilson and Womble 2006). Moreover, such benefits generally occur during the critical period of the year when many predators are preparing for migration and reproduction. For this reason, Anderson et al. (unpublished manuscript, 2009) suggest that management of Pacific herring include protections for spawning areas that also preserve feeding opportunities for these diverse predators.

7) *Great Blue Heron.* The rookery located approximately one mile east of Birch Bay State Park on a riparian corridor along Terrell Creek is one of the largest in the Pacific Northwest. This colony was first identified in 1983 and over the last 10 years has supported an average of more than 300 breeding pairs. Additionally, this colony contains the unique Pacific Northwest subspecies, *Ardea herodias fannini*, and resides in the area year-round (Eissinger 1994).This rookery is often called the "Birch Bay Colony." Research has shown that members of this colony include Birch Bay, Drayton Harbor, Semiahmoo Bay, Lummi Bay, and Lake Terrell in their range, although with less concentration (Eissinger 1994). The WWU/MESA survey found that the percentage change for

[14] Mussel soft tissue and herring spawn have approximately the same nutritional value. However, 85 – 90% of a whole mussel is shell, which must be processed and excreted because scoters ingest whole bivalves

this species was not statistically significant. The rookery was studied extensively by British Petroleum. The research found that foraging areas include marine shorelines, the intertidal zone, wetlands, streams, riparian areas, and upland fallow fields. The most concentrated foraging during the nesting season occurs in the intertidal areas near the colony (British Petroleum 2003).

9) *Western Grebes* are found in large numbers through marine waters, preferring deeper waters with relatively low currents such as bays or inlets, in Puget Sound during winter and summer; flocks often return to the same general area each year (Nysewander et al. 2005). Cherry Point is located in the northern portion of the Western Grebes non-breeding winter habitat, and adjacent to migratory routes (BirdWeb 2008).Western Grebes are a state candidate species. The PSAMP winter marine bird surveys documented Western Grebes in moderate to high densities (ranging from 25 to 1,954 animals per square kilometer) along the intertidal and nearshore area of central and southern Cherry Point, extending to approximately 5 kilometers offshore (Nysewander et al. 2005). Comparison of nearly identical transects surveyed during the MESA time period (1978 – 79) and the PSAMP time period (1992 – 99) indicate this species could potentially be decreasing by as much as 95%, a conclusion further supported by the 2004 study funded through Washington Sea Grant study on marine bird population in western Washington (Bower et al. 2005). The WWU/MESA survey found that the percentage change for this species was a statistically significant decrease (81.3%) compared with the MESA data and also with the when compared with Christmas Bird Count data (-85.9%).

10) *Osprey.* The Osprey is a species currently on the State Monitor list. It is a unique bird, the only species in its family, and it is found worldwide (WDFW 2005). Waterbodies (e.g., Nooksack River) surrounding Cherry Point support breeding habitat for the Osprey and necessary food resources, such as salmon. The WWU/MESA survey did not cover this species.

11) *Cavity nesting ducks.* Habitats identified as important wintering areas for Harlequin Ducks are located at Cherry Point, and were identified as such during the PSAMP marine bird surveys, including the eelgrass and kelp beds combined with rocky and cobble substrates, supporting the diverse mix of benthic invertebrate species that make up a prey base for this bird. The PSAMP summer marine bird surveys also documented high numbers in the northern portion of Cherry Point – between 50 – 65 animals/km^2, and 0 – 5 in the central portion of the nearshore area (Nysewander et al. 2005). Overall, for the entire survey, comparison of nearly identical transects surveyed during the MESA time period (1978 – 79) and the PSAMP time period (1992 – 99) indicate this species show fluctuating numbers in this species. The WWU/MESA survey found that the percentage change is not statistically significant for this bird (Bower, J.L., unpublished, 2009).

The PSAMP winter marine bird surveys documented Buffleheads along the northern and central nearshore of Cherry Point at densities of 10 – 25 and 25 - 50 animals/km^2 (Nysewander, D.R. et al. 2005). The PSAMP winter marine bird surveys documented goldeneyes along the northern and central nearshore of Cherry Point at densities of 10 – 25 and along the southern nearshore at 0 – 10 animals/km^2 (Nysewander et al. 2005). Of these cavity nesting ducks, the WWU/MESA survey found that the percentage change for the Common Goldeneye was a statistically significant decline (- 47.8%) compared with the MESA data. For Buffleheads and Barrow's Goldeneye, the percentage change was not statistically significant for this bird. The survey did not look at the Wood Duck or the Hooded Merganser (Bower, J.L., unpublished, 2009).

Marine Mammals

Marine mammals that use the Cherry Point Aquatic Reserve, or could use the habitat based upon

their presence in the southeast Strait of Georgia (Calambokidis and Baird 1994, WDFW 2007, Williams, 2007) include harbor seals (*Phoca vitulina*), Pacific harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), Steller sea lions (*Eumetopias jubatus*), California sea lions (*Zalophus californianus*), Gray whales (*Eschrichtius robustus*), Pacific Minke whale *(Balaenoptera acutorostrata),* the Southern Resident Killer Whales (*Orca orcinus*) and the humpback whale (Calambokidis and Baird 1994. Falcone et al. 2005).

Although gray whales have become regular summer residents in the enclosed marine waters of Washington since the species recovery, early records do not document historical numbers of gray whales for these inland and coastal waters. These "seasonal residents" in the Puget Sound are part of the Pacific Coast Feeding Aggregation (PCFA), and have been documented feeding in inland waters along Vancouver Island since the 1970's (Darling 1984). In 2007, sightings of gray whales in northern Puget Sound continued to reveal that this area is used as a springtime feeding area for a small, regularly occurring group of gray whales (Calambokidis et al. 2009).

The humpback whale habitat includes nearshore, pelagic marine habitat, open waters of the ocean and inshore waters of the bays. This species is primarily dependent upon schooling fishes and krill (krill only in the Southern Hemispheres), and is active both day and night (NatureServe 2009). Humpback whales were once common in the inland waters of Washington and British Columbia; however, as a result of commercial whaling, humpback whales were formally listed as "endangered" under the Endangered Species Act (ESA) in 1973. Humpback whales are designated as "depleted" under the MMPA and considered endangered under the Priority Habitat and Species List for Washington State (NOAA Protected Resources 2009, WDFW 2009). While the North Pacific population is estimated to exceed 6,000 humpback whales (Calambokidis et al. 1997) this is still less than 50% of the amount taken during commercial whaling from the North Pacific (NOAA Protected Resources Division, 2008). Humpback whales have recently been seen more frequently in the historic feeding grounds along the Washington coast, and more often in inland waters of Washington (Calambokidis et al. 2004; Falcone et al. 2005). In the spring of 2009, a humpback whale was spotted over multiple days in the southernmost part of Puget Sound (unpublished Cascadia Research sighting data). Threats to the humpback whales include entanglement in marine debris and ship strike (NOAA Protected Resources Division 2008).

In general, there are three groups of killer whales – *transients, residents* and *offshore*. Division of these groups is based upon mitochondrial DNA (mDNA) samples combined with visual identification of over 73 samples collected from orcas ranging from California to Alaska. Significant genetic differences have been demonstrated between 'transient' killer whales from California through Alaska, 'resident' killer whales from the inland waters of Washington, and 'resident' killer whales ranging from British Columbia to the Aleutian Islands and Bering Sea. Resident killer whales are divided into two communities, a northern and southern, and rarely come in contact with each other (NMFS 2005; Carretta 2007).

Another significant difference between resident and transient killer whales is their choice of food; although not a whale, the term "*Killer Whale*" was earned by the transients, who are well known for incorporating other marine mammals into their diet. Transients have been seen chasing gray whales, and over 22 different species of marine mammals have been identified from the stomach of transients. *Southern* and Northern residents killer whales appear to prefer Chinook (*Oncorhynchus tshawytscha*), and follow the runs of these salmon in their area (Ford et al. 1998, NMFS 2005; Flaugherty 1990). It is possible for any of these groups to use habitat along the Strait of Georgia,

near Cherry Point. However, the resident group is the most likely, as this group uses inland waters most frequently.

NMFS recognizes five killer whale stocks that can occur within the waters of the Exclusive Economic Zone (EEZ) of the Pacific Ocean, United States:

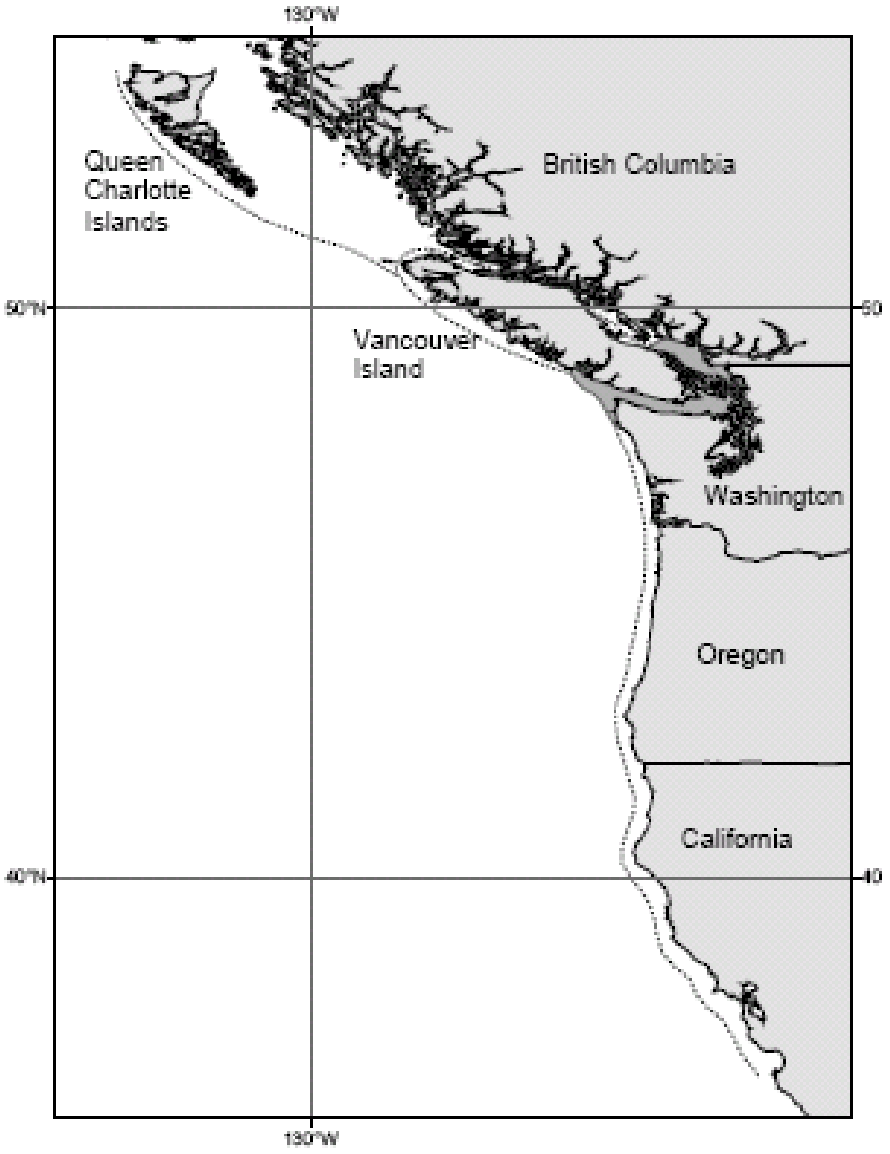
- Eastern North Pacific, Resident Stock – British Columbia through Alaska;
- Eastern North Pacific, Southern Resident Stock – inland waters of Washington and southern British Columbia;
- Eastern North Pacific, Transient Stock – Alaska through California;
- Eastern North Pacific Offshore stock – neither transient or resident, from Southeast Alaska through California; and
- Hawaiian stock.

The killer whale most likely to occur near the Cherry Point Management Area are those from the *Eastern North Pacific, Southern Resident Stock* (often called the Southern Resident killer whale), which habituate the inland waters of Washington and southern British Columbia (Figure 13) (Carretta 2007).

Three pods make up this stock – J, which is commonly found inshore during the winter months, and the K and L pods, often located farther offshore, even as far as Monterey Bay, California. NMFS (2005) describes the home range for all three pods in the conservation plan for the Southern Resident killer whale. Most information is gathered from late spring to early fall, when weather is best. During this period, all three pods are regularly present in the Georgia Basin, which is defined as the Georgia Strait, San Juan Islands, and Strait of Juan de Fuca (NMFS 2005).

During the warmer months, all three pods concentrate around major salmon migration corridors, including Haro Strait, Boundary Passage, the southern Gulf Islands, the eastern end of the Strait of Juan de Fuca, and several localities in the southern Georgia Strait given the importance of the Fraser River as the region's largest source of salmon. The pods expand into Puget Sound in early fall, following chum and Chinook salmon runs (see Figure 14). Killer whales have been observed foraging within 50-100 m of shore and using steep nearshore topography to corral fish (Wiles 2004).

Figure 13. Range of the Southern Resident Killer Whale (shaded area)



There is a limited amount of data on the Southern Resident killer whale's feeding preferences. Most information is based on a single study in British Columbia that focused primarily on northern residents, relied on surface observations and scale sampling, and reported on a relatively small sample of observations (Wiles, 2004). This data, which should be considered preliminary, indicates they prefer Chinook salmon during late spring to fall as much as their Northern cousins. This assumption was supported by toxicology studies, which found that the ratio of DDT and other contaminants in the blubber of the orca most closely matched that of salmon, compared to other fish species (see Kraughn et al. 2002). The British Columbia study found chum salmon are also taken in significant amounts, especially in autumn. Other species eaten include coho, steelhead, sockeye, and non-salmonids (e.g., Pacific herring and quillback rockfish [*Sebastes maliger*] 3 percent combined). These data on surface feeding may underestimate the extent of feeding on bottom fish; species such as rockfish (*Sebastes* spp.), Pacific halibut, a number of smaller flatfish, lingcod, and greenling are likely consumed on a regular basis. Pacific herring also contribute to the diet (Wiles 2004).

Figure 14. Primary area of occurrence for Southern Resident killer whale when present in Georgia Basin and Puget Sound (NMFS 2005)

Little is known about the winter and early spring foods of Southern and Northern Residents or whether individual pods or sexes have specific dietary preferences or have shifted preference for different prey species over time. A substantial amount of data exists on this stock's structure, behavior and movements, as a result of photo-identification of individual whales through the years. The first complete census of this stock occurred in 1974. Between 1974 and 1993, the stock increased by 35%, to 96 individuals. However, a substantial decline to 79 individuals by 2001 led to concern. By 2005, the stock had risen slightly again, to 91 individuals (Carretta 2007). The stock was listed as endangered in 2005 by the NMFS.

As a top-level predator, killer whales occur at naturally low densities, are long-lived, have low reproductive rates and long generation times, and invest large amounts of parental effort in each offspring. These characteristics mean that the loss of relatively few individuals can have serious consequences for their populations, as well as hinder recovery rates. Because of the combination of low population numbers, the recent steep decline in L pod, and continued threats to the population, the Washington Department of Fish and Wildlife has determined that the southern residents are at risk of extinction from all or a significant portion of their range in Washington and recommends that the species be listed as endangered in the state (Wiles 2004). NMFS has listed the orca as federally

endangered, and prepared a recovery plan. Prey availability, environmental contaminants, impacts from vessels and sound (including aircraft), oil spills, and disease are discussed in length by NMFS as potential stressors to the Southern Resident killer whale (2005) and should be addressed by DNR in any management plan. It is appropriate to support conservation and recovery measures for prey species until more is known about their importance to the whales (NMFS 2008).).

Harbor porpoise were once common in South Puget Sound, but are now considered rare. Harbor porpoise have been located at various times during the year in the vicinity of the inland trans-boundary waters of Washington and British Columbia, Canada (Osborne et al. 1988), and along the Oregon/Washington coast (Barlow 1988; Barlow et al. 1988; Green et al. 1992). Harbor porpoise feed on squid, octopus, herring, and small schooling fish (Yates 1988).

NMFS recognizes two stocks off of the coast of Washington: the Oregon/Washington Coast stock (between Cape Blanco, OR, and Cape Flattery, WA) and the Washington Inland Waters stock (in waters east of Cape Flattery). The recognition of two stocks is a risk averse management strategy, based primarily on restrictions noted in the intermixing rates within the eastern North Pacific harbor porpoises and the significant decline in harbor porpoise sightings within southern Puget Sound since the 1940s (Carretta 2007).

This species is considered a state candidate by the Washington State Department of Fish and Wildlife. Harbor porpoise are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. The latest stock assessment states that the status of both coastal and inland stocks relative to its Optimum Sustainable Population (OSP) level and population trends is unknown (Carretta 2007).

Dall's porpoise (*Phocoenoides dalli*)

The Dall’s porpoise remains year round in the Strait of Juan de Fuca, San Juan and Canadian Gulf Islands, and Admiralty Inlet and feeds on squid and small schooling fishes. It is known to possess very high powered sonar, but this ability has not prevented it from becoming frequently entangled with in gill nets (Yates 1988). NMFS states no information in available about population trends, current or maximum net productivity, and there are insufficient data to evaluate potential trends in abundance. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA (Carretta 2007). The Washington State Department of Fish and Wildlife classifies this species as “State Monitor.”

Stellar Sea Lion (*Eumetopias jubatus*)

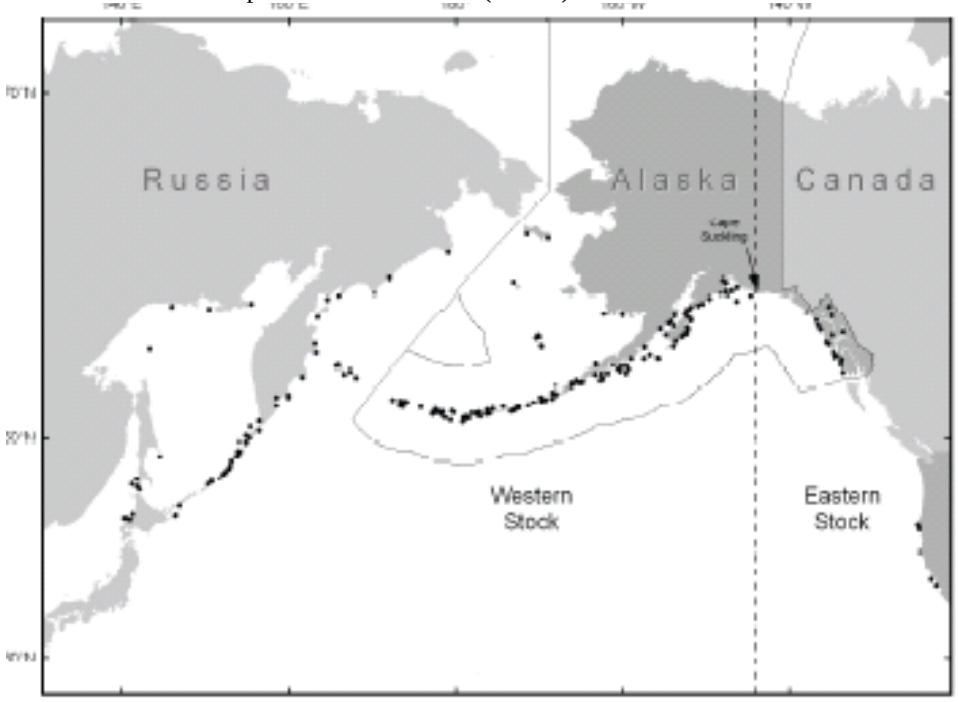
The Steller (or Northern) sea lion is the largest of the eared or otariid seals found in Washington waters and uses haulout sites primarily along the outer coast from the Columbia River to Cape Flattery, as well as along the Vancouver Island side of the Strait of Juan de Fuca. Although breeding rookeries are located along the Oregon and British Columbia coasts, no breeding rookeries are found in Washington (Jefferies et al. 2003).

Haul out sites are found on jetties, offshore rocks and coastal islands. This species may also be found occasionally on navigation buoys in Puget Sound as well. Both sexes are found in Washington waters, with males considerably larger (to 2,200 lbs) than females (to 700 lbs). Coloration varies from tawny through yellowish brown to dark brown. Vocalizations from adults can be described as a deep growling sound (Yates 1988; Everitt 1980).

