Lewis and Clark National Historical Park

Fort Clatsop Unit
Forest Restoration Plan
Environmental Assessment

Proposed by
National Park Service
May 2011

UNITED STATES DEPARTMENT OF INTERIOR - NATIONAL PARK SERVICE -
PACIFIC WEST REGION

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CHAPTER 1: PURPOSE AND NEED

PURPOSE, NEED, AND GOALS

Purpose

The purpose of this project is to restore and rehabilitate recently purchased industrial second and third-growth forest lands within the Fort Clatsop Unit at Lewis and Clark National Historical Park to forests that more closely approximate the structure, ecology, and appearance of forests in 1805-1806.

Need for Action

This project is needed to restore and re-create forests representative of those experienced by the Lewis and Clark Expedition. The park's 1995 General Management (GMP) and Environmental Impact Statement recommended purchasing forest lands adjacent to the fort site and restoring them to an approximation of historic conditions:

> *"The proposed boundary expansion would provide protection of the forested and agricultural landscape now surrounding the Fort area and, by practicing forest management on some of the land included, would allow a return to a forest landscape representative of that experienced by the Corps of Discovery."* (p.46)

In 2002, Congress passed the Fort Clatsop National Memorial Expansion Act and added the forest lands proposed for acquisition in the GMP – approximately 963 acres – to the Fort Clatsop Unit.

The industrial forest lands the park acquired are significantly different in appearance and ecology to unmanaged forest stands experienced by the Lewis and Clark Expedition. The trees within each stand are young, densely stocked and of the same age. Unmanaged stands would have been older, less dense, and contained trees of different ages. Perhaps the greatest difference between plantations and the historical forest is the forest floor. In many places, the Expedition journals describe a forest floor so thickly covered with fallen logs, shrubs and ferns, that it is almost impassable. For example, on November 12th, Clark wrote that his hunting party "found the woods So thick with Pine & timber and under growth that they could not get through." On December 1, 1805, Lewis remarked that "the wood was so thick it was almost impenetrable." Plantations are managed to allow access for machinery and timber crews. As a consequence, the understory of ferns and shrubs, downed trees, thick soils, snags and nurse logs that characterized the historic forest is often missing from plantations.

A substantial body of scientific research suggests that converting stands from tree farms to natural forests requires active and strategic intervention. Without intervention, these stands can remain in the same developmental stage for decades, if not centuries. Research suggests that intervention is necessary to increase structural and biological complexity, introduce greater species diversity, create snags and downed logs, restore forest soils and the forest floor, and create a more natural forest understory. Productive, lowland ecosystems such as those found in the Fort Clatsop unit are very resilient, and responsive to manipulation. While it is not possible to

restore the forests present during the time of Lewis and Clark in a generation, treatment can greatly accelerate the conversion from plantation to native forest.

This project is needed now because several of the younger forest stands in the Fort Clatsop Unit are in a critical window where treatment is extremely effective.

This project is also needed to address the disposition of former road, tracks, and staging areas that were built during the forest's use as a tree farm.

This plan only addresses the forest and forest floor within the Fort Clatsop Unit and does not address forests at Dismal Nitch, Station Camp, the Yeon Unit or Cape Disappointment. The National Park Service decided to take this approach for the following reasons:

1. Forests at the Dismal Nitch and Cape Disappointment Units are located on steep slopes and are already much closer to those experienced by the Expedition. They are not in need of immediate or substantial treatment.

2. Forests at the Station Camp Unit are still in private ownership. Management of these forests may be determined by a separate conservation easement and forest plan being negotiated between the landowner and NPS.

3. Forests at the Yeon property were planted for dune stabilization and are not historic. A separate management plan is being developed for the Yeon Unit by the North Coast Land Conservancy (holder of a conservation easement) and NPS.

Project Goals

NPS has developed several goals for this project. The first and primary goal is to develop a strategy to accelerate the forest's conversion from tree farms to a forest more natural and unmanaged in structure, function, and appearance. The target is to prepare stands to eventually become the kind of old-growth, late succession forests that are now very rare in the area.

The second goal is to engage the public in both restoration work and scientific study so that they understand forest ecology and development, including the process of converting tree farms to historic forests. The third goal is to create a monitoring program that will help us to use observations and new science to continue to manage the forests in the best possible way into the future.

The last goal is to develop a strategy for the disposition of roads and other features. Some of these roads could be converted to trails that would allow access to crews performing forest treatments. These trails would help the park to meet the interpretation and education goal above. Others may need to be permanently abandoned and, perhaps, decommissioned.