Over its range, Steller sea lion population numbers have declined significantly over the last 15 years. In Washington, Steller sea lion numbers vary seasonally with peak counts during the fall and winter months. In 1980 a report was compiled on marine mammal population for the Marine Ecosystems Analysis project (MESA). This study found 10 known haulout sites in Washington and adjacent waters for Steller seals at that time, including Sucia Island, Sombrio Point, and Race Rocks. However, the study also noted a decline in number at favored haulout sites over the study period, noting that no more than 20 animals were observed at a haulout site between 1978 and 1979. The total count for the study period, including coastal and inland animals, reached a maximum of around 500 (Everitt 1980). Again, one potential reason for this low number is that no rookeries currently exist in Washington; eastern population Stellar sea lions give birth in Oregon, California, and British Columbia.

The USFWS divides the population into two sub-species (see Figure 15), with the dividing line located at Cape Suckling, Alaska (144°W). Washington Stellar sea lions are east of this line.

Figure 15. Western and Eastern Populations of Northern (Stellar) Sea Lion



The USFWS has listed the eastern population as threatened and the western population as endangered. Washington State has also listed the species as state threatened (USFWS 2007). Everitt (1980) reported that sea lions in Washington are most abundant in winter, and thus most susceptible environmental perturbations at this time at favored haul out locations, such as in the eastern Strait of Juan de Fuca.

California Sea Lion (*Zalophus californianus*)

The California sea lion is also an otariid, or eared seal. The USFWS divides the California sea lion into three stocks, only one of which is found in the United States. The United States stock has a range that extends along the west coast of North America, from Baja California to Vancouver Island (Carretta 2007). In Washington and adjacent waters, California sea lions have been reported at 11 haul out sites, including but not limited to Race Rocks, British Columbia and a beached barge at Port

Gardner, Washington (Everitt 1980). A NOAA study in southern California investigated the diet of California sea lions, and found that the most common prey items included forage fish, and were (in order of abundance): Northern anchovy (*Engraulis mordax*), Pacific sardine (*Sardinops sagax*), Pacific whiting (*Merluccius productus*), Pacific mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*), shortbelly rockfish (*Sebastes jordani*), and market squid (*Loligo opalescens*). The study suggests that population numbers are highly responsive to prey availability, particularly when these resources decline in El Nino years, and suggests that the increase in seal population numbers will eventually reach carrying capacity during an El Nino year (Lowry, M. unpublished).

The California sea lion is not listed as threatened or endangered under the ESA, and it is not listed as depleted or a strategic stock under the MMPA. The population of the United States stock appears to be growing around 5 – 6% per year, but is heavily influenced by El Niño events, which affects adult female survivorship (Carretta 2007).

Harbor Seal (*Phoca vitulina richarsi*)

The habitat of the harbor seal encompasses coastal and estuarine waters off Baja California, north along the western coasts of the continental U.S., British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. The harbor seal is the most common, widely distributed pinniped found in Washington waters, and is frequently sighted using one of its hundreds of resting or haul out sites located along Washington's coast or inland waters. Harbor seals use the rocky beaches south of Point Whitehorn for hauling out and pupping for approximately 8500 feet along the shoreline. Group sizes typically range from small numbers of animals on some intertidal rocks to several thousand animals found seasonally in coastal estuaries (Yates, 1988; Jefferies et al. 2003). As managed by NMFS, harbor seals along the western continental United States have been divided into three coastal and inland stocks based upon differences in cranial morphology, pupping phrenology, and genetics (Jefferies 2003; Carretta 2007): (1) Washington inland waters (including Hood Canal, Puget Sound and the Strait of Juan de Fuca out to Cape Flattery), (2) Outer coast of Oregon and Washington, and (3) California (Carretta 2007).

Jeffries et al. (2003) report that 8,949 harbor seals were detected during inland stock haul-out counts in 1999. Correct population estimates are difficult because the seal pups are precocious. The 2006 stock assessment for this marine mammal reports that the Oregon/Washington population of harbor seals is declining (Carretta 2007). Harbor seals are not considered to be "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. The Washington State Department of Fish and Wildlife classifies this species as "State Monitor."

Elephant seal (*Mirounga angustirostris*) Although elephant seals are infrequent visitors to the Puget Sound, there are a usually a few animals that show up throughout the year with a peak in sightings occurring during summer (Osborne et al. 1988). Elephant seals encountered in Washington waters are generally males or young of the year. Elephant seals are generally found either floating at the surface or they are encountered hauled out on sandy beaches. In Washington State, if an elephant seal has hauled itself onto a beach, it may be molting and will remain on the beach until the molting process has finished. Human caused mortality primarily involve fishery entanglements, however from 2000-2004 stranding records from California, Oregon and Washington state's attribute three elephant seal deaths to boat collision (Carretta et al. 2008).

Non-native species

As a major shipping port, the Cherry Point industries receive most of their vessel traffic from ports in Alaska, and California with additional vessel visits from other Pacific Northwest ports and some Asia or Australian ports. Ballast and fouling organisms arriving with visiting vessels represent a potential invasion vector for numerous species. The United States Environmental Protection Agency (EPA)has identified ballast water as one of the most "universal and ubiquitous vectors" for the transport and discharge of non-native species in marine and coastal areas (EPA 2008).

The composition of non-native organisms that have established at Cherry Point has not been adequately characterized. Two species of non-native marine vegetation were identified at Cherry Point as part of an inventory of submerged aquatic vegetation: the Japanese alga *Sargassum muticum*, which has widespread distribution along Cherry Point and the Japanese eelgrass *Zostera japonica*, which has been documented in numerous patches from Birch Bay to south of Gulf Road (Fairbanks et al. 2005).

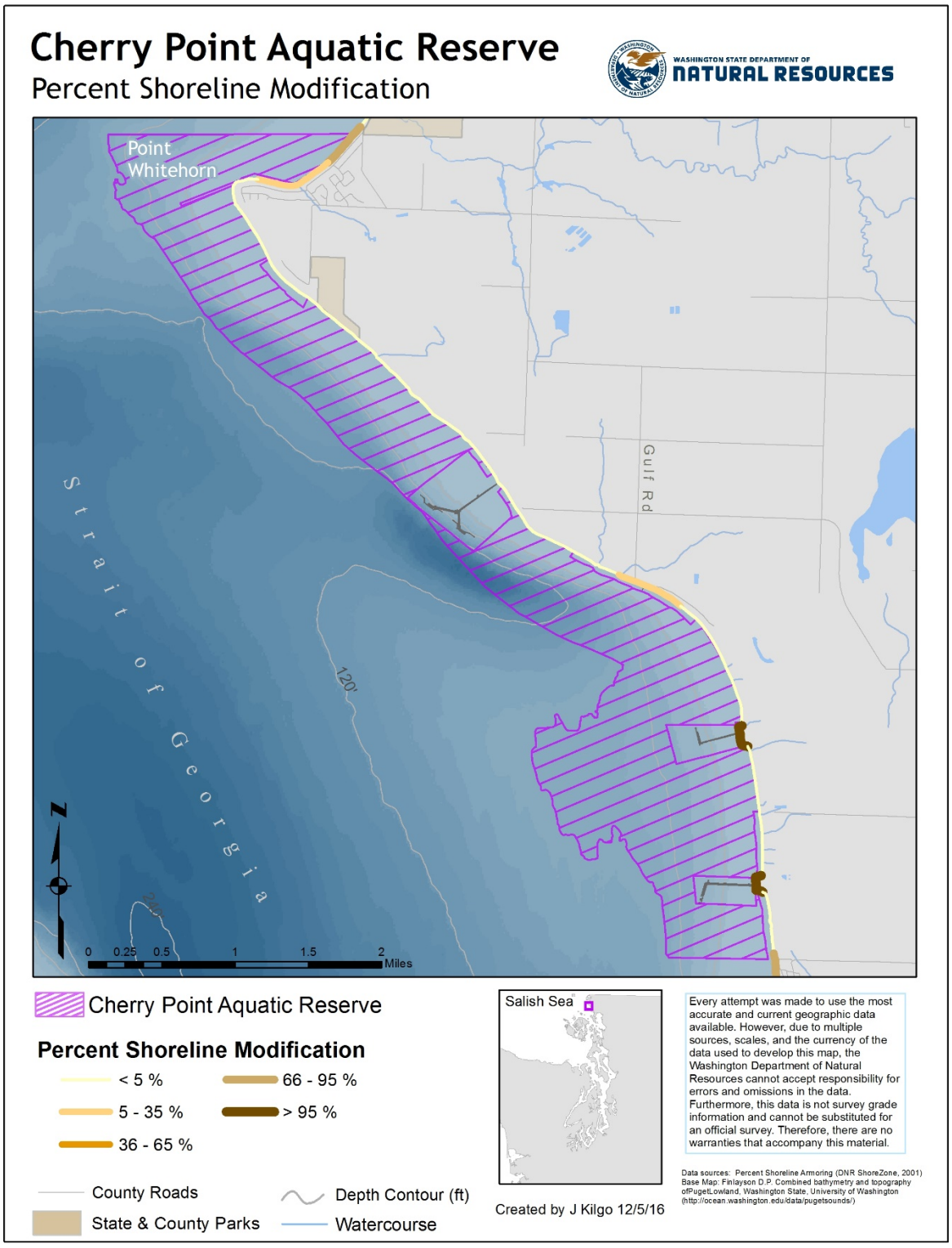
Appendix B - Risks to Ecosystems at Cherry Point

Overview of Risks

The Cherry Point Workgroup identified the following threats to Cherry Point natural resources, including: pollution from groundwater contamination, stormwater runoff, point discharges and air deposition; disturbance from recreational activities; shoreline modification, including overwater structures, loss of riparian vegetation, armoring, and derelict gear; artificial light and excessive intermittent sound; vessel traffic, including oil spills; ballast water and invasive species; and habitat impacts due to climate change. The Aquatic Reserves Program Technical Advisory Committee (TAC) noted the unique environment at Cherry Point and identified a number of threats to its resources, including: impacts associated with the piers and pilings, fill in the intertidal and the expanding threat posed by residential development along the northern and southern boundaries of the reserve.

Activities and physical changes that inhibit or modify the physical, biological, and chemical processes within the nearshore can lead to degradation of habitat structure and functions. Species dependent upon these habitats functions may be particularly sensitive to such changes. A potential source of data for identifying historical modifications to ecological processes, structures and functions and future risks is being developed by the Puget Sound Nearshore Partnership, lead by Washington State Department of Fish and Wildlife and the U.S. Army Corps of Engineers. This “change analysis” database was developed to investigate the fundamental causes of ecosystem decline due to human change to natural nearshore processes along Puget Sound's shoreline. It examined numerous existing datasets from two broad time periods, the advent of United States territorial settlement (circa 1850-1880) and present-day (2000-2009). The project is currently documenting how these changes will continue in the future if they aren't addressed, as well as how these changes affect ecosystem functions, goods, and services that the region depends on. The study will expand collaborations with stakeholders and the public to recommend a portfolio of restoration and protection solutions to address these problems and improve the condition of nearshore ecosystems.

Figure 16. Shoreline Modification at Cherry Point



Risks to Indicator Fish and Wildlife Species at Cherry Point

Salmon

The decline of salmon species in Puget Sound has generally been attributed to four factors: habitat loss, hydropower, harvest and hatcheries. Natural variations in ocean-climate conditions, climate change, and other factors such as predation and the introduction of non-native species have also contributed to the decline. For salmon in WRIA 1 using the nearshore, the primary threats to salmon populations are: modification of shorelines by armoring, overwater structures and loss of riparian vegetation; contamination of nearshore and marine resources through point sources, untreated runoff from impervious surfaces, and contaminated groundwater; alteration of biological populations and communities such as prey resources or eelgrass beds; colonization by invasive plants (Puget Sound Action Team 2005), and water temperature and stream flow modifications due to human actions and climate change (Glick 2005).These factors are discussed later in this chapter under the various subheadings.

Competition with pink salmon for prey resources has been hypothesized as affecting the survival of Puget Sound Chinook since the major 1982-1983 El Nino event (Fresh 2006). In the Strait of Georgia, most pink salmon enter marine waters in April, before Chinook salmon, and during even-numbered years. Prior to the large El Nino event, Chinook experienced greater survival during even-years, but since the El Nino event of 1982-1983 survival has been reduced, and some have hypothesized this is because of increased competition with pink salmon for prey resources. As a result, juvenile Chinook salmon may be entering marine waters at a time of reduced prey availability. In addition, the substantial decline in spawning Cherry Point herring during the early 1980s coincides with the reduced survival of Chinook and an increase in pink salmon abundance. It has also been hypothesized that the survival of sub-adults and adults may be impacted by a decrease in abundance of Cherry Point herring (PSAT 2005).

Cherry Point Pacific Herring

Since the 1970s, the size of the Cherry Point stock has shrunk from a high of approximately 15,000 tons to a low of about 800 tons in the 2000 spawning season, to an estimated 2,100 tons for 2007, followed by a decrease to 1,352 tons in 2008 (see Figures 17 and 18). The annual mortality rate estimate for the Cherry Point herring stock has increased from a range of 20-40% in the late 1970s to an average of 68% since 1990. The mean estimated natural mortality rate for other Puget Sound stocks has averaged 75%. Worldwide, natural mortality rates in the 30-40 percent range are considered typical, while higher rates, like those presently observed for the Puget Sound stocks are considered unusual (Stick and Lindquist 2008).

For the 2003-04 period, 50 percent of Puget Sound herring stocks are classified as healthy or moderately healthy. This is the lowest percentage of stocks meeting these criteria since development of the stock status summary in 1994; following 71% and 83% of stocks considered healthy or moderately healthy in 2000 and 2002, respectively. One stock, N.W. San Juan Island, was also added to the critical list in 2004. In the 1970s, the Cherry Point stock comprised more than half of the herring biomass in Puget Sound (Stick 2005).

The location of herring spawn deposition in lower intertidal and upper subtidal habitats and the

geographically specific nature of herring spawning behavior make herring spawning grounds vulnerable to shoreline development. As a result, it is likely that one of the potential threats to herring within the boundaries of the management area is from damage to eelgrass spawning and rearing habitat. Washington Department of Fish and Wildlife manages Pacific herring and regulate project approvals for in-water projects located in areas where there are documented herring spawning grounds (See discussion on "no net loss" in section 5.3.2 or consult the Washington Administrative Code Hydraulic Code Rules, WDFW, 2007). Certain recreational activities, such as recreational shellfish digging, also have the potential to impact herring spawning substrate. This issue is discussed later under the section:" Disturbance from Recreational Activities".

Industrial activities along the Cherry Point shoreline, including petroleum offloading and processing and aluminum smelting, represent possible sources of environmental contaminants. However, larval abnormalities in Cherry Point herring larva can occur completely independent of conditions at the shoreline, and in fact, were reproduced independently from zygotes reared in clean water in a controlled laboratory setting (see Hershberger et al. 2005). However, outplants of Cherry Point herring embryos along the shoreline in the 1990s (Hershberger et al. 1999) showed a geographical pattern of abnormalities unlikely to be due to chance alone, but testing to confirm the cause of these abnormalities has not yet been done (Marshall et al. 2005).

The current age structure of Cherry Point herring is made up of relatively young fish. The estimated age composition in recent years has been dominated by 2 and 3 year old fish, compared to a much higher proportion of older fish in the 1970's. While the ratio of 2 and 3 year olds increased, an increase in the natural predators of herring, including Pacific hake, spiny dogfish, and harbor seals, was also noted in recent decades (Stout et al. 2001; Mitchell 2006). The increase in predation rates combined with a higher rate of natural mortality (e.g., parasites) in the older age classes could be factors in the change in age class structure (WDFW, unpublished data, 2008). Relatively good two year old recruitment in recent years has been sustaining most stocks in Puget Sound despite high natural mortality rates. Recruitment failure, under the present natural mortality, would lead to dramatic stock biomass declines.

Because of their genetic uniqueness, and potential repository for variation, Cherry Point Pacific herring should be protected through careful management. This variation may include a greater tolerance for warm water in early life stages than seen in other regional herring (Dinnel et al. 2008).

The role of persistent organic pollutants

Studies have been published (West et al. 2001) that address the concentrations of PCBs and other persistent organic pollutants (POPs) within Cherry Point Pacific Herring and Puget Sound Pacific Herring stocks. O'Neal and West et al. (2001) documented that Pacific herring from central and southern Puget Sound basins had higher levels of PCB body burdens when compared to herring stocks from northern Puget Sound and the Strait of Georgia. West et al. (2001) determined that mean total PCB body burden for the Cherry Point herring stock was 54.89 µg/kg (standard deviation (SD) 13.00 µg/kg). The Semiahmoo stock that spawns in the same region as the CPPHS had total PCBs measured at a mean of 51.24 µg/kg (SD 31.27 µg/kg). The more southerly stocks had higher concentrations of total PCBs. The Puget Sound herring stock at Port Orchard had mean total PCBs at 189.40 µg/kg (SD 63.29 µg/kg) and at Squaxin Pass the mean total PCBs were 195.90 µg/kg (SD 48.95 µg/kg). As demonstrated by the high standard deviation, the southerly stocks have a wide range of individual measurements. More southerly stocks do have higher concentrations of PCBs.

In a later study, West et al. (2008) made additional collections of age 2-3 fish from Squaxin Pass, Quartermaster, Port Orchard, Cherry Point and two other Strait of Georgia stocks. PCBs and other POPs were measured for each stock and normalized to nanogram of compound per grams of lipid content (ng PCBs/g lipid). The levels were compared to the 10^{th} percentile residue effect threshold for the protection of juvenile salmonids, which was suggested by Meador et al. (2002) to be set at 2400ng PCBs/g lipid (2002).

Port Orchard exceeded this benchmark, Cherry Point had concentrations at about ½ the threshold, and Squaxin Pass was intermediate. The results show that Puget Sound Pacific herring and Cherry Point Herring have PCB concentrations that are near or above the suggested threshold concentration for juvenile salmonids of 2.4 ug/g lipid (Meador et al. 2002). Uncertainty exists in extrapolating between species of such different phylogeny, and comparable data are not available for other Pacific herring stocks. Studies on PCB effects to Pacific herring stocks outside of Puget Sound and Cherry Point would be informative.

PCBs are known to have a plethora of effects on development and immune function that are typically not included in fish toxicity tests. Development of toxicity tests for Pacific herring has been underway (Dinnel et al. 2008) and exploration of the effects of PCBs and other persistent organic pollutants could be informative. PCBs are known to affect degrade the immune systems of fish species (Zelikoff et al. 2000; Duffy et al. 2002). A high priority should be placed on the effects of these contaminants on immune function in consideration of the high incidence of disease in Pacific herring of this region. DDT and hexachlorobenzene residues are also found in the Pacific herring stocks and the pattern of bioaccumulation was specific to CPPH and the PSPH. These data provide information that the two groups of Pacific herring utilize different segments of the landscape (West et al. 2008).

The role of parasites and disease

Herring in Puget Sound and throughout the eastern North Pacific are impacted by at least three pathogens that exert population-level effects: Ichthyophonus hoferi, viral hemorrhagic septicemia virus (VHSV), and erythrocytic necrosis virus (Stick and Lindquist 2008). Stressors associated with age in herring include increased incidence of parasitism and/or disease. The syndrome parasite *Ichthyophonus hoferi* is highly prevalent in herring populations throughout the eastern North Pacific, and increases with the age of herring in Puget Sound, ranging from 12% among juveniles to 55% among the oldest adults (Hershberger 2002). Recent studies indicate that Ichthyophonus infected fish have a decreased swimming performance, resulting in preferential predation by salmon and sculpin. These data indicate both direct and indirect mortality from ichthyonphonus may contribute to the disappearance of the older herring age cohorts in Puget Sound and account for the truncation in observed age structure among Puget Sound herring stocks.

VHSV and other pathogens can also be found in Pacific herring in the Puget Sound region. (Hershberger et al. 2002; Landis et al. 2004; Landis 2005; Landis 2008). A combination of disease from VHSV and Ichthyophonus is a leading hypothesis accounting for the crash and failed recovery of Pacific herring populations in Prince William Sound, Alaska (Stick and Lindquist 2008). In Puget Sound, impacts of VHSV are typically most severe among the youngest herring age cohorts; cohorts that survive exposure develop strong resistance to the disease.

Pacific herring are also susceptible to viral erythrocytic necrosis, and is likely common among

juvenile herring. It is thought that population level impacts likely occur, but are typically covert and not easily detected. Disease is a stressor widespread in the region. Routine monitoring of the prevalence of disease within the various Puget Sound herring and Cherry Point herring stocks, in concert with the routine counting of the fish would be a useful tool in assessing the state of Pacific herring. As Hershberger has done, disease incidence should be determined for each age class and for each stock.

The role of interactions

As the change in ocean conditions occurred, diseases with broad host ranges, such as *I. hoferi* may have been introduced to the region. PCBs and other persistent organic pollutants with the ability to alter immune function may have made the fish more susceptible to infection. The combination could then lead to a persistent and widespread decline in the Pacific herring. No doubt other scenarios could be developed from this or similar datasets. Part of the issue is that the recognition of such an event could not have been done until recently.

The spring freshet of the Fraser River provides the nutrients and stable stratification needed for abundant primary and secondary production. Currents concentrate phytoplankton and zooplankton just south of Point Roberts very close to the Cherry Point herring spawning grounds (Legare 1957; Parsons et al. 1969). It has been known since the 1920s that the zooplankton biomass of the upper layer of the Strait of Georgia peaks in April through early June and is at times dominated by one species, *Neocalanus plumchrus* (Campbell 1934). Wailes (1936) examined the stomach contents of southern British Columbia herring in 1931-1934 and found samples from April and May with 98% to 100% *N. plumchrus* and rated this species along with *Euphausia pacifica* as most important for adult herring. The *Neocalanus plumchrus* population of the Strait of Georgia went into steep decline in 1971 while populations of smaller copepods such as *Calanus marshallae* increased (Gardner 1977). Gardner (1976) predicted declines in Strait of Georgia fish populations due to the greater energy expenditure needed to acquire the same amount of nutrition from smaller copepods as from *N. plumchrus*.

Malnutrition both decreases disease resistance and increases sensitivity to the toxic effects of PCBs and other POPs. Animals stressed by disease and/or toxic chemicals have trouble finding food or avoiding predators due to sensory and metabolic impairment. Mutually reinforcing stressors can result in precipitous drops in populations while making cause and effect conclusions very complicated and controversial.

Current regulatory protection

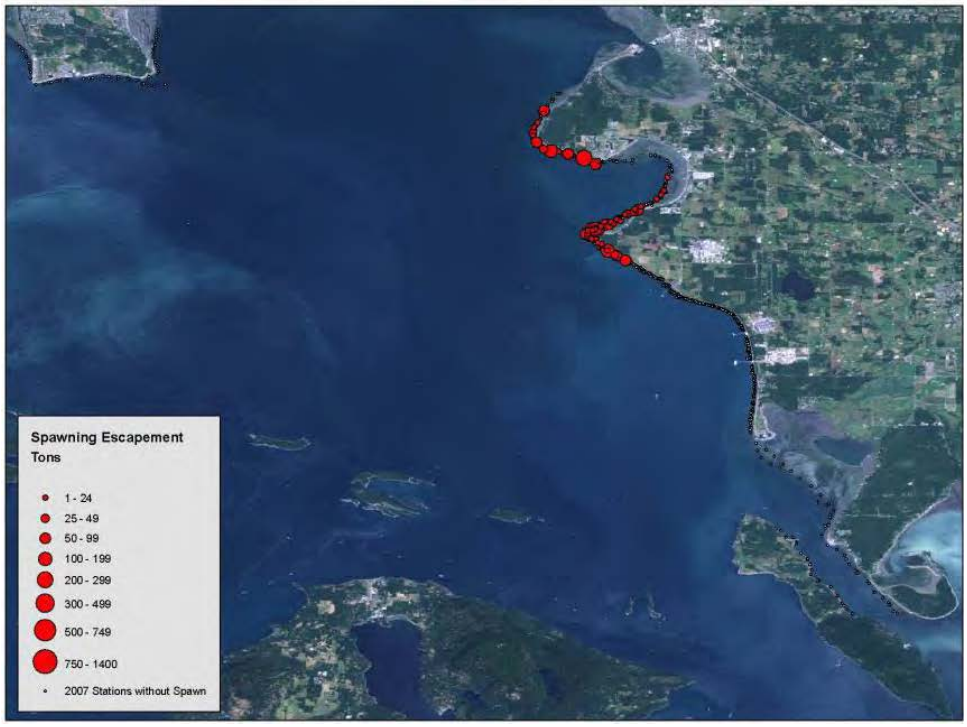
In response to a 1999 petition that addressed 18 species in Puget Sound, including Pacific Herring, the Department of Commerce, NOAA Fisheries, National Marine Fisheries Service, formed a Biological Review Team (BRT). While federal protection was not provided, the BRT stated (Stout et al. 2001):

> ". . .most members expressed concern that they could not entirely rule out the possibility that this Georgia Basin DPS at present is likely to become in danger of extinction, especially because some stocks within the Georgia Basin, such as Cherry Point and Discovery Bay, have declined to such an extent that they may meet the IUCN criteria to be considered "vulnerable" which is (of special concern), not necessarily endangered or threatened severely, but at possible risk of falling into one

of these categories in the near future."

While the petitions to list the Cherry Point Stock as a federally listed species under the Endangered Species Act (ESA) were not successful, continuing declines in the Cherry Point stock have listed it as "critical" by the Washington State Department of Fish and Wildlife. The Washington State Department of Fish and Wildlife also continues to list the Cherry Point stock as a candidate species.

Figures 17 and 18. Spawning escapement for Cherry Point Herring: 1973 – 1980 compared to 2007 (WDFW unpublished)



Surf smelt and Sand lance

Surf smelt and Pacific sand lance spawn on relatively undisturbed beaches. This makes them extremely vulnerable to shoreline modifications that alter substrate composition, thereby destroying spawning habitat. Rice (2006) examined the effects of four physical parameters compared to a control on surf smelt spawning success. It was found that an armored beach with no terrestrial vegetation had significantly higher daily light maximum light intensity, higher daily maximum and

minimum substrate temperature, significantly higher maximum daily air temperature, and a significantly lower relative humidity. The altered beach also contained approximately half the live surf smelt embryos as the natural beach. Admittedly, the small number of sites limits this validity of the results, but prompts the needs for future studies into the relationship between beach modification and surf smelt survival. Cherry Point currently has a lower percentage of shoreline modification compared to many other areas, but pressure for additional shoreline armoring is a threat to healthy forage fish populations.

Shellfish

Dungeness crab populations in Whatcom County are fairly healthy, although there is extra pressure placed on the population from increasing harvests of Dungeness crab (Whatcom MRC 2009) Threats to crab habitat include shoreline development (bulkheads and dredging), loss of eelgrass beds, pollution and competition with invasive species. Impacts of shoreline development are described later in this chapter.

Effects of urban pollution on Dungeness adults are not well known, but they are not tolerant of low dissolved oxygen. Larvae are highly sensitive to insecticides and heavy metals as well as to variation in temperature and salinity (Dethier 2006). All life stages show highest survival in higher salinity waters. The reliance of juveniles on estuaries, including eelgrass beds, suggests that this stage may be the most vulnerable to human impacts. Dredging in estuaries, for example, causes severe habitat alteration or loss for Dungeness crabs. Because crab larvae feed in the water column, in order to survive they require a predictable and non-toxic supply of plankton and edible detritus, and a minimal load of suspended sediment, which can clog their feeding structures. Toxic plankton blooms, even though they may not affect the shellfish themselves, can result in increased biological oxygen demand, resulting in reduced oxygen levels that are deadly to crabs. Harmful algal blooms of benthic algae, which may be caused by excess nutrients in the water column may smother organisms beneath them (Dethier 2006).

Any human impacts that alter sediment size or supply can reduce settlement, reduce growth, or outright kill many species of shellfish. For Dungeness crabs, preferred sediments are fairly fine sand or mud, often associated with eelgrass in shallower habitats (Dethier 2006). Crabs can also be affected by impacts to natural currents, as they rely on them for transport to nearshore settlement areas. Changes in the physical or chemical environment that causes physiological stress to organisms, such as loss of eelgrass beds, or changes in surface sediments, may make them more vulnerable to parasites or predators.

Introduced competitors and predators can also have negative effects on crab populations One species in particular, the European green crab (*Carcinus maenas*), has been shown to out-compete Dungeness crab of similar size for food and habitat. Although the European green crab population is currently fairly small in Washington, if it were to greatly increase, the Dungeness crab could lose more valuable habitat, thus placing additional pressures on the population (Whatcom County MRC 2009). Spartina, Japanese eelgrass, and other species may either alter habitat for crab, or compete with native plant species, making habitat unsuitable for shellfish.

Groundfish

Palsson et al. (2009) recently used a modified version of the American Fisheries Society's Criteria for Marine Fish Stocks to establish rockfish stock status. These criteria are based upon life

history parameters relating to population productivity and compare the magnitude of stock trends over ecologically appropriate time scales. Four status categories were based upon the magnitudes of trends and included Healthy, Precautionary, Vulnerable, and Depleted. Most rockfish species were in Precautionary condition, however, copper rockfish were Vulnerable in South Sound and quillback rockfishes were Vulnerable and Depleted in North and South Sound, respectively. Based upon stock assessments in adjacent coastal waters, yelloweye and canary rockfish were in Depleted status in North and South Sound. The relatively deepwater greenstriped rockfish, redstripe rockfish, and shortspine thornyheads were in healthy condition as were stocks of Puget Sound rockfish in South Sound. As noted earlier, three populations of rockfish in Washington's Georgia Basin were recently listed for protection under the Endangered Species Act: canary and yelloweye have been designated as "threatened" and a third rockfish species bocaccio, as "endangered."

The health of rockfish stocks in Puget Sound is impacted by factors that remove excessive numbers of individuals, chronically alter or degrade their habitats and block life history pathways, or affect other species that increase predation, disease, or competition (Palsson 2009). Many stressors potentially limit the productivity of rockfish stocks in Puget Sound and include fishery removals, age truncation, habitat disruption, derelict gear, hypoxia, predation, and fishery removals of larger and older individuals. These stressors may have even greater impacts when stocks are at low levels causing, higher mortality rates that can drive stocks to dangerously low levels. Among the potential stressors, fishery removals, derelict gear, hypoxia, and food web interactions are the highest relative risks to rockfish in Puget Sound. Chemical contamination is a moderate risk manifested by undetermined reproductive dysfunction associated with exposure to endocrine disrupting compounds, loading of larvae with persistent organics via maternal transfer, exposure of pelagic larvae to toxics via contaminated prey, and exposure of long-lived adults to toxics like polychlorinated biphenyl compounds that accumulate over the life of the fish. These are most likely to impact rockfish living in urban areas but may be more widespread in the food web.

Populations of Strait of Georgia and San Juan Islands flatfish like English sole, rock sole, starry flounder, sand sole, and Pacific halibut are estimated to be in above average condition when compared to historic abundance by state fisheries managers. The population of Dover sole, however, is in critically depressed condition and could be as low as 25% of historic abundance (Whatcom MRC 2009). Toxic chemical contamination in shallow bays and estuaries where flatfish live, spawn and grow accumulate in their tissues, impair growth, resistance to disease and reproductive capability. Disrupting eelgrass and kelp beds in bays and inlets where young fish find shelter and grow takes away important nursery areas.

Commercial fishing has occurred in the past at Cherry Point and derelict fishing gear is likely present on the seafloor in the Reserve. Lost nets, crab and shrimp pots associated with current commercial and recreational fishing can continue capturing target groundfish species as well as other fish, shellfish, marine mammals and birds

Birds

Key threats to seabirds and migratory waterfowl at Cherry Point include decrease in prey species such as salmon and herring, toxic contaminants, oil spills, derelict gear, and changing water temperatures. Threats to listed and indicator species are described below.

Marbled Murrelets

Marbled Murrelets (*Brachyramphus marmoratus*) are threatened by habitat loss and fragmentation, accidental by-catch of gill net fisheries, and environmental contamination from oil spills and pollution (WDFW 2005). Critical habitat was designated in 1996. Recently the United States Fish and Wildlife Service re-listed the bird, after conducting a 5-year review and determining that the bird continued to decline. The USFWS also determined that the bird was a Distinct Population Segment under the Endangered Species Act. The review team determined that the Marbled Murrelet population in Washington, Oregon and California continues to decline and faces a broad range of threats, such as nesting habitat loss and fragmentation and predation. Although some threats, such as gillnet bycatch and lack of regulatory mechanisms, have been reduced since listing, most continue and the species faces new threats, such as abandoned fishing gear at sea, harmful algal blooms and observed changes in the quality of the bird's marine food supply. As Cherry Point provides foraging habitat for these species, management actions should address water quality and removal of derelict gear.

Loons

A comparison of the PSAMP survey data to the 1978-79 MESA survey shows a large decline (64% decrease, $p < 0.001$) (Nysewander et al. 2005). Adjacent habitat to the Reserve provide quality wintering habitat for the common loon, and high winter counts have been documented along the Strait of Georgia, in Drayton Harbor, Lummi Bay, Hale Passage, Bellingham Bay and Padilla Bay (MESA; Wahl et al. 1981). However, the 1992 – 99 PSAMP surveys document fewer than 5 birds per square kilometer along the Cherry Point (Nysewander et al. 2005), perhaps due to the lack of inlets and the presence of deeper waters.

Cormorants

Cormorants are sensitive to human disturbance to colonies. Cormorants as a group have been killed and harassed by people who believe that the birds damage the commercial fishing industry (pelagic cormorants, however, feed on fish that aren't fished by commercial fisheries). Population fluctuations may also be tied to the California current, which is associated with upwelling, deep ocean water, rich in nutrients. Changes in upwellings that occur in El Niño and La Niña years affect food availability for this species. El Niño events reduce the number of breeding pairs as well as the reproductive success of breeders.

Such disturbances, plus commercial fishing and pollution, oil spills, gill-net entanglement, and toxic contamination of prey also affect the cormorant populations (BirdWeb 2008). The sensitivity of cormorants to human disturbance, and its reliance on fish populations for food, can be used to help monitor overall the health of ocean currents, certain fish species, and habitat at Cherry Point.

Bald Eagle

Delisted in 2008 from the federal Endangered Species list, the bald eagle (*Haliaeetus leucocephalus*) will remain protected under the federal Bald and Golden Eagle Protection Act, federal Migratory Bird Treaty Act and the State Bald Eagle Protection Act RCW 77.12.655. The State law requires the establishment and enforcement of rules for buffer zones around Bald Eagle nest and roost sites. The majority of Bald Eagle nests are found on private land not dedicated to conservation (Bohannon, J. WDFW, personal communication, 2008). Perching habitat along the shoreline has been severely reduced in Birch Bay as a result of residential development. The reliance of this bird on forested areas near waterbodies containing adequate amounts of fish, birds and mollusks for food can be used as an indicator for the overall ecosystem health at Cherry Point.

Common Murres

Common Murre numbers fluctuate annually, in response to food supply and climatic events. Common Murres are the most frequent avian victims of oil spills along the Washington coast. Other threats to the population include pollution, over-fishing of prey, gill net entanglement, and predators (WDFW 2005). The population experienced a crash as a result of the 1983 El Niño event, dropping from 30,000 to fewer than 3,000 birds. While some populations have recovered, others have yet to rebound, and the population is about one-third the former level (BirdWeb 2008). Common Murres are highly sensitive to human presence, whether humans are on foot, in a boat, or in a low-flying plane. When disturbed, the birds may knock eggs and chicks out of the nest sites in their haste to fly clear of the disturbance. The unguarded chicks and eggs become easy prey for gulls and other avian predators (WDFW 2005; BirdWeb 2008). Common Murres can be used as an indicator of the overall water quality and presence/absence of marine debris, for the foraging areas at Cherry Point. Researchers should investigate and see if this significant decline is a result of the El Nino crash, or if the population is unable to recover because of other issues. Management actions should be developed, as appropriate, for any Murres within or adjacent to the Reserve.

Surf Scoter

North American populations of scoters (*Melanitta perspicillata*) have declined by about 60% over the past 30 – 50 years, including 57% declines for all three scoter species combined in a Puget Sound since the late 1970s (Hodges et al. 1996; Dickson and Gilchrist 2002; Nysewander et al. 2005). Reasons for these declines are becoming clear, as recent research by WWU (Bower, J.L. 2009) helps link the declines over time to the declines in herring populations. Other factors include heavy metal contamination and oil spills.

Scoters in general showed significant declines in both PSAMP/MESA (-57%) and the WWU/MESA (-33%) comparisons. The Surf Scoter declined by 60% when WWU compared results to MESA counts. Bower, J.L. (2009, unpublished) states that much of the decline in Surf Scoters in the WWU/MESA comparison resulted from greatly decreased numbers of Surf Scoters congregating at the collapsed Cherry Point herring spawn event (Stout et al. 2001). For example, during the MESA study, on 30 April 1978, MESA researchers counted 40,100 Surf Scoters at Cherry Point. However, WWU counted in late April of 2004 and 2005 in the Cherry Point area and there were less than a thousand surf scoters.

To show how herring impacts surf scoter population, removal of the spring Cherry Point spawn event from the WWU/MESA data set results in reduction of the census-wide decline in Surf Scoters by one half. In this case, the temporal and geographic resolution of the WWU/MESA comparison offers evidence that much of the apparent decline in Surf Scoters is tied to the collapse of the herring spawn in the Cherry Point area (Bower, J.L., unpublished, 2009).

As discussed in Appendix A, scoters both rely on herring spawn as a food source, but research shows that herring spawn may be critical for surf scoters to help build up fat reserves prior to migration. For this reason, Anderson et al. (unpublished manuscript, 2009) suggest that management of Pacific herring include protections for spawning areas that preserve feeding opportunities for these diverse predators.

Great Blue Heron

The Washington Department of Fish and Wildlife has placed great blue herons on the State Monitor List out of concern for its potential to become a species of concern as defined by WAC 232-12-297. Great Blue Herons can be vulnerable because of their tendency to aggregate during the breeding season. The availability of suitable great blue heron breeding habitat is declining as human population increases in Washington State. In addition, Great Blue Herons may abandon breeding colonies or experience reduced reproductive success when disturbed by humans. WDFW considers Great Blue Herons a "priority species" and has developed management recommendations to conserve great blue herons in the state (Quinn and Milner, 1999). While loss of nesting habitat may be an issue, adjacent to Cherry Point, the birds dependence on nearshore areas for food make them vulnerable to anthropogenic changes from shoreline armoring, increased nutrient loads, and shading.

During the 1992 – 99 PSAMP marine bird surveys, Great Blue Herons were the most common and widespread wading bird seen during summer surveys, often observed in shallow bays and estuaries. Although the most commonly observed wading bird, trends during this time period seemed to indicate a decrease in density, and the authors suggested further study.

Summer surveys were compared for two time periods: 1992-94 and 1995–1999. In the Cherry Point area, between 1992 and 1994, blue herons were observed in the northern and central portions at low to moderate densities (2 – 10 animals/km^2) and in the southern portion in higher densities (20 – 132 animals/ km^2). From 1995 through 1999, densities decreased in the southern portion to low (2 – 10 animals/km^2). Winter densities are reduced even further (0 – 2 animals / km^2 in Cherry Point) as females and young move to freshwater and males remain in marine areas (Nysewander et al. 2005). Continued monitoring and support for the rookeries along and within the Cherry Point Aquatic Reserve are necessary for this species.

Western Grebes

Grebes, including western, used to be killed for their feathers. This practice was ended, and the birds have since recovered to the point where they are breeding in areas not occupied historically. However, wintering populations of Western Grebes have declined in all wintering sites in Puget Sound covered by Christmas bird counts. The winter aerial surveys in western Washington 1994-2005 (Nysewander et al. unpublished data) also confirm the same type of decline in wintering numbers for Western Grebes in the inner marine waters. This species exhibits the greatest percentage of decline (81 to 95 percent) over the last 30 years for any one marine species. Despite these declines, Washington continues to support globally significant numbers of Western Grebes between late autumn and early spring. Up to 20 to 25 percent of the world population of Western Grebes (Kushlan et al. 2002) over-winter in the state. This suggests that Washington will play an important role in any conservation effort expended towards this species. Fluctuating water levels, oil spills, gill nets, and poisons such as rotenone (used to kill carp) are factors that negatively affect the population. When approached by humans, the parents will leave the nest, leaving eggs vulnerable to predation and the elements. Thus, areas frequently disturbed by humans may have low productivity. Grebes are considered a Candidate species by the Washington Department of Fish and Wildlife (BirdWeb 2008; Nysewander et al. 2005).

Currently, the greatest threat to grebes is human development. In addition to shoreline armoring, decreasing forage fish spawning areas, loss of eelgrass beds due to increasing nutrient loads, and overwater structures leading to increased shading, the increased scour of forage fish habitat areas

would significantly reduce available food supplies. This bird is an indicator of forage fish resources, invertebrates, and both freshwater and estuarine habitats. For these reasons, its numbers should be watched closely as an indicator of the resources it relies upon for survival.