NPS GUIDANCE

The NPS Organic Act of 1916 states that the fundamental purpose of the National Park System "is to conserve the scenery and the natural and historic objects and the wildlife therein." The 1978 Amendments to the Organic Act known as the "Redwoods Act" states "... the protection, management and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established...".

Section 4.4.1 of the NPS Management Policies, the agency's interpretation of the Organic Act, further addresses the biological resources within park boundaries, stating that the Service will

"successfully maintain native plants and animals by preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and communities and ecosystems in which they occur."

Often, as is the case at Lewis and Clark NHP, NPS inherits lands that support the park's purpose, but that might lack many of the ecological characteristics they had historically. In these cases, section 4.1.5 of the NPS Management Policies directs the Service to:

"…reestablish natural functions and processes in parks unless otherwise directed by Congress. Impacts on natural systems resulting from human disturbances include the …disruption of natural processes. The Service will seek to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated."

The park's 1995 General Management and Environmental Impact Statement recommended the acquisition and restoration of the lands that are the subject of this EA:

"The proposed boundary expansion would provide protection of the forested and agricultural landscape now surrounding the Fort area and, by practicing forest management on some of the land included, would allow a return to a forest landscape representative of that experienced by the Corps of Discovery." (p.46)

The Fort Clatsop National Memorial Expansion Act of 2002 accomplished the boundary expansion proposed in the park's GMP.

In conclusion, guidance in law, policy and decision documents clearly directs the park to restore both the historical appearance and ecological function of its forests whenever feasible.

HISTORICAL AND EXISTING CONDITIONS

Historical Conditions

The Fort Clatsop Unit lies within the Sitka spruce vegetation zone described by Franklin and Dyrness (1988). This forest type stretches in a long, narrow zone along the west coast of North America from northern California up to the Gulf of Alaska. In most areas it extends only a few kilometers inland. Maritime influences predominate, with high precipitation, frequent fog, and mild year-round temperatures. Sitka spruce (*Picea sitchensis*) and western hemlock (*Tsuga heterophylla*) are the dominant tree species, with western redcedar, pacific silver fir, grand fir, Douglas fir, Pacific yew, bigleaf maple, and red alder present in varying degrees. These are the wettest forests in North America (Long 2002).

Historically, large Sitka spruce and western hemlock trees dominated the forests of Lewis and Clark NHP. Prior to European settlement, at least 40% of the coastal hills were old-growth Sitka spruce/western hemlock forest (Agee 2000).

Table 1: Historical and Existing Conditions

Attribute	Historic Conditions	Existing Conditions
Trees	Sitka spruce/western hemlock with bigleaf maple, Pacific yew, western redcedar, alder	Western hemlock/Sitka spruce with Douglas fir
Forest Floor	More biomass on forest floor than in standing trees. Thick organic layer	Very few downed trees except in recent windthrow areas, very thin organic layer
Structure	Mixed ages, landscape heterogeneity	Even aged, landscape homogeneity
Snags	Common	Rare
Stem Density	Variable, open	Extremely dense
Understory	Rich, diverse, multi-layered	simple or absent
Wind	Creates small patchy openings	Creates very large areas of windthrow
Fire Risk	Very low, caused by extremes in climate	Low, caused by extremes in climate
Growth	Large tree diameters due to sufficient resource allocation	Small diameters due to competition for light
Succession Pathways	Open	Closed

Disturbances play important roles in structuring the coniferous forests of western North America (Agee 1993, Franklin et al. 2002, Veblen et al. 1994). Their variation in type, extent, intensity and frequency lead to unique post-disturbance conditions and forest developmental pathways.

Stand replacing disturbances initiate the forest development sequence while chronic, small-scale disturbances are important agents of tree mortality and pattern formation within the development sequence. Wind is the primary disturbance in coastal Sitka spruce Zone forests. Storms with hurricane force winds—potential stand replacing events—have swept the Pacific Northwest coast approximately once every 20 years in the last 200 years (Henderson et al. 1989). In addition, smaller windstorms blow down or damage individual trees or groups of trees on a much more frequent basis. Additional complexity is introduced by feedbacks between wind-created edges along canopy gaps and blowdown areas, which expose additional trees to wind disturbance (Greene et al. 1992). As a consequence, wind disturbance becomes chronic, and blowdown patches can be seen to grow and migrate across coastal forest landscapes at annual to decadal time scales in complex wave and partial wave patterns (Harcombe et al. 2004). The net effect of this variable-intensity wind disturbance regime is a complex landscape mosaic of different patch types and sizes, often with high within-patch heterogeneity.