Past (PSAMP 1999; MESA 1979) and recent research (Bower et al. 2005) which show this species is declining in large numbers and should be supported by the management actions in this plan. A discussion on the grebes decline by Bower makes the following statements (Bower, J.L., unpublished, 2009):

- The Western Grebe is showing a different pattern of decline in that it is declining across many locations, and in every month of the survey;
- Western Grebes over-wintering in industrial locations have been shown to contain high levels of industrial contaminants that approach levels needed to disrupt endocrine function in other birds;
- Western Grebes are known to be mortally impacted by oil spills;
- Western Grebe breeding colonies rely upon freshwater lakes, often impacted by development, pollution, and recreational activities, and
- Similar declines have been reported in the northeastern lakes and central Alberta lake

Peregrine Falcons

Peregrine Falcons (*Falco peregrines*) were severely endangered (and actually extirpated from eastern North America) in the mid-20th Century, mostly due to the pesticide DDT, which softens eggshells and results in widespread nest failure. With the ban of DDT in the United States, the falcons have begun to recover, but WDFW still considers environmental contaminants a specific problem with this bird. Another specific problem is disturbance by humans (WDFW 2005). The population is still small and is highly vulnerable to disturbance and environmental contaminants, but productivity levels are high and the population continues to increase (Bohannon, J. WDFW, personal communication 2008). The sensitivity of this species to environmental contaminants, and human disturbance, can be used as an indicator for both water and habitat quality at Cherry Point.

Osprey

The primary threat to the Osprey (*Pandion haliaetus*) has been organchlorine biocide use, such as DDT, which results in the thinning of eggshells. The ban of DDT in 1972 continues to support a strong recovery in much of North America. Artificial nest platforms have significantly increased nesting in many areas. The Breeding Bird Survey has reported a significant increase in the Osprey population in Washington. Other threats may include gunshots, steel traps, impacts with or electrocution by high-tension wires, and being caught or drowned in fishing nets (NatureServe 2008; BirdWeb 2008). The sensitivity of this species to environmental contaminants, human development, marine debris, quality of fish as a food source, and human disturbance, can be used as an indicator for a the overall health of the Cherry Point ecosystem.

Cavity Nesting Ducks

The diet of cavity nesting ducks includes a high percentage of aquatic insects, invertebrates, shellfish, crustaceans and small fish. Low benthic macroinvertebrate abundance may limit the productivity of Harlequin Ducks (Bengtson and Ulfstrand 1971). Populations are highly sensitive to additional mortality from hunting, oil pollution or food contamination. Lease and Kraege (1999) recommend protecting rocky shoreline areas that are used during winter and limiting disturbances at

traditional molting sites. The use of herbicides that affect emergent vegetation, and activities that may contribute contaminants which would bioaccumulate should be considered. The use of herbicides or pesticides near wetlands may affect cavity-nesting ducks by lowering the numbers of invertebrates, and by adversely affecting aquatic and emergent vegetation. These ducks are known to accumulate toxins in their tissues, especially in areas where toxins are elevated, such as downstream from mines, pulp and paper mills (Lewis and Kraege 2000).

Marine Mammals

Generally speaking, threats to marine mammals at Cherry Point include: toxic contamination and oil spills, vessel strikes, entanglement in marine debris, disturbance from vessel noise, and loss of prey.

Gray Whale

Despite the reduction in stock abundance, the population of gray whales in the eastern Pacific is estimated to have increased compared to commercial exploitation in the mid-1800's. Numbers are around 23,000 and the U.S. Fish and Wildlife Service removed the species from the list of threatened and endangered species in 1994. The Washington State Department of Fish and Wildlife also down listed from "state threatened" to "state sensitive." (Angliss and Outlaw, 2005; Richardson, 1997).

Northern gray whales are summer residents in Northern Puget Sound. During these times, they are often found in shallow coastal waters, where feeding activities involve scooping up bottom sediment and benthic invertebrates, which are then strained. Because of the way gray whales feed, this species has the potential to ingest toxic contaminants in nearshore areas of Puget Sound and Georgia Straits (Richardson 1997; Yates 1988). Potential impacts to the food source – benthic invertebrates - should be taken into consideration. Impacts to gray whale habitat include sounds generated for oceanographic research, disturbances related to oil and gas exploration, contaminants in the benthos, vessel traffic, and onshore and nearshore development (Richardson 1997). From 1980 to spring, 2009, gray whales in Washington waters had the highest incidence of documented mortality due to blunt force trauma, which were generally attributed to ship strike (Douglas et al. 2008, unpublished stranding data, Cascadia Research Collective).

Killer Whale

Killer whales in Washington face three main potential threats: prey availability, pollution and contaminants, and effects from vessels (NMFS 2008). Other risk factors include: demographics, small population size, and vulnerability to oil spills. Healthy killer whale populations are dependent on adequate prey levels. Reductions in prey availability, such as salmon, may force whales to spend more time foraging and might lead to reduced reproductive rates and higher mortality rates. The NMFS recovery plan addresses salmon restoration to ensure adequate food supply for the whales.

Recent studies have revealed that transient and southern resident whales are heavily contaminated with organochlorine pollutants, primarily PCBs and DDT residues. Both populations are now considered as among the most highly contaminated marine mammals in the world (Wiles 2004). Killer whales are candidates for accumulating high concentrations of pollutants because of their position atop the food web and long life expectancy ((NMFS 2008). While PCBs and DDT are no longer produced in Canada or the United States, a growing list of so-called "emerging" contaminants and other pollutants, such as brominated flame retardants (BFRs), perfluorinated compounds, persistent polycyclic aromatic hydrocarbons, and numerous other substances, are increasingly being linked to harmful biological impacts as well (nmfs, 2008). These pollutants come from a wide

variety of sources, such as: municipal incinerators, runoff from sewage sludge, wood treatment, oil spills, electrical components and backings of televisions and computers, textiles and vehicle seats, pesticides and refrigerants, flame retardants, plasticizers, paints, sealants and additives in lubricating oils, detergents, shampoos, plastics, and pulp and paper mills. The NMFS recovery plan addresses cleanup of existing contaminated sites, minimizing discharge of contaminants harmful to whales, and monitoring of emerging contaminants.

Commercial shipping, whale watching, ferry operations, and recreational boating traffic have expanded in many regions in recent decades, including the northeastern Pacific. Commercial fishing boats are also a prominent part of the vessel traffic in many areas. Vessels have the potential to affect whales through the physical presence and activity of the vessel, the increased underwater sound levels generated by boat engines or a combination of these factors (NMFS 2008). Vessel strikes are rare, but do occur and can result in injury. In addition, underwater sound can be generated by a variety of other human activities, such as, dredging, drilling, construction, seismic testing, and sonar.

Killer whales rely on their highly developed acoustic sensory system for navigating, locating prey, and communicating with other individuals. Increased levels of anthropogenic sound have the potential to mask echolocation and other signals used by the species, as well as to temporarily or permanently damage hearing sensitivity. Exposure to sound may be detrimental to survival by impairing foraging and other behavior, resulting in a negative energy balance. In other cetaceans, hormonal changes indicative of stress have been recorded in response to intense sound exposure (NMFS 2008). Chronic stress is known to induce harmful physiological conditions including lowered immune function, in terrestrial mammals and likely does so in cetaceans. The threshold levels at which underwater sounds become harmful to killer whales remains poorly understood. The NMFS recovery plan addresses evaluation and improvement of guidelines and regulations for vessel activity near southern resident killer whales.

An important short-term risk to killer whales and their prey in the Georgia Basin and Puget Sound is the threat of sizable oil spills. Despite the great increase in killer whale research in Washington and British Columbia since the early 1970s, researchers remain divided on which of these threats are most significant to the whales. It may well be that a combination of threats are working to harm the animals, especially L pod.

Water Quality

Nonpoint Pollution Management

Nonpoint source pollution, unlike permitted discharges from industrial and municipal sewage treatment plant outfalls, comes from many different sources as a result of rainfall and/or snowmelt moving over and through the ground. Runoff collects nutrients and toxics from upland surfaces and discharges them into streams and marine receiving waters without any treatment. Nonpoint sources of pollution include yards, roads, construction sites, marinas, forest lands and agricultural lands. all industrial sites monitor storm water runoff as required by NPDES permits, however there are many other potential sources of storm water runoff that aren't monitored in the Reserve area..

Nonpoint source pollution, if untreated, can contribute to water pollution. In many areas of Puget Sound it affects the flow, chemistry, mixing, temperature of receiving waters, and results in localized

decreases in salinity and dissolved oxygen levels. It can also increase biological activity resulting from nutrient inputs and result in shellfish bed closures and other health issues.

The following are potential sources of nonpoint pollution to fresh and marine waters in the Cherry Point Aquatic Reserve:

- Excess fertilizers, herbicides, and insecticides from residential areas;
- Oil, grease, metals, and toxic chemicals from roads and impervious surfaces;
- Soil from erosion on construction sites and eroding bluffs due to drainage problems on residential properties;
- Bacteria and nutrients from pet wastes, and faulty septic systems.

Whatcom County (2006) describes the nearshore and marine waters as receiving inputs from natural sources of major nutrients, such as nitrogen and phosphorus, on a level several magnitudes greater than anthropogenic contributions to Puget Sound. The impact is offset by the continuous circulation and mixing between the nearshore and marine environments.

Nutrient loading is traced to river discharge and land uses within the watershed. Upland sources include agricultural operations, wastewater treatment plants, and residential runoff. The Nooksack River contributed the third highest annual nitrogen load and the fourth highest annual phosphorus load of all the major U.S. rivers entering Puget Sound from 1980 to 1993 (Whatcom County 2006). Nutrient contributions to the Cherry Point reach from the Nooksack River and the Fraser River have not been quantified. Nutrient input, whether natural or anthropogenic, can be detrimental at high levels. As the results from the Marine Water Quality Study showed (Newton et al. 2002), nearshore areas along Whatcom County shorelines are susceptible to eutrophication from high levels of nutrients including Portage and Drayton Harbors (shellfish protection districts), and Bellingham Bay, an enclosed bay that receives large amounts of fresh water and nutrients from the Nooksack River. These sheltered bays are especially susceptible to elevated pathogen levels from upstream anthropogenic sources. However, the role of nonpoint source pollution in affecting water quality at Cherry Point in not well understood.

Researchers examining declines in the growth of eelgrass suggest a link to increased human development (Short et al. 1996, Lee et al. 2003). While there appears to be no direct link to increased nitrogen loads, the data suggest an indirect link as a result of increased competition from algae, eelgrass epiphytes and nutrient tolerant vegetation (Short et al. 1996; Lee et al. 2003). Impacts associated with increased freshwater inputs may also be a factor in the decline of eelgrass. As impervious surface increases, estuarine environments can receive greater amounts of freshwater decreasing salinity levels that can result in increased habitat for species more tolerant of freshwater (Short et al. 1996). Decreases in the depth of the euphotic zone from increases in suspended sediments and phytoplankton populations may also be a factor in eelgrass declines.

Groundwater Contamination

Ecology and others have expressed a concern that contaminated groundwater is discharging directly to the herring spawning zone in some locations along the Cherry Point reach (Wigfield, personal communication, 2008). Additional testing is needed to determine if this is the case and to identify potential sources if contamination is detected.

Legacy sources of contamination resulting from historic (unregulated) industrial waste disposal may still exist on adjacent uplands, such as the TreOil Industries Limited site (4242 Aldergrove Rd.). Contaminants may have leached into the groundwater which later discharges into the nearby marine receiving water. The abandoned TreOil site was historically used to process TreOil, a by-product of the kraft pulp and paper industry. An inspection by Ecology in 2000 revealed the presence of an unsecured laboratory in a modular-type home, a number of above-ground storage tanks and drums with unknown material, many of which were leaking, and other unsecured industrial waste. Some of the drums contained a rosin-type substance which was sampled by the inspectors (see Figure 19). A sand-blasting area was located on the property, and the presence of grit was noted.

Ecology has identified the site as potentially hazardous to human health and /or the environment. Ecology also notes there is some potential for this site to be contributing to herring mortality through groundwater transport to the nearshore areas of management area (Marshall, R. personal communication). The TreOil site is ranked 2 on Ecology's list of Hazardous Sites awaiting cleanup as of February 20 2008 (Ecology Hazardous Sites List 2008).

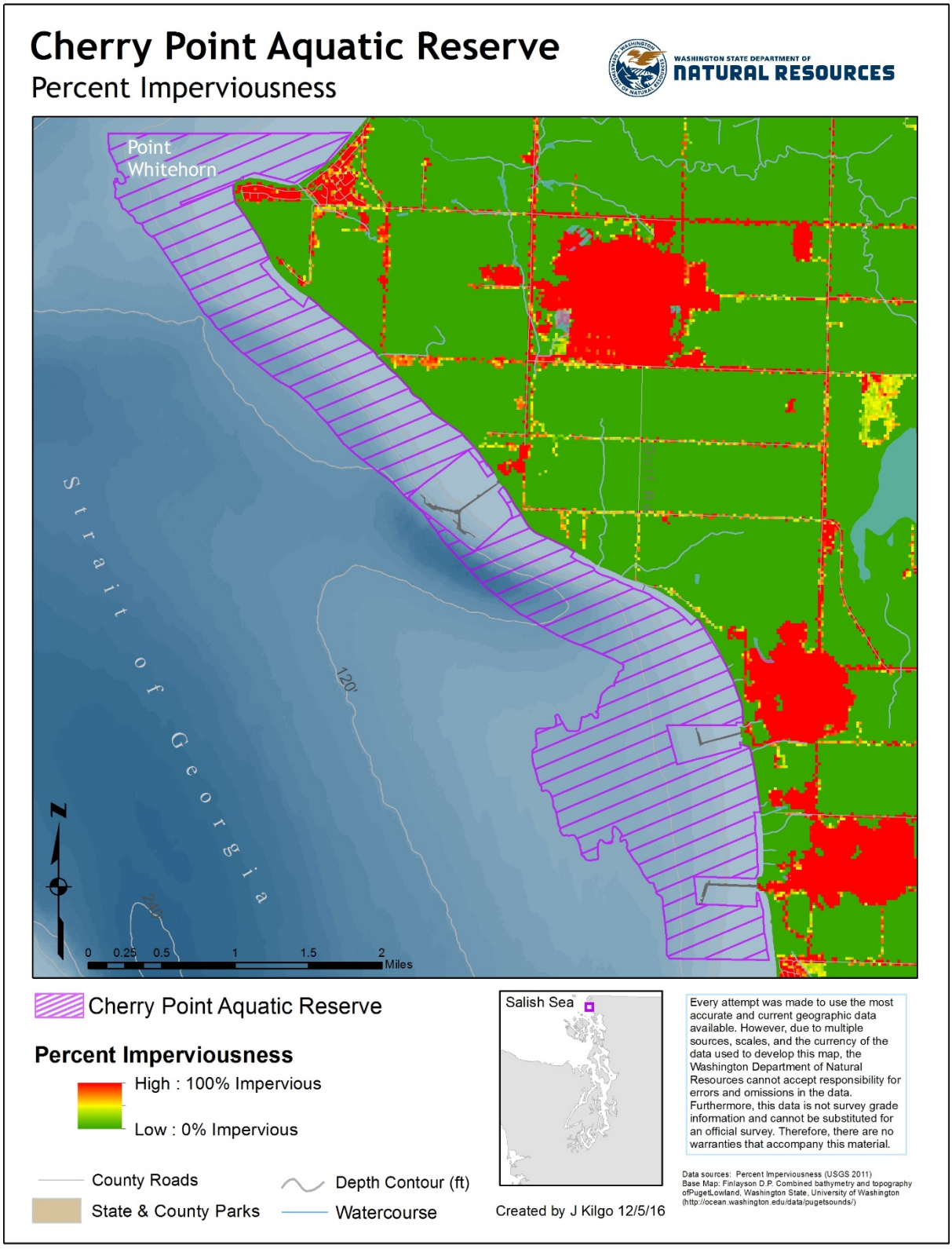
Figure 19. Close up picture of rosin pile at TreOil property, taken by Ecology Inspector in 2000

Point Source Pollution Management

As part of the requirements for obtaining industrial wastewater or stormwater permits, the three Cherry Point industries have allowed or conducted tests of the surrounding water column and sediments. While initial testing indicated the presence of certain potentially historical contaminants, current work by state agencies as addressed in recent NPDES permits indicates improvement (Ecology 2007). In general, compared to other locations in Puget Sound and the Strait of Georgia, chemical concentration in receiving waters and sediment at Cherry Point is relatively low. The Cherry Point reach receives considerable dilution from freshwater inputs, as noted earlier in this document. The freshwater inputs increase dilution along the reach, decreasing the possibility of high nutrient load from industrial and municipal outfalls. Considerable dilution is believed to occur in the Cherry Point area and Georgia Strait due to the contributions of fresh water from the Fraser River (Wigfield, K. personal communication, 2008). Figure 20 shows the general number of NPDES

permits, industrial discharge permits and outfalls that are permitted to discharge into or adjacent to the receiving waters of Cherry Point. Figure 20 also shows the percent of impervious surface, which is often associated with stormwater outfalls to control discharge (not shown on this map).

Figure 20. Percent Impervious Surface



Sediment studies within the area have mostly consisted of monitoring conducted under the three industrial NPDES discharge permits. Although this monitoring has documented contamination

associated with the three industries, Ecology cannot tie any sediment violations of Sediment Quality Standards to existing industrial discharges. Contaminated sediment in the area of Alcoa-Intalco Works's pier has been traced to historical spills or releases from the aluminum smelter.

Sediment studies were performed at the BP facility in 2006, at ConocoPhillips in 2004, and at Alcoa in 2000. Although contaminants were detected at all three facilities, levels were not at concentrations sufficient to cause listing on the Washington Department of Ecology 303(d) list of "impaired waters" or the imposition of a "sediment impact zone" (SIZ). The contaminants were detected in a localized area around the discharge locations under the industrial outfalls with concentrations of Polyaromatic Hydrocarbons (PAH) below the current sediment quality standards (SQS), as set by the Department of Ecology. Contaminants were also detected in sediment at the pilings containing creosote, linked to the wood treatment materials for those pilings (Wigfield, personal communication, 2008).

Future Information Needs

Further information is needed regarding the environmental fate of the natural and anthropogenic discharges entering the Cherry Point Aquatic Reserve. Studies should build a better understanding of bioaccumulation in both flora and fauna species of interest at Cherry Point. These studies should pay particular attention to the intertidal and upper subtidal zones. Should adverse impacts be identified, management agencies should consider the need for additional controls to reduce or eliminate these impacts to the habitat and species identified for conservation in the Reserve.

The following elements of water quality in the Reserve should be monitored closely:

- Localized ambient water temperature changes and associated sources
- Exceedances of the State Sediment Management Standards and sources
- Exceedances of the State Water Quality Standards and sources.
  The potential cumulative effect from the natural discharges, anthropogenic discharges, and water current/temperature modeling. This evaluation will become more important as sea temperatures rise with climate change and increases become measurable in the Reserve.
- Relationship between nearshore species, survival and water quality

Modeling of the area needs to be revisited. Water quality within the Reserve is influenced by a variety of natural and anthropogenic sources including the Fraser and Nooksack rivers, outflow from Birch and Lummi Bays, industrial discharges, domestic discharges (sewage and septic), marinas, recreational and commercial vessel discharges, and stormwater runoff along the Cherry Point shoreline. A number of studies, particularly since 1954, have documented some of these influences and the natural or ambient water quality of the area. In 2001, at the request of the Cherry Point Technical Workgroup, ARCO, TOSCO, and Alcoa-Intalco contracted with ENSR/AECOM Consulting and Engineering to model the cumulative effects of the three effluent plumes from their plants to the Cherry Point Aquatic Reserve. The model consisted of a three-dimensional hydrodynamic circulation and effluent transport study. While the final model results concluded that accumulation of effluent from the three industries does not occur and water quality standards are not exceeded, there were several limitations to this model (Wigfield, personal communication, 2008).

The model did not include consideration of the following:

- Discharge from the outfall belonging to Birch Bay Water and Sewer District,

- Discharge from the Lummi reservation wastewater outfalls,
- Discharge from the stormwater runoff from Unick Road,
- The impacts of other varied sources of non-point source pollution such as groundwater seepage from hazardous waste cleanup sites,
- Influence of pollutants and freshwater from the Fraser River, and
- Evaluation of the potential for pollutants to accumulate in the nearshore during certain wind or storm conditions (Wigfield, personal communication, 2008).

While the three current industrial outfalls are in compliance with applicable permits, a more thorough analysis of cumulative water quality impacts should be conducted, preferably through the collection of in-water samples to verify the conclusions of the 2001 modeling effort (Wigfield, personal communication, 2008).

Disturbance from Recreational Activities

Disturbance to the beach by recreational shellfish digging is altering the ecosystem in several areas of the Cherry Point Aquatic Reserve (Kyte 2007). Area scientists believe the direct and indirect impacts from this activity are significant to herring and other shellfish reproduction. Habitat alteration results in impacts to benthic habitat, intertidal biota, and particularly impacts to herring spawning substrate.

The impact is caused by a relatively small number of recreational shellfish harvesters who do not refill holes as required by WDFW regulations. This results in permanent alteration to Cherry Point beach and intertidal habitat. The impact is primarily in boulder and cobble substrates where the mounded material dug from the hole is not typically restored by tidal and wave action. Public and private property have been impacted, including Point Whitehorn to south of the Gulf Road.

Recreational activities other than shellfish harvest may impact habitat and wildlife in the area. Questions have been raised regarding disturbance of birds and marine mammals by dogs and human activities. Beach fires reduce habitat and threaten riparian areas. Trampling of sensitive vegetation can result in impacts to sea grasses and algae. As public access increases, these issues could be amplified. At this time there is a lack of education regarding the sensitive nature of many of the systems and resources along Cherry Point.

Shoreline Modification at Cherry Point

Despite the presence of three large industrial piers, the Cherry Point Aquatic Reserve has much less shoreline modification than many other comparable areas in Georgia Strait. Only 9% of the shoreline has been significantly modified (Whatcom County, 2006). This is far less than the Georgia Strait region where 32.6% of the shoreline has been modified (Berry et al. 2001).

Shoreline modifications occur in several locations within the Reserve, potentially influencing ecological characteristics of the shoreline at Cherry Point (see Figure 16). The primary forms of armoring are bulkheads in the area of Point Whitehorn on Birch Bay. In addition there is armoring along Gulf Road. Finally there are two large rock revetments and fills at the Conoco and Alcoa-Intalco piers. Evidence of adverse impacts from Birch Bay bulkheads has been the focus of Whatcom

County managers for several years where they are requiring modifications of these bulkheads. Riparian habitat acts as the interface or transition zone between aquatic and terrestrial ecosystems. Shoreline armoring and fill, overwater structures and land clearing associated with industrial, residential, and recreational land use and activities have the potential to adversely impact, the riparian areas along Cherry Point (Figure 18). Such impacts include disturbance and loss of habitat functions. Additional concerns include the removal of native vegetation, degradation of water quality, and altering recruitment of large woody material and sediment by either accelerating or limiting input. Climate change may also affect riparian areas. Species affected by impacts to the riparian habitat include peregrine falcon, bald eagle, great blue heron, and coho salmon.

Disturbance and loss of riparian habitat functions could lead to a net loss of resource values and function within the Cherry Point Aquatic Reserve. The level of habitat disturbance and alteration should be monitored. For example, tracking removal of native vegetation and any degradation of water quality are ways to monitor disturbance and loss of habitat function.

Armoring and modifications have the potential to disrupt sediment supply and transport. Shoreline armoring alters beach and subtidal substrates when sediment distribution patterns are changed or cut off. Often substrates become coarser, affecting the natural or successful growth of kelp, macroalgae and eelgrass. Natural nearshore drift processes are essential to the support and conservation of the resources identified in Section 4, particularly nearshore vegetation and the species that rely upon these ecosystem components, such as juvenile salmon and herring. The Cherry Point "feeder" bluff supplies sediment north to Birch Bay and further south toward the refineries and Sandy Point and into Lummi Bay. The Puget Sound Salmon Recovery Plan (2005) recommends these sediment transport processes be protected through critical areas and appropriate shoreline management designations as well as stewardship efforts.

Shoreline armoring, and/or filling intertidal areas impact wave energy by diverting it in different directions. This wave energy is needed to keep the natural hydrology intact, keep drift cells and sediment moving, and prevent the erosion of beaches. Hard shoreline armoring structures can also result in scouring, if this energy is re-directed to a different location along a shoreline (Jacobson 1980; Whatcom County 2006). Further research is needed to determine the type and magnitude of effect of shoreline armoring in the Reserve.

Overwater Structures at Cherry Point

All heavy industrial facilities at Cherry Point possess wharves and piers for commerce of their materials. Design, level of use, and management, dictate the level of impact on ecosystems from structures such as these. Potential environmental impacts tend to be highly correlated with the level of light intensity below the structures, and research (DNR 2007) has shown that the spatial extent of the area influenced by an overwater structure is the sum of both the footprint of the activity and the areal extent of the alterations that are the result of the activity/structure (area of alteration). Industrial wharves and piers can impact water quality, create diversions in the local hydrology, disrupt sediment flow along drift cells, shade aquatic vegetation, and diminish the euphotic zone in the area of the facility. There is also potential for impacts from vessel traffic, noise, prop wash, ballast water and waste discharges, fuel spills, hydraulic fluid spills, material spills, and other activities associated with these facilities that may directly and indirectly impact aquatic flora and fauna (Nightengale and Simenstad 2001). At this time, little information is available regarding the environmental effects of the existing piers or their operations.

Light Shading

One potential impact from overwater structures is the alteration of light in the surrounding area. During day, light under the piers may be limited due to shading. This is a function of the width of the dock and its orientation. At night, security and operational lights on the dock or moored vessels may brighten the otherwise naturally dark waters. Alteration of light conditions in the nearshore has been shown to alter fish migratory behavior and distribution, and affect the ability of predatory fish to see their prey (Simenstad et Al. 1999). Loss of submerged aquatic vegetation has likely occurred from overwater structures at Cherry Point, but this has not been well studied. A study of the ARCO pier found that shading from the pier appears to limit the growth of marine vegetation (Shapiro & Associates 1994.)

Grette and Associates (2007) reports that in Bellingham Bay, Whatcom County, intertidal and subtidal shading decreased the availability of light under and surrounding overwater structures located in the Port of Bellingham. It is further discussed how shading is a primary concern because it reduces the amount of light available for photosynthesis by aquatic vegetation, which can have implications for habitat structure, complexity, and for the surrounding food web (Grette and Associates 2007). The U.S. Corps Wetlands Regulatory Assistance Program reported that within seagrass habitats, increasing plant biomass and density (i.e. complexity) have been shown to be correlated with higher density and biomass of many fisheries species (Blackmon 2006).

Studies in the Puget Sound region have suggested that under-pier light limitations could result in the following behavioral changes: 1) migration delays due to disorientation; 2) loss of schooling in refugia due to fish school dispersal under light-limited conditions, and 3) increased size-selective predation risk due to changes in migratory routes to deeper waters to avoid light changes (Nightengale and Simenstad 2001). This behavioral relationship makes sense in light of the point that teleost fishes, a classification that includes all fish, depend upon sight for feeding, prey capture, and schooling. The underwater light environment determines the ability of fishes to see and capture their prey. There are also species-specific differences to consider with respect to how fish react to light. Species that occupy and defend stream territories, such as coho, tend to be quiescent at night while species that disperse to estuaries, such as chinook, pink and chum typically school, show nocturnal activity, and demonstrate an aversion to light (Nightengale and Simenstad 2001).

Nighttime attraction to artificial lighting has been studied extensively at the Bangor Submarine Base Explosives Handling Wharf (EHW) in Hood Canal (Prinslow et al. 1979). The security lights at this facility are low-pressure sodium vapor lights and incandescent spotlamps, producing 1 to 19 lux[15] at the water surface. No significant difference in catch of chum was detected during period of lights on or lights off. However, at high levels of lighting, chum appeared to congregate, delaying migration (Prinslow et al. 1979). These aggregations were observed in both 1977 and 1979, with different light levels (24 to 61 lux in 1977, 1 to 19 lux in 1979). When considering these results it is important to note that the security lighting at the EHW is focused directly on the water.

Congregation of salmon predators has also been observed in freshwater environments. Nightengale and Simenstad (1999, 2001) report that increased artificial lighting levels at night on the dams of the

[15] The **lux** (symbol: **lx**) is the SI unit of illuminance and luminous emittance. It is used in photometry as a measure of the *apparent* intensity of light hitting or passing through a surface.

Columbia, Snake and the Sacramento Rivers attracts juvenile chum and may delay outmigration while increasing predation. In a 2004 study on the Cedar River, Tabor et al. observed that increased light intensity caused out-migrating sockeye salmon fry to slow or stop, making them more vulnerable to capture by predators.

One of ongoing questions is how to quantify the amount of shading in order to appropriately assess if an adverse impact is occurring, and if so, how to mitigate for it. Nightengale and Simenstad (2001) addressed this question. In a laboratory setting, studies have shown that the threshold for the lowest levels of maximum prey capture for juvenile chum and pink salmon occurs between 10^{-1} and 1 foot-candles which is partially equivalent to 0.5 (PAR) Photosynthetically Active Radiation. This represents the lowest end of light levels characterizing dawn or dusk which ranges from 10^{-1} to 100 ft-candles. Measurements of light levels under ferry terminals have identified under-dock areas that drop below the threshold even in the high light conditions of summer. When light intensity falls below this threshold, the fish must "dark adapt" to rod vision. During this time they are in a state of blindness with visual adaptation taking between 35 to 50 minutes. This "dark adapt" process is likely what is reflected in fish pause or directional change behavior. To summarize, if an area on a pier is measured at dropping below 0.5 PAR, fish must adapt their eyesight, which can take 35 – 50 minutes, during which they are vulnerable to predation.

Nightengale and Simenstad concluded that during daylight hours, at very minimum, under-dock light levels must be maintained at levels above 0.5 PAR to avoid this behavioral interference. They point out that this lower threshold of light level only addresses migration delays and behavioral alterations associated with required visual adaptation to light intensity variations and transitions from cone to rod vision. Cone vision is often the only form of vision for larval marine fishes. Fish visual development takes place on varying levels. Within juvenile cone vision development stages, there are also varying levels of sensitivity to the full spectrum of ultraviolet wavelengths. As visual development proceeds, juvenile marine fishes are known to behave and feed in response to specific ultraviolet wavelengths, as compared to forms of artificial light, such as fluorescent lights. Note that artificial lighting does not contain both UV-A and UV-B spectra. Evidence reveals that juvenile fish, such as salmonids, feeding in shallow nearshore waters utilize natural ultraviolet wavelengths for prey capture. Therefore, Nightengale and Simenstad (2001) conclude that by allowing the transmission of increasing levels of natural light, and thus ultraviolet light spectra, to the under-dock environment this will reduce structural interference with fish ability to capture under-dock prey.

Wave Shading

Wave shading, also known as the breakwater effect, may impact sediment transport, vegetation, local temperature, and water quality. Few site-specific studies have been conducted at any of the existing marine facilities along Cherry Point pertaining to the impact of wave structures on wave sheltering and their effects on sedimentation. In 1999, DNR commissioned a risk assessment to investigate the potential impacts of ARCO/BP's request to build an addition to its existing pier to increase the efficiency of loading and unloading activities on the Cherry Point herring stock. In 1999, EVS performed a risk assessment based on a study provided in the *Gateway Pacific Terminal Draft Environmental Impact Statement* (EVS 1999) and in a subsequent memorandum (Isaacson 1997). The study used a wave model that included various oceanographic processes, such as wave climate, currents, tides, sediment and beach characteristics, and wave breaking, to determine the sheltering effects of piled structures on wave propagation.

The potential impacts of the existing marine facilities were generally assessed by considering the

reduction of wave energy on the sheltered side of structures and docked vessels, and then considering how this change in wave energy might influence sediment transport behavior. Most winds (and therefore wave energy) come from the south, but also that there are major wind events occasionally from the west and west-northwest. Waves from the west-northwest are estimated to undergo substantially more attenuation because they would need to propagate past many rows of piles, however, these waves are usually smaller.

The ARCO/BP, Intalco, and Ferndale refinery piers have approach trestles extending to the wharfs used for berthing cargo vessels. The wharfs are generally substantially shorter than the approach trestles. All of the wharfs are roughly parallel to the shoreline while the approach trestles are perpendicular to the shoreline. Although there are insufficient data to calculate transmission coefficients for each of the existing facilities, EVS (1999) concluded that there is probably no significant reduction in wave height resulting from any of the existing facilities.

Ships and barges moored at existing piers along the Cherry Point reach can interfere with wave propagation, the extent of this influence depending on the number of ships and barges visiting a facility per year, their length, and the total time vessels are moored. As an example, from the years 1982 through 1998, an average of 229 vessels per year called at the ARCO/BP facility (EVS 1999). Assuming each vessel was moored for at least 24 hours, this represents, at a minimum, 229 days out of the year that vessels moored at the ARCO/BP facility would interfere with wave propagation. From this analysis, he estimated that the impacts of docked vessels at the existing structures would be very small.

The orientation of the existing piers are generally north-south to northwest-southeast. Because of the proximity of the piers and their similar orientation, EVS concluded that sedimentation on the sheltered side of the piers would not be significant. However, there have been no studies done to verify this.

EVS (1999) concluded that existing structures and docked vessels along the Cherry Point reach would not likely cause substantial wave sheltering or increases in sedimentation. Furthermore, when compared to the total shoreline available along the Cherry Point reach, approximately 14.5 km (9 mi), the combined influence of these three piers would represent only a fraction of the available habitat. Thus any potential effects due to wave sheltering and sedimentation would be expected to be minimal when compared to the available habitat.

Changes in Epibenthic Assembles

Haas et al. found a statistically significant difference in the epibenthic assemblages that exist around large overwater structures when examining ferry terminals in Puget Sound (2002). These differences were demonstrated in both density and composition of the epibenthos at three ferry terminal structures, both over time (stratified-monthly sampling) and at several tidal elevations and habitat types (stratified-monthly sampling, eelgrass sampling, and cross-terminal sampling). While differences exist, the exact feature or features of the overwater structures which cause these differences was not determined in the study. Haas et al. concluded that decreases or changes in epibenthos density, diversity, and assemblage composition are probably caused by the following four interacting factors:

(1) direct disturbance and/or removal by regular vessel disturbance;
(2) reduced benthic vegetation or compromised benthic vegetation function due to shading and physical disturbance;
(3) physical habitat alterations (e.g., altered grain-size distribution from propeller wash

or piling effects), and

(4) biological habitat alterations (e.g., increased shell hash from sea star foraging and reduced eelgrass density due to benthic macrofauna disturbance)

However, while recognizing that nearshore vegetated habitats are highly productive and play an important role in ecosystem food chain support, the U.S. Army Corps of Engineers calls for further studies to gain a clear understanding of the overall importance of eelgrass and kelp habitats for food web productivity in the Pacific Northwest (Blackmon, D. 2006). More information is needed regarding epibenthic conditions around the Cherry Point piers before conditions can be evaluated.

Potential Impacts of Excessive Intermittent Sound on Forage Fish

Noise has been identified as a potential stressor on Pacific Herring and other commercial fish species. (EVS 1999; Schwartz and Greer 1984); most commercial fish react to loud noise, and these reactions are most pronounced in migratory schooling fish which rely upon hearing to detect environmental cues, such as approaching predators. Physical impacts can occur associated with construction project noise, such as pile driving, and have been documented (Laughlin 2005). Vessel noise is also intermittent, but the impacts are not well studied. Whether it is "loud" to various species of concern at Cherry Point is not understood. What is known is that despite vessel traffic and the associated noise, Cherry Point herring stock have continued to spawn on the Cherry Point shoreline and near the three existing marine industrial facilities.

Defining Noise at Cherry Point

There are three primary types of underwater noise:

- Physical – wind-driven, rainfall, breaking waves
- Biological – animal sounds
- Man-made – ship machinery, propellers, water disturbance.

Ambient noise conditions in the marine environment are dependent on source, propagation, and absorption conditions. Underwater noise in the natural environment is strongly affected by currents; bottom topography; water density variation due to salinity, turbidity, and temperature; the presence of manmade structures; noise from other sources; and surface conditions (wind and wave). Noise levels increase in shallow, hard bottom habitats. In the Cherry Point Aquatic Reserve, seafloor topography may create an unusual hydroacoustic situation. Alden Bank borders the western portion of the vessel-approach path. Sound produced by traveling vessels may reflect off Alden Bank and continue to resonate between the shore and the bank over the southern portion of the herring spawning area (EVS 1999).

It is unclear how vessels frequenting herring spawning grounds affect the fish. It is also unclear if the noise affects either herring spawning success or individual health. A preliminary study conducted during pier maintenance at the ConocoPhillips Ferndale Refinery is the only available study of underwater noise at Cherry Point. This study, conducted in 2007, measured ambient noise levels ranging from 139 to 159 decibels (dB). The ambient noise consisted of sounds generated by above-water construction (a crane on a barge), normal operations at the marine terminal, and natural sources. These levels are comparable to those cited by Washington State Department of Transportation of 115 to 135 dB measured in the Hood Canal replacement project, and 136 decibels

dB in Eagle Harbor on Bainbridge Island. For comparison, a level of 150 – 220 dB generally occurs within pile driving, and at around 180 db, Atlantic Cod have been documented as losing hearing (Laughlin 2005).

Schwartz and Greer (1984) tried to address research questions by playing recorded natural and anthropogenic sounds on captive Pacific herring. Avoidance responses were elicited by sounds of large vessels approaching at constant speed, by smaller vessels but only when on accelerated approach, and by 11 different triads of the electronically synthesized sounds. Alarm response and less frequently, a startle response, were both elicited by those electronic sounds with an essentially instantaneous rise time in amplitude. Herring did not respond visibly to any of the taped sounds of natural origin or to sonar or echo sounders. Post-spawning Atlantic and Pacific herring may be more sensitive to acoustic stimuli than pre-spawning or spawning adults (Mohr 1964; FAO 1970; Schwarz and Greer 1984).

Post-spawning Pacific herring are voracious feeders (O'Toole, personal communication, 1999a) and vessels have been shown to disrupt feeding behavior (Schwarz and Greer 1984). It is not clear what long-term effects temporary startling has on herring schools (Olsen 1971). Sufficient uncertainty exists from published studies and local conditions that one cannot make a definite statement that ship noise does or does not have any effect. Additional study is necessary to judge the effects of current and future increases in vessel traffic. Research is necessary to ascertain whether underwater sounds like those found at Cherry Point can affect herring or other species of concern at any life stage.

Vessel Traffic

Cherry Point contains the largest refineries in Washington State; over half of all the crude and refined oil and petroleum products are loaded and offloaded here. Also present is the Alcoa-Intalco aluminum.

The industrial facilities located along Cherry Point have expanded considerably since their original construction, resulting in increased vessel traffic. BP is the largest refinery in Washington State, originally built by Arco in 1972 and has increased its capacity from 4 million to 9 million gallons of crude oil daily. The Conoco-Phillips refinery was originally built by General Petroleum in 1954 with a capacity of 1.5 million gallons per day; it as increased to nearly 4 million gallons a day. Most crude oil arrives by tanker, with a smaller amount coming from Canada by pipeline. Refined product is shipped out by pipeline, barge and rail.

The Alcoa-Intalco Works aluminum smelter was built in 1966. The capacity in 1993 was 256,000 tons of alumina processed per year, which has increased to 307,000 tons yearly or 841 tons per day. Alumina is brought to the smelter by bulk carrier to the marine terminal.

Large vessels load and unload raw materials and products at the three current facilities located in the Cherry Point area. Since these facilities have shown a steady increase in productivity, expansion, and commercial growth (market driven), it is concluded there is a corresponding increase in regional and international vessel traffic necessary to transport raw material and finished products. Vessel traffic within the Cherry Point region is predicted to increase within the next 10 – 20 years. Much of this predicted increase in traffic has been attributed to operations at a new terminal proposed for construction south of the BP pier.

The vessel traffic within the Cherry Point Aquatic Reserve is likely to continue to increase. For some time, a vessel traffic risk assessment has been in development for Cherry Point, similar to the one developed for the Washington State Ferries. This effort is supported by the Washington Maritime Association, and the Washington State Office of Marine Safety (Harrald 2006). The Vessel Traffic Risk Assessment is as part of the NEPA process resulting in an Environmental Impact Statement (EIS) for the proposed BP pier extension. The Risk Assessment will be made public with the EIS, providing further information on vessel traffic in and adjacent to Cherry Point. DNR's intention is to incorporate the information into the management strategies of this plan, if necessary, after the plan is released and in consultation with the management/regulatory agencies that have signed the MOU to implement this management plan. Cherry Point is also frequently used by commercial and recreational crab-fishing vessels, commercial trawlers and by seasonal whale-watching tours.