Fires, while rare, also perturb coastal Sitka spruce Zone forests. The incidence of fire in these forests is low because ignition sources are infrequent and ignitions rarely coincide with fuel moisture levels conducive to carrying wildfire. The limited available fire history data for Sitka spruce forests indicates that stand replacement fires occur only during extreme weather conditions associated with dry east winds (Agee 1993). Fahnestock and Agee (1983) calculated a fire return interval for the Sitka spruce type in western Washington at over 1,100 years. Long and Whitlock (2002) estimated a fire return interval of 240 ± 30 years over the past 2700 in northwest Oregon. A major stand-replacing fire event—the Nestucca Fire— burned Sitka spruce zone forests at what is now the Cascade Head Experimental Forest in northwest Oregon sometime between 1845 and 1849 (Morris 1934, Munger 1944). The Nestucca fire started in the Willamette Valley and was pushed over the Coast Range by strong east winds. It is unknown if this significant fire was of natural or human origin. The famous Tillamook Burn, a series of fires that burnt 355,000 acres of coastal forest between 1933 and 1951, is believed to have been human in origin but bolstered by unusually high temperatures, low humidity, and east winds. In any case, stand replacement fire events are certainly possible in the Sitka spruce Zone, although the probability of occurrence is quite low. Fire rarely follows windthrow. Historically, wind storms occur much more frequently than fire; the overwhelming majority of these wind throw events have not been followed with fire – rather, the blown down trees decompose in place, building rich organic soils and serving as nurse logs for the next generation of trees.

Fire was also used as a management tool by northwest coastal tribes to maintain forest openings to improve hunting opportunities and increase berry production (Sauter 1974, Deur 2005).

Existing Conditions

When the Corps of Discovery first laid eyes upon this landscape, many of the trees they were seeing may have been relatively young, but the overall ecosystem was the result of thousands of years of complex evolutionary relationships. Since the last ice age approximately 20,000 years ago, climate and vegetation in the Pacific Northwest have gone through several major transitions; conditions similar to the present have maintained in most places in the last 5,000 to 6,000 years. Post – nineteenth century logging practices, agricultural use, and settlement patterns have largely replaced wind as the primary disturbance factor. This has resulted in an imbalance of the ratio of

old growth forests to younger stands on a regional scale. In the Youngs Bay and Skipanon watersheds alone, changes in overall vegetation composition have been dramatic: since 1850, mixed coniferous and Sitka spruce forests have decreased by more than 15,000 acres, while land in clearcuts and Douglas fir plantations has increased by over 40,000 acres (NRCA 2010). As a consequence, there is much less spruce, much more Douglas-fir and hemlock and many more young stands than would have existed prior to the advent of steam-powered logging at the end of the 19th century.

Managed landscapes have been altered such that the response to typical perturbations is different from that of unmanaged landscapes. For example, past harvest has created forest stands with hard edges, decreasing forest ecosystem resistance to wind disturbance (Ruth and Harris 1979). The high stand density causes trees to have high height: diameter ratios, with stand stability reaching a minimum in the mature (*sensu* Franklin et al. 2002) stage. During early maturity, where natural single cohort stands are just beginning to transition into multi-cohort structure and composition, the likelihood of high severity wind disturbance is greatest (Acker et al. 2000, Greene 1992, Harcombe P.A. Et al. 2004, Harcombe P.A., Harmon, M.E., Greene, S.E. 1990, Harris 1989, Jane 1986, Rebertus et al. 1997, Wimberly and Spies 2001). A likely outcome for these single cohort western hemlock dominated stands originating from catastrophic disturbance (timber harvest) is to move into a high-severity wind disturbance regime, in contrast to the historical low severity wind disturbance regime that maintained the landscape in a high proportion of old-growth.

The role of wind as a powerful shaper of local forest dynamics was dramatically demonstrated in December of 2007. A severe wind storm struck the northwest coast of Oregon, causing significant damage throughout Clatsop, Tillamook, and Columbia counties. Hurricane force winds struck down thousands of trees throughout the park, creating very large gaps, standing snags, and heavy coarse woody debris (CWD) loads. The adaptive management proposed under the Preferred Alternative would allow the park to approach the storm-damaged areas on a case-by-case basis and determine what degree of management is appropriate in each affected area.