Projected increases and other changes in marine vessel traffic in the area may increase the risk of spills, discharges, impacts from fugitive dust and introductions of non-native species. Increased vessel traffic also increases the possibility of "strike" to wildlife in the vicinity of the vessel. This may include fish, diving birds, seals, dolphins, but the most commonly followed example is that of ships or vessels striking whales. In the interest of brevity, while recognizing that strike can impact many species, the discussion will be limited to whales. Of all the animals, they are often the most difficult to see, the hardest to avoid, and can also damage many medium to smaller size ships and vessels.

Vessel traffic in Washington State is tracked by Washington State Department of Ecology's Spill Response Program. According to Ecology, tanker traffic heading to Canada has increased significantly between 2006 and 2007 (See table 6). Ecology's vessel inspector Captain Laura Stratton has stated that 99% of these tankers take the Strait of Juan de Fuca, passing by Cherry Point. The alternative is the shallower, narrower, and much more dangerous Queens Island Sound route.

The data below from Ecology's Vessel Entries and Transits (VEAT) System for Washington shows a fluctuating number in entries and transits for tankers and barge traffic, neither significantly increasing nor decreasing over the five years examined.[16]

Table 6. Data from Ecology VEAT reports showing vessel traffic patterns in Puget Sound

Type of Tank Vessel[17]	Total					
Year	2008	2007	2006	2005	2004	2003
Tank ships bound for Puget Sound	508	614	627	575	609	588
Tank ships bound for Canadian ports via Strait of Juan de Fuca	31	231	94	50	66	55

[16] It should be emphasized that these numbers represent a fraction of the overall vessel traffic entering, transiting within and leaving Washington state waters. Please see the VEAT reports for more information at: http://www.ecy.wa.gov/biblio/spills.html

[17] A "tank vessel" is defined as any ship that is constructed or adapted to carry, or that carries, oil in bulk as cargo or cargo residue [RCW 88.46.010(20)].

Tank barge transits in Puget Sound	2,967	2,472	3,125	3,913	3,186	3,007

Currently, the majority of raw materials used by the facilities are delivered by vessel. While future trends are difficult to predict, increases in productivity, expansion and organic commercial growth (market-driven) reflect a steady increase in regional and international vessel traffic associated with raw material and finished product shipments. However, not all ship transits are of equal risk; risk is based upon size, type of vessel, cargo, weather, route, and other factors.

Risk of spills and strike spills

The risk of a spill in the vicinity of Cherry Point is best measured by the amount of traffic traveling through the Strait of Juan de Fuca. As vessel traffic increases, the risk of a spill increases (Stratton 2008). It is not possible to gauge how a spill would affect Cherry Point resources, but the risk is present, it is increasing with the rate of vessel traffic, and impacts to threatened and endangered species could be catastrophic.

Spills have occurred at the BP and Conoco-Philips Cherry Point facilities on several occasions. There is a wide range in confidence as to the accuracy of the volume of oil that has been spilled in the area, especially in earlier accounts. Accurate reporting of spills is important in determining impacts to habitat and biota. Washington State Department of Ecology has prioritized efforts on stopping the source of the spill, containing the spill, recovering the spilled product, and protecting environmental and human health. It was standard practice to accelerate cleanup and disposal of the waste generated, not analysis of cleanup volume, to achieve the most immediate, effective response. Only recently has Ecology begun to track and calculate the volume of spilled oil recovered.

The following list was provided by Ecology Spill Response Program (personal communication, 2009) during March 2009. The list is for reported spills where over 25 gallons of oil impacted water. This standard initiates a Natural Resource Damage Assessment (NRDA) and the amount of oil recovered within the first 24 hours of a spill event will be determined. The location does not necessarily dictate a responsible party.

- December 12, 1997 – FNT-340 barge @ ARCO dock: Spill of JP-5 jet fuel occurred while pumping, the lines backed up and product came out of the vents. After the leak was discovered, the USCG ordered offloading of the fuel. A drop valve was left open, product overflowed onto the deck and into the water. NRDA settled on 30 gallons to water.
- June 27, 1999 – ARCO Texas @ TOSCO Ferndale: Spill occurred during offloading, when strong currents and winds pulled the vessel away from the pier and pulling the loading arm off of the dock. No containment was used and there was no documented recovery volume. The spill to water was 1,050 gallons of crude oil, and NRDA estimated and settled on 300 gallons to water.
- June 13, 2001 – T/V Overseas Boston, ATC @ TOSCO Ferndale: The loading arm broke and released under pressure on the ship's loading arm. A significant quantity of the spill went to the dock and the ship deck. It was determined that 2,436 gallons of ANS crude oil was spilled to water and 2,016 gallons were recovered. The vessel was quickly boomed, which prevented the oil from spreading.
- August 28, 2001 – ITB Baltimore @ BP Cherry Point: Slop oil from the tanker leaked through a hole into a separated ballast tank. This ballast tank was being discharged while the tanker was being unloaded, resulting in a spill of oily wastewater. 150 gallons of gasoline

went to water during the discharge. The total volume of wastewater discharged cannot be confirmed by Ecology.

- January 18, 2005 – Tank barge Noho Hele @ Conoco Phillips Ferndale: A tug hit the barge while positioning it at the docks, and a bolt from the fender system on the tug punctured a hole into the side of the barge. Diesel spill of 416 gallons to water, and NRDA determined that 91 gallons were recovered.February 14, 2005 – Tank barge PB-20 @ Conoco Phillips Ferndale: A fracture in the hull allowed heavy black oil IFO 380 to spill into the water. 109 gallons went to water, 91 recovered.
- June 9, 2008 – Tug Tiger @ Conoco Phillips Ferndale: Diesel spilled from the starboard day tank while the Tug was maneuvering from the lay berth to the end of the dock, possibly caused by a slight list. 120 gallons went to water, 0 recovery was documented (though it was likely that >50 gallons was recovered). NRDA settled on 0 gallons recovered.

During two of these spills, there were herring larvae present. The impacts of large spills on resources, including herring and other fish and wildlife, have been widely studied in Prince William Sound. The Exxon-Valdez investigations indicated that oil spills can result in significant reproductive impacts to Pacific herring. It must be stated that the Exxon Valdez spill was an environmental catastrophe, and the scale of these studies was of similar magnitude. The relevance to Cherry Point may be limited. However, the investigations at Prince William Sound do provide helpful data for the potential impacts of a major spill impact. For more information, see study summaries in EVS (1999) pp 4-198 through 201.

Efforts to Address Potential for Spills

In Washington, a variety of ongoing efforts are being undertaken to better understand vessel traffic and spill risk along Cherry Point, including: major vessel traffic risk assessments required as part of new terminal developments, US Coast Guard review of designated anchorages, Department of Ecology oil spill contingency plan rules revisions and new oil transfer regulations, and ongoing Geographic Response Plan and Northwest Area Contingency Plan updates. Ecology has recently required that all refineries pre-boom tankers before oil is loaded and unloaded. Other measures to increase spill response requirements are being phased in slowly. Further study of dry cargo vessels may be needed, as they have been shown by the International Maritime Organization and Coast Guard to have the highest accidents rates among commercial vessels worldwide. Shipping companies mitigate these risks through thorough vetting processes. Vetting is a competitive process used by companies to gauge how well a vessel meets expected operating standards.

All tank vessels are also required under RCW 88.46.040 to prepare and submit an oil spill prevention plan, and all vessels greater than 300 gross tons must also submit a contingency plan per RCW .46.60. However, approval of a contingency plan by Ecology does not constitute an express assurance regarding the adequacy of the plan nor constitute a defense to liability imposed under that chapter of the RCW or other state laws (see RCW 88.46.040 (7) and RCW 88.46.060(10).

Since the industrialization at Cherry Point, significant efforts have been made by industry, government and the public to reduce the risk of oil spills and the impacts of commercial and recreational vessel traffic within this area. Recent investments by the tank vessel and barge industry in double hull and dual propulsion tankers are positive steps towards reducing the risk of a spill. As Alaskan oil continues to decline (Energy Information Administration 2009) the number of tankers calling from distant ports increases the exposure of Washington waters to less capable ships.

Ship Strike

With vessels, ships and hydrofoils, whales are the marine mammal often most vulnerable to strike. Ship strike injuries to whales can take two forms: (1) propeller wounds characterized by external gashes or severed tail stocks; and (2) blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae, and massive bruises that sometimes lack external expression (Laist et al. 2001). The type of injury can differ according to species; for example, on both the east and west coast of the U.S., fin whales appear highly susceptible to strike, and the cause is almost always blunt force trauma (Laist et al. 2001; Douglas et al. 2008). Laist et al. (2001) examined historical and anecdotal records, and worldwide stranding databases to locate information on whales and ship strikes. The researchers present a number of conclusions, some of which are supported by other studies in the Pacific Northwest:

- The most severe and lethal injuries are caused by ships travelling 14 knots are faster; historical records of collisions also increased sharply after 1950 when the average speed of most merchant ships increased to 15 knots.
- All types and sizes of vessels may hit whales, but the most lethal and serious injuries to whales are caused by relatively large vessels (generally 80 meters or longer).
- A great majority of ship strikes seem to occur over or near the continental shelf.
- The behavior of whales in the path of approaching ships is uncertain, but in some cases, last-second flight responses have been described or video-taped
- Ship collisions probably have a negligible impact on the status and trend of most whale populations, with the exception of very small populations or discrete groups. With the highly endangered populations, or smaller population segments, significant impacts may occur.

Douglas et al. (2008) reported on ship strikes in Washington State. In their research, the increased vessel traffic through northern Washington, into the Strait of Juan de Fuca, and to Cherry Point, Seattle and Tacoma is discussed. An estimated 11,000 vessels greater than 300 gross tons passed through the Strait in 1999, and it is expected to increase to 17,000 by the year 2025. As traffic will increase, the risk of strike also increases. The types of ships that call upon the piers at Cherry Point, in general, are large tankers and cargo ships. While it is often assumed these ships travel at less than 14 knots, which would lower the risk of a strike, Douglas et al. (2008) reports of a female fin whale on the bow of the "New York" Alaska tanker, which has a maximum speed of 16 knots. This tanker most likely struck the fin whale outside of the inland waterways and brought her in to the general vicinity of Cherry Point, near Ferndale, Washington. As Laist et al. (2001) discusses the size of a ship and the speed are two risk factors, coupled with the increasing vessel traffic in an area used by whales, that can set the stage for a collision (Laist et al. 2001).

NOAA has researched ways to reduce the possibility of ship strikes and admits that this is a complex problem to address. No easy technological advances are present or are expected in the foreseeable future that would assist mariners in substantially reducing their chances of collisions. In Hawaiian waters where high-speed catamaran ferries operate between the islands year-found, at least one ferry has been outfitted with two thermal imaging cameras, which are reported to facilitate detection of whale and whale blows ahead of the vessel at night. During the winter months, humpback whales use the waters around the main Hawaiian Islands to calve and breed, attaching new detection technology on these ferries may be an effective way to assess how useful they will be in areas with lower densities of whales. To be useful, thermal imaging will have to detect whales in rough seas, at a distance far ahead of the ship so that the vessel operator has time to maneuver, and the number of false positive detections will have to be assessed (Silber 2009).

Currently, NOAA suggests that reducing the potential for co-occurrence of whales and vessels in space and time is the only sure means of reducing ship strikes. In June of 2009, NOAA and the U.S. Coast Guard implemented regulations to reduce the risk of collisions between ships 300 gross tons and above and the endangered North Atlantic Right Whale. Vessels transiting into shipping lanes during months that the North Atlantic Right Whale would be present and feeding will be asked to use slightly modified routes. These changes were adopted by the International Maritime Organization (Silber et al. 2009).

Ballast Water Management

Washington is among the states that have chosen to regulate aspects of ballast water management. Other states include Maryland, California, Oregon, and Michigan. On an international level, voluntary efforts are guided by the International Maritime Organization. Congress is examining current EPA authorities to regulate ballast water in coastal areas. One of the primary incentives to better control of ballast water is to stem the introduction or re-introduction of non-native species to other countries or areas. Future efforts to control non-indigenous species introduced to the Cherry Point area will be directed by Ecology, WDFW, the U.S. Coast Guard, and EPA.

Ballast Water Issues

The rising level of maritime shipping is increasing the risk of invasion by non-native species in Puget Sound and the Strait of Georgia. Un-exchanged ballast water discharges from commercial ships are a primary vector for introducing non-indigenous species. As commercial shipping has been increasing at Cherry Point, this is an area that has been monitored over the years. Per the 2000 Ballast Water Law (RCW 77.120) managed by WDFW, most vessels entering Washington waters are now required to conduct an open-sea exchange prior to discharging ballast. The exchange must take place 50 nautical miles or more offshore. And, with improvements in travel technology, the rate of introductions of nonnative species has increased dramatically.

The risk of non-native aquatic plant and animal species being introduced through ballast water is a serious one. Non-native aquatic plant and animal species can displace, disturb, consume, and compete with native species (CRS 2007). Even harder to manage, non-native organisms may also be attached to the hulls of commercial vessels. This is an identified problem at Cherry Point (Markiewicz et al. 2005). Other introductions result from recreational boaters, commercial aquaculture, indirect Canadian maritime sources, and some natural sources.

A 2007 Congressional Research Service report was developed as Congress was considering whether or not to reauthorize the *Nonindigenous Aquatic Nuisance Prevention and Control Act* (NANPCA), including amending it to add specific provisions that would modify how ballast water is managed.

The CRS report found that globally, an estimated 10,000 marine species each day may be transported across the oceans in the ballast water of cargo ships. The economic, social, recreational, and ecological losses/costs attributable to aquatic invasive species are difficult to quantify. Some costs have been estimated, such as the $5 billion in damages to water pipes, boat hulls, and other hard surfaces by zebra mussels in the Great Lakes. Other costs, such as the loss of native species and environment restoration to pre-invasion quality, are unknown (CRS 2007).

Ships can manage ballast water through exchange or treatment. Exchange means that before reaching

port, the lower-salinity coastal water from the last port is released and replaced with higher-salinity ocean water. This reduces the number of non-native species by flushing them out to sea, and it is assumed they are less likely to survive in the higher salinity environment. However, there is no guarantee all organisms are flushed out (CRS 2007). Another approach is to treat the water. Ballast water treatment is currently highly researched, and a number of methodologies are being proposed. One treatment involves ultraviolet light, another is filtration and separation, others propose using heat, or electric current, and finally there are chemical treatments, such as biocides. A combination of these treatments is also possible (CRS 2007).

Nonnative and Exotic Species at Cherry Point

The risks of nonnative and invasive species were analyzed for the region including Cherry Point. Funded by U.S. EPA as part of a program to calculate the risk of an invasive species, the study identified two species of risk to Cherry Point: the invasive species European Green Crab (*Carcinus maenas*), and the nonnative *Sargassum*, a non-native brown alga. At the time of the research, green crab were being captured along Vancouver Island – in relatively close proximity to Cherry Point (Landis et al. 2005; Colnar and Landis 2007). Conversely, *Sargassum* is clearly an important habitat component in Cherry Point, enhancing the underwater vegetated communities, although possibly posing a risk to native algae (Landis et al. 2005; Colnar and Landis 2007).

History of Federal Attempts to Regulate Ballast Water Management

In 1996, the National Invasive Species Act (NISA) created a national ballast management program modeled after the Great Lakes program. All ships entering U.S. waters after operating in the offshore, beyond the U.S. Exclusive Economic Zone, were directed to undertake high seas (i.e., mid-ocean) ballast exchange or alternative measures pre-approved by the Coast Guard as being equally or more effective.

Reporting was low during the first two years, as reporting was voluntary. The U.S. Coast Guard proposed mandatory reporting, with penalties for those failing to submit Ballast Water Management reports. The Coast Guard has implemented a similar program in the Great Lakes and other waterbodies, and it has proven very effective.

The CRS report states that other aspects of the NISA have been criticized as inadequate and faulted for several alleged shortcomings, including agency weakness or delay in implementing some of its provisions. Since then, NISA has exempted most coastal wide vessel traffic from ballast water exchange guidelines. Vessels traveling short distances between U.S. ports (e.g., from San Francisco Bay, which is highly invaded, to Puget Sound, which is less so) are exempt from controls. Some parties are critical of the provisions of 16 U.S.C. §4711(k)(2)(A) giving the vessel owner a blanket exemption to ignore any mandatory regulations if the master determines that the vessel might not be able to safely conduct a ballast water exchange on the open ocean. Finally, NISA has been criticized for its apparent failure to actually prevent additional introductions of damaging organisms into the Great Lakes, despite this being the one area where the requirements for managing ballast water have been the most stringent for the longest time (CRS 2007).

While the Coast Guard is responsible for managing the Ballast Water Management Program, and ensuring that vessels abide by it, the U.S. EPA is responsible for ensuring that the discharged water complies with the Clean Water Act.

On September 18, 2006, the federal district court ruled that EPA's regulations exempting ballast

water discharges from the Clean Water Act was contrary to congressional intent and ordered EPA to promulgate new regulations within two years. This ruling essentially directs EPA to ensure that shipping companies comply with the Clean Water Act by restricting the discharge of invasive species in ballast water. The government has appealed the district court's ruling, and the parties are waiting for a ruling from the appeals court. However, in June 2007, EPA also initiated steps seeking public comment on regulating ballast water discharges from ships, an information-gathering prelude to a potential rulemaking in response to the district court's order (CRS 2007).

Air Quality, Global Warming, and Climate Change

Airborne contaminants are included in this plan because of potential impacts of atmospheric deposition to Cherry Point Aquatic Reserve water and sediment quality. Cherry Point is located in the Georgia Basin/Puget Sound airshed, which is made up of two smaller and intertwined airsheds. The Georgia Basin airshed ranges from the lower Fraser Valley, and includes Whatcom County and the coast of the Strait of Juan de Fuca. The Puget Sound airshed encompasses counties located south of Whatcom County. Cherry Point air quality is influenced by air movement within this area. The Environmental Protection Agency has described the Georgia Basin/Puget Sound airshed (Figure 21) in order to gain a better understanding of the current status of and trends in air quality, particularly given the rapid development in the area. Further detail can be found in *Characterization of the Georgia Basin/Puget Sound Airshed* (2004).

Figure 21. Georgia Basin/Puget Sound Airshed

Common Air Contaminants

The group of air pollutants referred to as common air contaminants (CAC) in Canada and as "criteria" pollutants in the Unites States includes: sulfur dioxide (SO_2), nitrogen (NO_2, ozone (O_3), carbon monoxide (CO), fine particulate matter ($PM_{2.5}$) and lead (Pb). The effects of these pollutants have been well-documented by the Northwest Clean Air Agency (2008) and include:

- **Health effects -** These can be chronic (arising from long-term exposure), or acute. For example, ozone is a very powerful oxidant which is an eye irritant and can also cause breathing difficulties, especially to older people or sick people or children.
- **Visibility impairment -** Small particles are very efficient at scattering light and therefore reduce visibility.
- **Materials damage -** Air pollutants may chemically alter the structure of a material. For example a sandstone sculpture will turn into gypsum after it has been exposed to sulfur dioxide, and gypsum is something that is much more brittle than sandstone. Ozone damages materials and causes fading to pigments.
- **Agricultural damage -** Ozone is responsible for damage to the leaves of plants, it reduces crop yield and stunts tree growth. Acid rain not only affects bodies of water but also trees and crops.
- **Climate change -** Global warming has been shown to be due to certain anthropogenic pollutants, also known as greenhouse gases, such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), ammonia (NH_3) and others. Particulate matter also might cause global cooling due to increased PM emissions. Other pollutants include ammonia (NH_3), which is considered toxic and is involved with the formation of $PM_{2.5}$. Indeed, most $PM_{2.5}$ is secondary in nature[18], with sulfate $PM_{2.5}$ and nitrate $PM_{2.5}$ originating from SO_2 and NO_2 respectively. Particulate matter may include heavy metals such as mercury and arsenic. Volatile organic compounds (VOC) are a group of gases that react with other airborne pollutants to form O_3, $PM_{2.5}$ and other secondary compounds. VOC also include the airborne persistent organic pollutants (POP) that are of particular concern because of their ability to bioaccumulate in living organisms.

Within the Georgia Basin/Puget Sound air basin, just like in many other areas of the USA and Canada, the main air pollutants of interest are ozone and $PM_{2.5}$, mostly because both pollutants are secondary in nature, thus making their control difficult. Ozone is detrimental to human health and causes damage to vegetation and physical structures. $PM_{2.5}$ is linked to respiratory and other health problems and also impairs visibility. Therefore, ozone and $PM_{2.5}$ constitute the main air quality pollutants in the Basin.

Point Source Emissions of Common Air Contaminants

In the *Characterization of the Georgia Basin/Puget Sound Airshed* (2004), EPA examined emissions from point sources. These are stationary emitters of pollution, such as refineries or power generating facilities, compared to an emitter that is not stationary (mobile sources, such as cars, or marine and locomotive engines) or a natural (biogenic) source. The EPA compared Puget Sound to the Georgia Basin and noticed that while some of the contaminants were similar, the contributors were slightly different.

[18] Secondary pollutants are those which are not emitted directly into the atmosphere from identifiable sources but rather are created in the atmosphere from other pollutants. O_3 is such a pollutant, which is created in the atmosphere by VOC, oxides of nitrogen, and sunlight. Primary pollutants, on the other hand, are those which are emitted directly in the atmosphere from identifiable sources. CO from combustion sources is such a primary pollutant.

In Georgia Basin, the most recent emissions inventory for 2000 (Department of Ecology in EPA 2004) for the entire airshed shows the beginning of a change in important sources of contaminants. Marine vessels account for 22% of the NOx emissions, with light-duty vehicles responsible for 23%. Marine vessels are the largest single source of SO_2 in the airshed emitting 33 per cent of the SO_2 emissions. Agriculture is the dominant source of PM_{10} (21%), with space heating responsible for 20% of the $PM_{2.5}$. The 2000 inventory also shows how the use of a single surrogate (population) to compare emission levels can be misleading. Whatcom County has just 7% of the entire population in Georgia Basin, but also has several major industries, contributing 29 % of the-smog-forming emissions. Contrast this to the Greater Vancouver Regional District, with 83 % of the population, emitting 56% of smog-forming emissions, and the Fraser Valley Regional District, with 10 % of the population, producing just 15 % of the emissions (EPA 2004).

Local Air Quality

Between the years 1900 and 1970, the emissions of various pollutants increased significantly. In 1970, the Clean Air Act Amendments (CAAA) were signed into law, providing a departure from previous federal strategy on combating air pollution. Two types of pollutants were to be regulated according to these new laws:

- The criteria pollutants[19] which were to be regulated to achieve the attainment of the National Ambient Air Quality Standards (NAAQS), including primary standards for the protection of public health, and secondary standards for the protection of public welfare.
- The hazardous air pollutants[20] which were defined as those "to which no ambient air standard is applicable and that... cause, or contribute to… an increase in mortality or an increase in serious irreversible or incapacitating reversible illness."

The local clean air authority that monitors Whatcom, Skagit and Island counties is the Northwest Clean Air Agency (NWCAA). The NWCAA is one of seven regional air quality control agencies located throughout Washington State. It was established in 1967 after passage of the Washington State Clean Air Act (RCW 70.94). The agency is responsible for enforcing federal, state and local air pollution regulations in Island, Skagit and Whatcom counties. Also, the NWCAA monitors ambient air and emissions. Ambient air monitoring helps air quality authorities gather data about pollutants in the air, monitor for trends, judge progress, and determine if emergency measures are needed to alleviate air pollution episodes.

The NWCAA produces annual emission inventories from large stationary industrial facilities within its jurisdiction, including those located within the Cherry Point site. The data shown in the table below do not include emissions from mobile sources, biogenic sources, or area sources. The NWCAA reports that for the 2004 and 2005 years, for all of Whatcom County, the primary stationary sources of particulate matter (PM_{10}), sulfur dioxide (SO_2), nitrogen dioxide (NOx), volatile organic compounds (VOC), and carbon monoxide (CO) were the industrial facilities located at Cherry Point: Alcoa Primary Metals (Intalco), BP West Coast Products, and ConocoPhillips (NWCAA, 2006).

These facilities at Cherry Point contributed an average of 92% of all monitored industrial air

[19] The current list of the six criteria pollutants are: ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter and lead.

[20] The list of 188 HAP, about half of which are either known or suspected carcinogens, includes benzene, mercury, asbestos, and others.

pollutants from stationary sources in Whatcom County in 2005 and 2006. Results of monitoring showed that four of the five monitored pollutants decreased between 2004 and 2006 (NWCAA, 2004, 2005, 2006).

Table 7. Emissions inventory, in tons per year, from large industrial facilities leasing state-owned aquatic land at Cherry Point compared to Whatcom County total, for the years 2004, 2005, and 2006. From the Tri-County Emissions Monitoring Reports, Northwest Washington Clean Air Agency.

Cherry Point Facilities and County Total Emissions	Particulate Matter (PM_{10})	Sulfur Dioxide (SO_2)	Nitrogen Dioxide (NOx)	Volatile Organic Compounds	Carbon Monoxide (CO)
2004 County Total, including facilities	480	4,242	3,836	1,181	16,442
2004 Cherry Point Facilities (% of county total)	402 (84%)	4,186 (99%)	3,447 (90%)	1,070 (91%)	16,328 (99%)
2005 County Total, including facilities	450	3,676	3,793	1,359	12,586
2005 Cherry Point Facilities (% of county total)	363 (81%)	3,627 (99%)	3,420 (90%)	1,228 (90%)	12,462 (99%)
2006 County Total, including facilities	431	3,499	3,622	1,412	12,616
2006 Cherry Point Facilities (% of count total)	347 (81%)	3,478 (99%)	3,241 (89%)	12,96 (92%)	12,500 (99%)
Cherry Point Facilities Change 2004-2006	(-133)	(-764)	(-595)	+115	(-3,942)
County Change 2004-2006	(-49)	(-743)	(-214)	+231	(-3,826)

The county is currently in attainment (meeting requirements) under EPA standards set forward by the Clean Air Act and administered by the Northwest Clean Air Authority for this region (NWCAA, 2008).

While considerable work has gone into understanding and regulating air pollution in the region and specifically at the Cherry Point industrial facilities, little is actually known about the relationship of this pollution to the health of the aquatic ecosystem and the organisms that rely on it. Water quality studies in this area should attempt to quantify air deposition in their evaluation of sources.

Climate Change

Atmospheric concentrations of greenhouse gases are the primary contributor to climate change. The gases trap the sun's radiation as it passes through the atmosphere, altering natural climate variability through a mechanism known as "global warming," an average increase in the temperature of the atmosphere, which contributes to changes in global climate patterns. At Cherry Point, global warming will occur within the context of existing inter-annual and inter-decadal climate variability. The El Niño/Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO) influence PNW climate and natural resources on seasonal to interannual scales. There is no consistent indication at this time of discernible changes" in ENSO intensity or frequency in the 21st century (CIG 2009). Climate change is expected to have significant impacts on the Pacific

Northwest (PNW) by mid-21st century (CIG 2009). Global climate models scaled to the region project an increase in average temperature on the order of 0.2°-1.0°F (0.1°-0.6°C) per decade throughout the mid-21st century with a best estimate average of 0.3°C (0.5°F) per decade. Temperature increases occur across all seasons with the largest increases in summer. The best estimate rate of warming in the PNW through the mid- 21st century -- 0.5°F (0.3°C) per decade -- is three times the rate of change per decade observed in the PNW during the 20th century (0.15°F [0.8°C] per decade). The per-decade rate of change for the second half of the 21st century is dependent on the choice of emissions scenarios.

Changes in annual precipitation are less certain. Most of the models analyzed by CIG project decreases in summer precipitation and increases in winter precipitation with little change in the annual mean. Precipitation changes are projected to be small compared to the interannual and decadal variability observed during the 20th century. The majority of models show increases in winter precipitation and reduced summer precipitation.

Sea surface temperatures are expected to increase. Climate models project warming in summer sea surface temperature for the 2040s on the order of 2.7°F (1.5°C). This change is somewhat less than the warming projected in the 2040s for PNW land areas (3.5°F [2.0°C]), but is significant relative to the small interannual variability of the ocean. The highest increases in temperature are occurring in or adjacent to the shallowest areas, as would be expected. This may have implications for nearshore resources that are temperature sensitive, such as spawn, and may exacerbate the effects from warm water inputs already being discharged into the nearshore area, by increasing the surrounding ambient temperature.

Climate Change Impacts

Human and naturally induced climate change has the potential to significantly alter the physical and biological characteristics of the region and Cherry Point. Impacts include: ocean acidification, sea level rise, increased storm severity, changes in ocean upwelling, increased water temperature, and photo enhanced toxicity, all or some of which may result in changes to species abundance and distribution.

Researchers that the University of Washington's Climate Impacts Group estimate that average annual temperatures in the Pacific Northwest could rise by an additional 0.9 to 4.7° F by the 2020's and 2.7 to 5.8° F by the 2040's, contributing to higher stream and estuary temperatures as well. Warming by small incremental amounts such as a few degrees can have a wide variety of impacts. According to the EPA and Ecology, warmer temperatures can affect our snowpacks, time of peak snow melt, glaciers, lower stream flows, exacerbate the decline of salmonids, and increase sea level rise (Ecology 2007), as previously discussed, sea level rise could lead to flooding of low-lying property, loss of coastal wetlands, erosion of bluffs and beaches, saltwater contamination of drinking water, and decreased longevity of low-lying roads, causeways, and bridges. In addition, sea level rise could increase the vulnerability of coastal areas to storms and associated flooding**.** Projections vary, but the most recent projections from the IPCC report show a 7-23-inch rise in global average sea level by 2090-2099. (IPCC, 2007.)

A reduction in the availability of tidal marsh/tidal flat habitats could occur, as sea level rise combined with increased river flow increases the salinity of the nearshore area while decreasing the availability of tidal marsh areas. A recent study that modeled the potential impact of sea-level rise on key coastal habitats in the Pacific Northwest estimated that the Nooksack Delta, Lummi Bay, and

Bellingham Bay could result in a a 22-percent loss of swamp (including tidal swamp), a 22-percent loss of brackish marsh, and a 42-percent loss of estuarine beach. No information was available for Cherry Point, which has several scattered salt marsh habitats that could be affected by changes in salinity and rising water levels. The EPA states that commercial shellfish communities (e.g., oysters and clams) and migratory shorebird populations that utilize these flats for habitat and feeding also may decline accordingly. The commercial and recreational shellfish activities in the Reserve may also be affected by these changes. And changes in the composition of tidal wetlands could diminish the capacity for those habitats to support salmonids, especially juvenile Chinook and chum salmon (Glick, 2007).

Washington's coastal region consists primarily of cliffs and a few low-lying tidal flats. Possible responses to sea level rise include building walls to hold back the sea, allowing the sea to advance and adapting to it, and raising the land (e.g., by replenishing beach sand and/or elevating houses and infrastructure). Each of these responses will be costly, either in out-of-pocket costs or in lost land and structures. The cumulative cost of sand replenishment to protect Washington's coastline from a 20-inch sea level rise by 2100 is estimated at $143 million to $2.3 billion (EPA 1997).

Changes in Fish and Wildlife

The EPA stated in a 1997 report that the primary natural features of Washington that are vulnerable to climate change are its extensive rivers, streams, and coastal estuaries, noting that these three environments are critical for a wide diversity of wildlife, endangered species, and commercial and sport fisheries. Water temperatures are among the most important factors affecting the health and distribution of salmonids. Even a small increase in stream temperature above optimal ranges can result in changes in migration timing, reducing growth rates, reducing the availability of dissolved oxygen, and increasing susceptibility of fish to toxins, parasites, and disease (Glick, 2005). Food supply could also be reduced as a result of increased temperatures. Should climate change alter the flows of freshwater streams, whether seasonally or otherwise, it could reduce the amount of suitable salmon spawning habitat. Earlier peak spring flows and lower than normal summer flows can make it more difficult for adult fish returning from the sea and for juvenile fish to make it to the ocean. Excessively high winter flows can cause scouring events that result in loss of gravel beds and nesting sites. In recent years, populations of salmon and steelhead have been reduced to less than 10% of historical levels. The EPA states that these past losses cannot be attributed to climate change, but that pink and chum salmon – both of which are documented at Cherry Point - could lose all of their habitat with climate change. Other cold water species such as brook trout, brown trout, and mountain whitefish could lose most of their habitat.

Changes in sea temperatures can have both direct and indirect impacts on herring survival. The observed decline of the Cherry Point stock since the mid-1970s coincided with warmer/dryer than average conditions in the Pacific Northwest (Stout, 2001). Chapman et al (1941) considered Cherry Point and Discovery Bay populations to be at low levels in the 1930's when similar climatic conditions occurred. Conditions shifted back to cold/wet or average during the 1940s and 1950s, and it was reported that the Cherry Point and Discovery Bay populations had returned to relatively high levels of abundance during those decades (Stick and Lindquist, 2008).

There is some preliminary evidence that the Cherry Point herring are better suited to warm water than other herring stock and further investigation is needed (Marshall, R. 2009). Climate varies naturally over both short and long time-scales, but natural climate variability can be distinguished

from human-caused climate change.

Initiatives to address emissions and global warming

Western States Climate Initiative

The Western States Climate Initiative (WCI) was launched in 2007 to identify, evaluate, and implement collective and cooperate ways that will reduce greenhouse gases in the region, focusing on a market-based cap-and-trade system. It is a collaboration involving seven U.S. governors and four Canadian Premiers. The goal of this program is to assist with a regional effort to reduce the pollution that causes global warming to 15% below 2005 levels by the year 2020 (WCI 2008).

MARPOL and other Initiatives

Air pollution from ships burning diesel, bunker oil and other fuels is a concern, according to the EPA. As mentioned earlier, a recent inventory of emissions in Georgia Basin airshed shows marine vessels account for 22 per cent of the NOx emissions, and also that marine vessels are the largest single source of SO2 in the airshed emitting 33 per cent of the SO2 emissions (EPA 2004). Vessel traffic at Cherry Point is expected to increase within the next two decades, partly as a result of extending the length of the BP pier. A majority of the vessels are tankers and barges – these oceangoing vessels often run engines large enough to be classified as a Category 3 marine diesel engine. These engines have a per-cylinder displacement at or above 30 liters per cylinder (For comparison, Dodge Viper's five-hundred-horsepower engine has ten cylinders, and displaces 8.3 liters.) These large engines have been targeted for new standards to promote new technology that will reduce NOx and SOx emissions within and outside U.S. waters.

Emissions from all types of oceangoing vessels have been monitored globally. The Member States of the International Maritime Organization (IMO) is a United Nations Agency that facilitates development of standards to control air exhaust emissions from engines that power ships. The international air pollution standards, which include estimates for international shipping and carbon emissions, are found in the Annex VI to the International Convention on the Prevention of Pollution from Ships (also called MARPOL).

During October of 2008, the IMO Marine Environment Protection Committee updated a 2000 study on greenhouse gas emissions from ships. Using activity data and international fuel statistics, the conclusion was that 2007 CO2 emissions from international shipping would be 2.7% of all global CO2 emissions, or 843 million tons. This is an increase from 1.8% estimated in 2000.In the absence of future regulations on CO2 emissions from ships, such emissions were predicted in the base scenarios to increase by a factor of 2.4 to 3.0 by 2050 (IMO 2008).
Recognizing that marine diesel engines and their fuels contributed to greenhouse gases, on October 9, 2008, the IMO adopted new international standards regulating oceangoing vessels. Details may be found in the amendments to Annex VI to the International Convention for the Prevention of Pollution from Ships (also called MARPOL), or on EPA's website for oceangoing vessels (EPA 2008, 2009). Shortly after the MARPOL amendments were developed, EPA proposed new rules for oceangoing vessels. The EPA's proposed standards mirror MARPOL standards, as adopted under Annex VI, and can be found at EPA's website on oceangoing vessels. If adopted, the proposed changes would ensure the Clean Air Act and regulations for oceangoing vessels are consistent with global efforts by the IMO to control marine diesel and fuel emissions.

One change involves the designation of sensitive areas, or designated Emission Control Areas

(ECAs). In these areas, ships will be required to use the most advanced technology-forcing engines, and monitor the sulfur and nitrogen content of the fuel. On July 17, 2009, the United States and Canada amended MARPOL Annex VI to designate specific areas of the coastal waters as Emission Control Areas or ECAs. The North American ECA may go into effect as early as 2012. The North American ECA will require all vessels operating in designated ECAs to use fuel that does not exceed 1.1 percent sulfur (10,000 parts per million). In 2015, this requirement becomes more stringent, and vessels will need to change to fuel that does not exceed 0.1 percent sulfur (1,000 ppm). The following year, NOx requirements become applicable. (EPA 2009). In all other areas of the world, including on the high seas, engine emissions will be also be reduced, and the global fuel sulfur cap outside ECAs will drop to 5,000 ppm in 2020 (pending an availability review in 2018) (EPA 2008, 2009).

Summary of Climate Change Considerations

In summary, the alterations due to natural and human induced climate change will affect many of the actions listed in the remainder of the document. An adaptive management approach which considers climate change trends and indicators is recommended when planning research studies and evaluating impacts of new management. Adaptive management requires that the potential for change be measured, the effects monitored and that management actions be modified to meet the need. Further measurement and monitoring can then provide information on the effectiveness of the management activity. In the case of climate change it is unlikely that any one activity at Cherry Point can effectively alter the degree of the global warming trend, but if the impacts are identified early and understood, this will help develop appropriate mitigation and/or adaptive management actions for this resource protection and management plan.

Appendix C - Archaeological, Cultural, and Historical Resources

Native American History

The Puget Sound prehistoric record is divided into three broad chronological periods: the Early Period (15,000–5,000 Before Present), the Middle Period (5,000-1,000 Before Present), and the Late Period (1,000-250 Before Present).

The Early Period is characterized by chipped stone assemblages attributable to fluted projectile point, leaf-shaped projectile point, and cobble tool traditions. Subsistence patterns exhibit reliance upon inland hunting, supplemented with fishing and marine invertebrate procurement in riverine and coastal areas. Settlements were typically located on upland plateaus or river terraces, although coastal occupations may have been flooded because of seismic activity or changes in sea level related to glaciation (Carlson 1990; Kidd 1964; Nelson 1990)

The Middle Period represents a proliferation in tool diversity within regional assemblages. Notched stone projectile points were characterized by a decrease in size, and toolkits were supplemented with groundstone, bone, and antler industries. Subsistence practices showed an increased orientation toward marine and riverine habitats; shellfish, salmon, and sea mammals became more important resources; and shell middens appeared in the archaeological record. Occupation areas expanded to include modern shorelines and islands and the earliest evidence of seasonal village sites dates to this period (Carlson 1990; Kidd 1964; Nelson 1990).

The Late Period is characterized by assemblages containing exotic trade goods imported from indigenous populations in the Columbia Plateau as well as metal arrowheads and trade beads from Euro-American groups. Small side-notched and triangular stone projectile points persisted but were superceded by an emphasis on bone and antler tools. Salmon became a major staple as evidenced by elaborate fish traps; subsistence practices were supplemented by terrestrial hunting and plant procurement. Permanent, village sites described by Euro-American settlers and ethnographers were established and persisted into the historic period (Carlson 1990; Kidd 1964; Nelson 1990).

Central Coast Salish Native Americans occupied the Puget Sound area during the late historic times. In the Cherry Point vicinity, three linguistic subdivisions of the Central Salish are recognized:

Halkomelem speakers lived north of Birch Point and along the lower Fraser River valley. *Nooksack* speakers lived in inland sections of the Nooksack River drainage, and *North Straits'* speakers occupied the coastal areas north of Anacortes as well as the San Juan and other islands in the southern section of the Strait of Georgia.

At that time, subsistence focused on seasonal harvests of marine foods such as salmon, herring and lingcod, which were eaten fresh or dried and stored for winter use. Terrestrial foods that were favored included deer, elk and bear, which were caught with pitfalls, snares, bow and arrow, while women gathered shellfish, sea urchins and barnacles along the coast. The Central Coast Salish also utilized western yarrow, creambush, oceanspray, western red cedar, swordfern, salal, skunk cabbage, and vine maple for pharmaceutical, technological, and ceremonial use (Moerman 1999; Suttles

1990).