When settlers began arriving in large numbers in the early 1800s, timber harvest increased. Since the initiation of industrial logging practices in the mid-nineteenth century, large-scale timber harvest has replaced wind as the major disturbance factor. One very significant effect of this has been the removal of huge amounts of biomass from forested ecosystems. Removing woody biomass from a forest rather than letting it decompose onsite can affect soil chemistry, soil fertility and plant growth. Decomposing wood helps replenish soil nutrients (ODF 2008). When biomass is removed, essential nutrients such as nitrogen are removed along with them. Conventional logging practices also utilize controlled burning and/or herbicide applications to reduce competition from brush with newly planted seedlings. Removing these early colonizing shrubs and alders, which are nitrogen fixing, also reduces nitrogen inputs into the ecosystem (Luoma 1999). Thus far, nitrogen has not been found to be a limiting factor in growth rates of western Oregon forests, but repeated clear-cut style harvesting may eventually deplete the soil (Luoma 1999).

Another consequence of past timber management practices is an overabundance of dense, crowded, young stands of naturally regenerating western hemlock and planted Douglas fir with

tall, thin trunks. These dense, even–aged western hemlock and Douglas fir dominated stands, which are now the dominant stand type across the landscape, are much more susceptible to catastrophic blow down than the structurally diverse forests of the past (Beese 2001).
The maps shown in figures 1 and 2 are based on Weyerhauser timber cruise data taken in 2004. Figure 1 shows the approximate current ages of the stands to be treated under this plan. Figure 2 displays the dominant and co-dominant tree species composition of the stands at present. This information will aid prioritization of stand treatments and preliminary project planning.