The Revised Code of Washington, Chapter 27.44 protects Indian burial sites, cairns, petroglyph (incised in stone) and pictograph (painted) markings, and historic graves on public and private land. The chapter further stipulates that persons knowingly removing, destroying, or defacing these resources will be charged with a Class C felony. RCW Chapter 27.53 protects sites, objects, structures, artifacts, and locations of prehistoric or archaeological interest located in, on, or under the surface of any lands or waters owned or under the control of the state of Washington or its counties, cities, or political subdivisions. Disturbing archaeological resources without an archaeological excavation permit is punishable as a Class C felony.

Lummi Indian Nation

The shoreline at Cherry Point was the primary home of many Lummi villages and Traditional Cultural Properties (TCPs) within the traditional homeland of the Lummi. This area is an important component of the Lummi usual and accustomed grounds and stations used since time immemorial for hunting, fishing and gathering. The development of the Cherry Point shoreline by Euro-Americans since the 1950's has resulted in the elimination of fishing and gathering grounds and stations, village sites, landing sites, and locations where commerce was conducted. This development has also resulted in the filling of previously extensive and productive natural tidelands and has caused the contamination of previously pristine waters and sediments due to the operation of industrial and commercial facilities (Lummi Indian Nation, 2008). The existing piers and associated vessel traffic preclude and/or interfere with the ability of Lummi tribal members to exercise their treaty-protected fishing rights to fish.

The Lummi Indian Nation resides in an area ceded by the Lummi, Nooksack, and Samish Indians; these groups now comprise the Lummi Indian Nation. The Lummi are thought to have derived their name from *Lkungen*, the name that the North Straits-speaking Songish of Vancouver Island called themselves. The Lummi occupied coastal areas surrounding the mouth of the Nooksack River as well as several islands in Puget Sound. The Nooksack, meaning "mountain men," lived in the Nooksack River drainage. The Samish occupied additional islands in Puget Sound, including one that now bears their name as well as Guemes and Fidalgo islands (Ruby and Brown 1986; Suttles 1990; Swanton 1978).

The Lummi Indian Reservation is located south of Cherry Point. The Lummi Nation has a Department of Natural Resources, under which the Water Resources staff provide technical support for Lummi Indian Reservation Tidelands and Coastal Zone Management.

Nooksack Indian Tribe

For millennia before trappers, traders, lumbermen, gold seekers and homesteaders came to the Nooksack River valley, the Nooksack people resided in numerous villages at the banks of the Nooksack and Sumas.

Their fishing grounds extended from today's Bellingham Bay to British Columbia. They used nets and fish traps in the rivers to harvest various species of salmon. During the fish runs in the fall and spring, a number of families typically shared a smokehouse on the riverbanks next to the fish traps. The Nooksack also dug up clams, gathered meadow berries, stalked mountain goats for food and skins, and grew wild carrots (sbugmack

The Nooksack never signed a treaty with the U.S. that would have given them a reservation, because they had been overlooked. Thus they were vulnerable with no treaty to offer them any protection and lost their lands to white settlers. It was not until 1958 that, though landless, the Nooksacks won compensation for the loss of their lands, whose value was pegged at 1858 dollars.

In the mid-1930s, the Nooksack tribe voted to accept the provisions of the Indian Reorganization Act (1934), which had secured new rights for Native Americans, and began to work on a tribal constitution. Since they lacked a land base, they were denied federal recognition as a tribe. In 1971, however, the Nooksack Tribe won full federal recognition, and a reservation was founded on one acre at Deming. Since then, the tribe's holdings have expanded to 2,500 acres, which include 65 acres of trust land (www.u-s-history.com)

Euro-American History

Whatcom was named after a noisy waterfall, called “What-Coom” by the Lummi Indians, which means “noisy, rumbling water”. The first Europeans were Spanish Explorers in the late 1700s, followed by James Vancouver from England. Early land uses included fur trapping and trading, logging, lumber processing, farming, salmon packing, and mining coal. The first non-Indian residents settled including Hudson's Bay Company, which ran from 1825 to 1846. In the early 1850's, a high demand for timber in California led to scarce lumber supplies (Figure 22). Coal was discovered in the early 1800’s, and the lumber trend turned to mining. Bellingham Bay Coal Company became the area’s largest employer. In the mid 1800’s, a large influx of gold seekers entered the area on their way to the Fraser River to seek gold (Kyte, 1999). The County of Whatcom was created by territorial legislature on March 9, 1854 (Whatcom County website, 2007).

Northern Pacific Railroad expanded its infrastructure into Whatcom County in the late 1800’s, bringing further opportunities as Bellingham was linked to Vancouver, B.C., via Ferndale and Blaine, stimulating the lumber and salmon packing industries. The population increased by sixfold during this time, from approximately 3,000 to 18,000 (Kyte, et al. 1999). The national depression stopped the boom, and the railroad left. The population of the bay decreased, but by the turn of the century, Whatcom County was growing again. New lumber and shingle mills, salmon canneries, shipyards and agriculture brought stability to the area. Between 1890 and 1925, logging cleared thousands of acres for farmsteads. Development of commercial and residential areas increased, and major fish processing plants were constructed at Bellingham Bay. Between 1950 and 1990, coal mining had ceased, while sand and gravel mining grew in importance (Kyte, et al 1999).

Figure 22, Postcard, mailed 1908 showing logging train heading to Bellingham

Appendix D - Existing Encumbrances directly adjacent to the Aquatic Reserve

The following encumbrances have specific exceptions from the aquatic reserve in the original Commissioner of Public Lands withdrawal order and are therefore treated as leases adjacent to the aquatic reserve.

Birch Bay Water and Sewer District: DNR Aquatic Lease 51-082214 – Easement pertaining to the Birch Bay Water and Sewer District wastewater pipeline and diffuser.

A right of way measuring 2,300 feet in length and 100 feet in width comprising a total area of 5.28 acres of tidelands and bedlands was established in on March 23, 1975 as a lease (Lease 20-010521) and renewed as an easement on January 13, 2009.

British Petroleum: DNR Aquatic Lease 20-A09122 – Lease pertaining to BP/ARCO pier and outfalls

The BP Cherry Point Refinery is located at 4519 Grandview Road in Whatcom County, Washington. The refinery is situated on 849 acres of developed land 8 miles south of the U.S./Canada border and 20 miles northwest of Bellingham, Washington. BP owns an additional approximately 2000 acres of undeveloped land around the refinery, including approximately 1000 acres of marine riparian land between the Cherry Point Refinery Dock and Point Whitehorn. The refinery has been in operation since 1971 processing mainly Alaska North Slope (ANS) crude oil with an increasing percentage of oil from other parts of the world as ANS crude supplies decline over time. Refinery throughput averages approximately 200,000 barrels of crude oil per day, from which Cherry Point produces multiple grades of gasoline, jet fuel, low-sulfur and ultra low-sulfur diesel fuel, calcined coke, butane, propane and sulfur. The Cherry Point Refinery operates 24 hours a day, 365 days a year and has approximately 780 full-time BP employees; an additional approximately 1000 contractors also work on-site.

The Cherry Point Refinery Marine Terminal is located approximately 1.5 miles south of the refinery, extending 2,100 feet offshore into the Southeast Strait of Georgia in a "Y" configuration and terminating in two vessel berths - the North & South Dock Wings. The Cherry Point Dock is constructed of concrete on steel pilings and there is a minimum of 65' of water alongside each dock wing at MLLW. The Cherry Point Dock can accommodate only one tanker or barge at a time on the seaward side of each dock wing (2 vessels max at any time). The maximum vessel length that can be accommodated is 1,100 feet.

Nearly 100% of all crude oil used by the refinery is delivered by tank vessel. Approximately 75 percent of the refined petroleum products are transported through the Olympic Pipeline to marketing terminals in western Washington and Oregon. The remaining products are transported by tanker, barge, or truck to other West Coast locations. In 2007, approximately 370 vessels transited to/from the Cherry Point Dock.

The refinery has approximately 50 crude oil and refined product storage tanks with a combined working capacity of over 7,500,000 barrels. The Cherry Point Refinery processes industrial

wastewater and stormwater through its on-site wastewater treatment plant and discharges an average 3,500,000 gallons of combined treated process wastewater and stormwater per day under NPDES Permit No. WA 002290-0 to the Strait of Georgia through a diffuser located below the North Dock. BP Cherry Point's NPDES permit requires daily effluent quality monitoring, effluent mixing and fish toxicity studies, groundwater studies, sediment quality studies, and the development and implementation of Pollution Prevention Plans.

Dock Operations at the BP Cherry Point Refinery are conducted in accordance with the BP Cherry Point Refinery's USCG- and Washington Department of Ecology-approved Oil Handling Facility Operations Manual, which describes personnel responsibilities, Dock operating procedures, and safe operating envelopes. The BP Cherry Point Refinery has a rigorous Dock inspection and maintenance program designed to protect the marine resources of the Cherry Point Aquatic Reserve and ensure the long-term operational integrity of the BP Cherry Point Dock.

The term for the BP lease, # 20-A09122, is April 1, 1999 – March 31, 2029

Ferndale Refinery operated by Phillips: DNR Lease 20-B11714 – Lease pertaining to Phillips/Tosco pier and outfalls

The Phillips Ferndale Refinery is located in Whatcom County on an 850 acre site, fronting on the Georgia Strait between Cherry Point and Sandy Point, five miles west-southwest of Ferndale, Washington. Originally built in 1954, the refinery has completed several upgrades and expansions since then and, as of January 2008, has a capacity to process approximately 105,000 bbl per day of crude oil. The main source of crude oil is from tankers delivering oil from Alaska's North Slope and Canadian crude via pipeline. The crude oil is processed to produce a range of fuels and products including: gasoline, diesel (low sulfur & ultra low sulfur), liquid petroleum gas, residual fuel oil, marine bunker fuel oil, and sulfur. The refinery currently employs about 280 people with an additional 150 contract employees. The indirect employment associated with the refinery is about 900 people. The refinery operates 24 hours per day and 365 days per year, except during turnaround periods which occur about once every two to three years.

As part of normal operation, the refinery has substantial water-dependent activities associated with the receipt of raw materials, shipping of products, vessel fueling and permitted Clean Water Act (CWA) discharges. In 2007, approximately 530 vessel transfers were conducted at the refinery dock. These vessels primarily consist of crude oil tankers and petroleum product barges. The scheduling of vessel and cargo activities at the marine terminal is coordinated by the refinery and is intended to meet raw material needs for the refinery and product distribution to the market.

All governmental regulations and Phillips' standards and procedures are strictly enforced throughout docking and loading/unloading operations. The refinery maintains and updates its Marine Terminal Safety & Operations Manual, which describes personnel responsibilities, operating procedures, and related data concerning the refinery dock and transfer operations, including the pre- booming of oil transfers in accordance with state requirements which came into effect in 2007. In compliance with federal and state regulations, the refinery also maintains and updates plans and programs, such as the Oil Spill Prevention Plan, the Oil Spill Response Plan, the Spill Prevention, Control, and Countermeasure Plan, the Integrated Contingency Plan, and Oil Handling Personnel Training. Phillips has an ongoing program for periodic inspection, maintenance, repair, and replacement activities required to ensure the longevity and reliability of operations at the dock and associated facilities; these activities may include above-water, on-water, and in-water work and are conducted in accordance with approvals received from federal, state, and local permitting agencies.

The refinery operates an NPDES AKART-permitted wastewater treatment plant. The NPDES outfall discharges into the Strait of Georgia approximately 1200 feet from the shoreline. The outfall line also periodically conveys treated wastewater from Tenaska, a cogeneration facility located adjacent to the refinery. The refinery NPDES permit requires monitoring, effluent mixing and toxicity studies, sediment sampling, and Stormwater Pollution Prevention Plan updates and implementation.

Intalco Aluminum Corporation, now owned by Petrogas – DNR Lease 20-A08488 – Lease pertaining to Intalco pier only (outfalls are managed using a separate lease instrument).

Petrogas Energy Corp. entered into agreements with Intalco Aluminum in 2016 for the acquisition of Intalco's Ferndale, Washington deep water Wharf and a portion of Intalco's lands. The Wharf is adjacent to the Petrogas Ferndale Terminal which provides storage and distribution of propane and butane to domestic and international markets. The sale will not impact Intalco's ability to operate the smelter which will continue to utilize the wharf for receiving and offloading alumina.

Intalco Aluminum Corporation (Intalco), a subsidiary of Alcoa Inc. (Alcoa), the world leader in the production and management of primary aluminum, fabricated aluminum and alumina combined, is located in Whatcom County approximately 100 miles north of Seattle, Washington and 50 miles south of Vancouver British Columbia. Intalco operates an aluminum smelter that occupies approximately 300 acres of a 1,500 acre tract fronting on the Georgia Strait between Cherry Point and Sandy Point near Ferndale Washington. Intalco has been part of the local community for more than 40 years and began operation in 1966 as a primary aluminum smelter, owned by Alumax, Pechiney and Howmet. In 1998, Alcoa acquired Alumax, resulting in Intalco becoming an Alcoa subsidiary.

Intalco produces aluminum metal utilizing the Hall-Heroult reduction process. This process utilizes electrical current to dissolve alumina in a cryolite bath inside large carbon-lined aluminum reduction cells. Once dissolved the molten aluminum separates from the solution and collects at the bottom of the reduction cell where it is removed and transported to natural gas fired furnaces. The molten aluminum is then cast into various sizes and forms to be utilized in casting or extrusion processes to make products such as window frames, wheels and ladders.

Intalco was originally designed and built to accommodate a paste plant, bake furnace, three operating potlines, and a casthouse. Each potline consists of 240 side worked, pre-bake aluminum reduction cells for a total of 720. While the smelter is currently permitted to produce 307,000 tons of aluminum metal per year, rising power costs in early 2001 caused the facility to operate in a curtailed mode since June of 2001. Since that time Intalco has been operating in a curtailed mode and as of March 2008 is operating at approximately 70% of capacity with a workforce of over 600 full time employees. Economic study has shown that every Intalco job in Washington creates an additional three jobs in the community.

Intalco's pier operations consist of permitted Clean Water Act (CWA) discharges and unloading activities as described in the current Aquatic Lands Lease between Intalco and the State of Washington (Department of Natural Resources). This lease currently allows for unloading alumina ore and liquefied petroleum gas. It also allows for the addition of future loading and unloading activities pending regulatory permit approvals.

There are numerous State and Federal regulations that apply to the activities throughout the facility including those activities associated with the loading/unloading operations at the facility's pier.

These include, but are not limited to Spill Prevention, Control, and Countermeasure Plans, National Pollutant Discharge Elimination System permits, Title V Air Operating Permits, DNR Aquatic Lands Lease requirements, etc. Intalco takes all of these regulations seriously and is routinely inspected by State and Federal regulatory agencies to ensure compliance.

Appendix E – Legal Description

Withdrawn Public Land Boundary Description

That portion of the tidelands and bedlands of navigable waters owned by the state of Washington, fronting and abutting Sections 2, 11, 13, 14, and 24, Township 39 North, Range 1 West, Willamette Meridian and fronting and abutting Sections 19, 20, 29 and 32, Township 39 North, Range 1 East, Willamette Meridan described as follows:

Lying south of the south line of government lot 1, of said Section2, Township39 North, Range 1 West, W.M. being the south line of Birch Bay State Park; lying north of the south line of Township 39, Range 1 East; and extending waterward to a line which is 70 feet below mean lower low water OR 0.5 mile beyond extreme low tide, whichever line is further waterward;

EXCEPTING THEREFROM, the following Use Authorizations issued by the Department of Natural Resources; lease application numbers 20-A09122, 20-A11714, 20-A08488, and 20-010521;

ALSO EXCEPTING THEREFROM, any second class tidelands previously sold by the State of Washington.

Situated in Whatcom County, Washington

Appendix F – Commissioner's Order

201701

COMMISSIONER'S ORDER

STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES
Peter Goldmark
Commissioner of Public Lands

AMENDED WITHDRAWAL AND DESIGNATION ORDER
FOR THE CHERRY POINT AQUATIC RESERVE

The State of Washington is owner of aquatic lands known as the Cherry Point Aquatic Reserve, consisting of tidelands and bedlands at Cherry Point in Whatcom County. Under statutory mandates, the Washington State Department of Natural Resources is responsible for managing state-owned aquatic lands in a manner that includes:

> Ensuring environmental protection as a management objective for state-owned aquatic lands (RCW 79.105.030(3)), and
>
> Considering natural values of state-owned aquatic lands as wildlife habitat, natural area preserves, representative ecosystems or spawning areas prior to the Department issuing any lease or authorizing any changes in use (RCW 79.105.210(3)), and
>
> Withholding from leasing lands which the Department finds to have significant natural values (RCW 79.105.210(3)).

In accordance with such powers and obligations, certain state-owned aquatic lands possessing significant natural values near the Cherry Point Reach were withdrawn from general leasing on August 1, 2000 and identified as the Cherry Point State Aquatic Reserve.

Following creation of the Reserve, the Department worked with others to develop a plan to manage the Reserve in a manner that protects its unique resources. In November 2010, this effort resulted in completion of the Cherry Point Environmental Aquatic Reserve Management Plan. The Plan identifies the natural resources and addresses the proposed uses, future threats, and management actions that will be employed by DNR to protect the resources. Consistent with the objectives of the Plan, on November 18, 2010, the Commissioner of Public Lands rededicated the Cherry Point State Aquatic Reserve as the Cherry Point Environmental Reserve.

In 2016, the Department evaluated a request to change the Reserve boundary to add lands previously excluded under the August 1, 2000 and November 18, 2010 Orders. As supported by the November 2, 2016 Determination of Nonsignificance, and the November 20, 2016 recommendations of the technical advisory committee, as well as public comments received by the Department, the amendment of the Reserve boundary will further accomplish the purposes of the Reserve, is compatible with existing and projected uses of the area, and best serves the public interest.

Therefore, according to the powers vested in the office of Commissioner of Public Lands (RCW 79.105.030(3), RCW 79.10.210, and WAC 332-30-151), I, Peter Goldmark, hereby ORDER and DIRECT amendment of the Cherry Point Environmental Aquatic Reserve to include additional lands. Henceforth the Washington State tidelands and bedlands described below are withdrawn from the general leasing program and shall be managed according to the Final Cherry Point Aquatic Reserve Management Plan for 90 years from November 18, 2010.

> That portion of the tidelands and bedlands of navigable waters owned by the state of Washington, fronting and abutting Sections 2, 11, 13, 14, and 24, Township 39 North, Range 1 West, Willamette Meridian and fronting and abutting Sections 19, 20, 29 and 32, Township 39 North, Range 1 East, Willamette Meridan described as follows:
>
> Lying south of the south line of government lot 1, of said Section 2, Township 39 North, Range 1 West, W.M. being the south line of Birch Bay State Park; lying north of the south line of Township 39, Range 1 East; and extending waterward to a line which is 70 feet below mean lower low water OR 0.5 mile beyond extreme low tide, whichever line is further waterward;

EXCEPTING THEREFROM, the following Use Authorizations issued by the Department of Natural Resources; lease application numbers 20-A09122, 20-A11714, 20-A08488 and 20-010521;

ALSO EXCEPTING THEREFROM, any second class tidelands previously sold by the State of Washington.

Situated in Whatcom County, Washington

Dated this 3rd day of January, 2017.

STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES

Peter Goldmark
Commissioner of Public Lands
Olympia, Washington

Appendix G – Cherry Point Workgroup Activities

The Common Aim

"Participants of the Cherry Point Collaborative Process will work together to create an agreement that contains a set of recommendations for action, to be jointly submitted to the appropriate entities, for the sustainable long-range management of the Cherry Point (Resource Area).

In the process of developing this agreement, the following objectives will be considered:

- protection and restoration of the Cherry Point water quality, aquatic ecosystem, and its valued species, including but not limited to, Cherry Point herring, Nooksack Chinook, and migratory waterfowl;
- public recognition of Cherry Point's unique ecological resources;
- determining whether there is an ongoing need for the Cherry Point Aquatic Reserve;
- respecting reserved treaty rights that protect cultural resources including the sustainable harvest of natural resources in usual and accustomed areas; and
- sustainable economic development, and the long-term viability of existing and pending leases as planned for by Whatcom County's current shoreline management program, and other activities at the site, in a way that is not detrimental or does not put resources or adjoining neighborhoods in jeopardy.

All of these objectives will be considered in a way that respects all interests in environmental protection and restoration, economic sustainability of water-dependent uses, and community goals. Although all of the above objectives will be considered in developing the agreement, there is no present commitment made to include any or all of them in the agreement. However, no party will consider entering the agreement unless it determines its interests have been met."