Figure 1: Existing Conditions, Showing Current Stand Age Classes

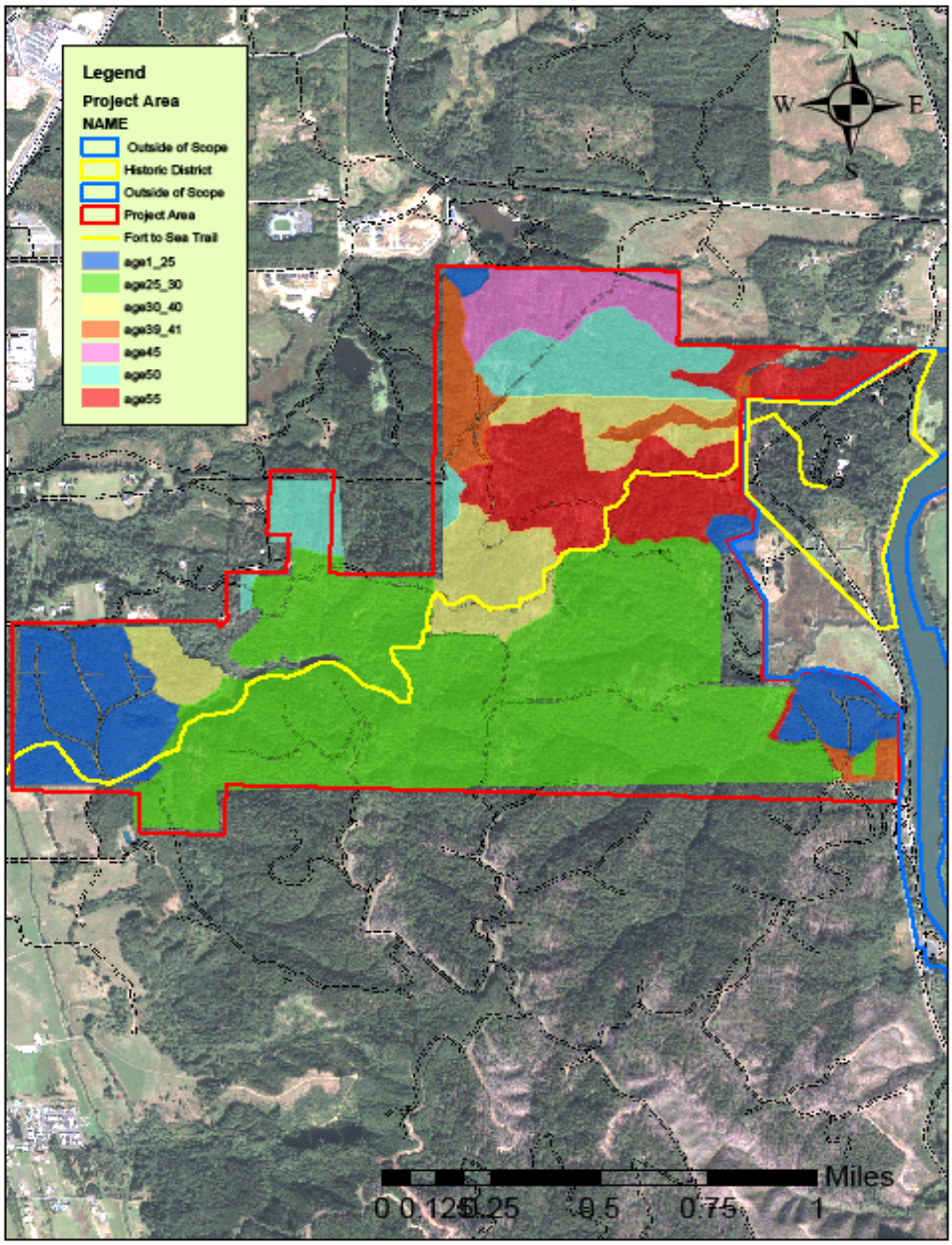
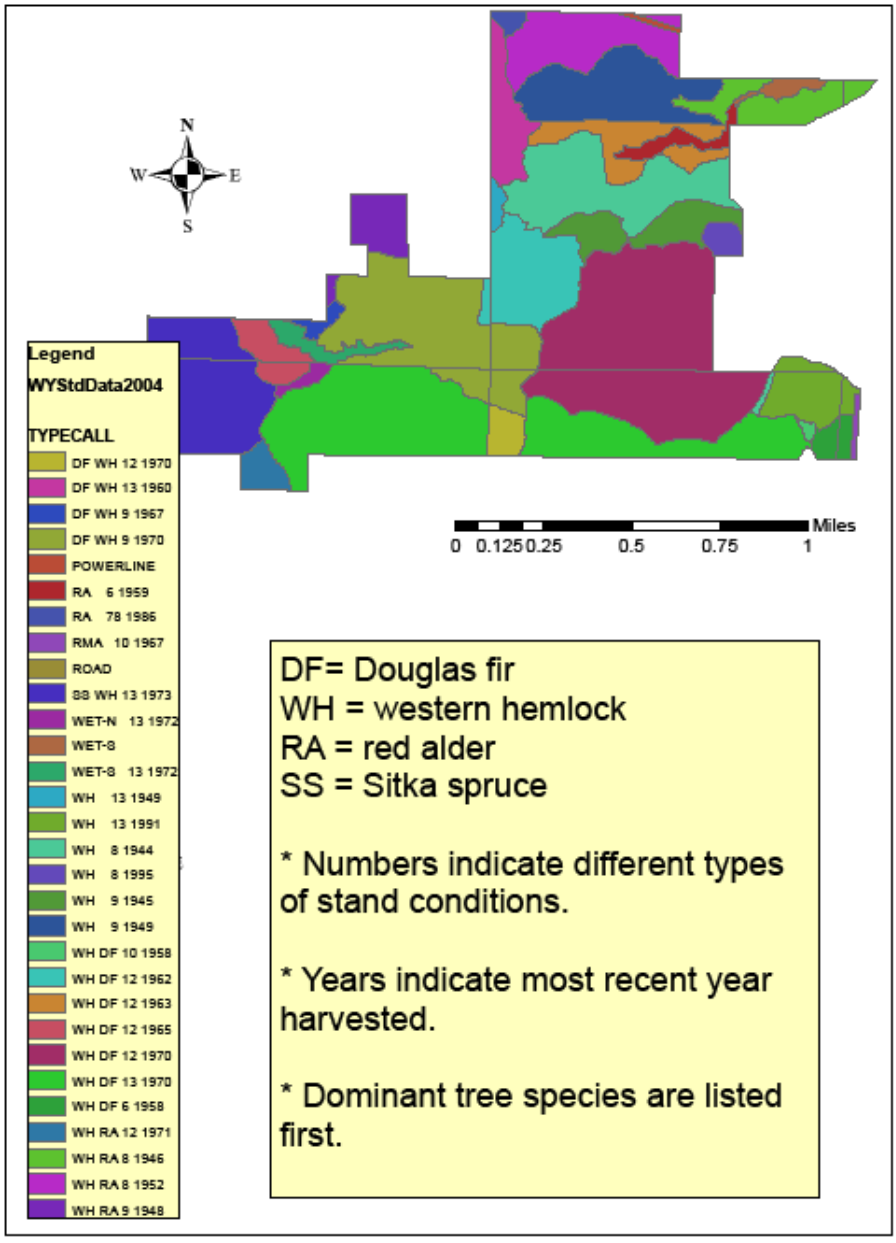


Figure 2: Existing Conditions, Showing Stand Types



Regional Context

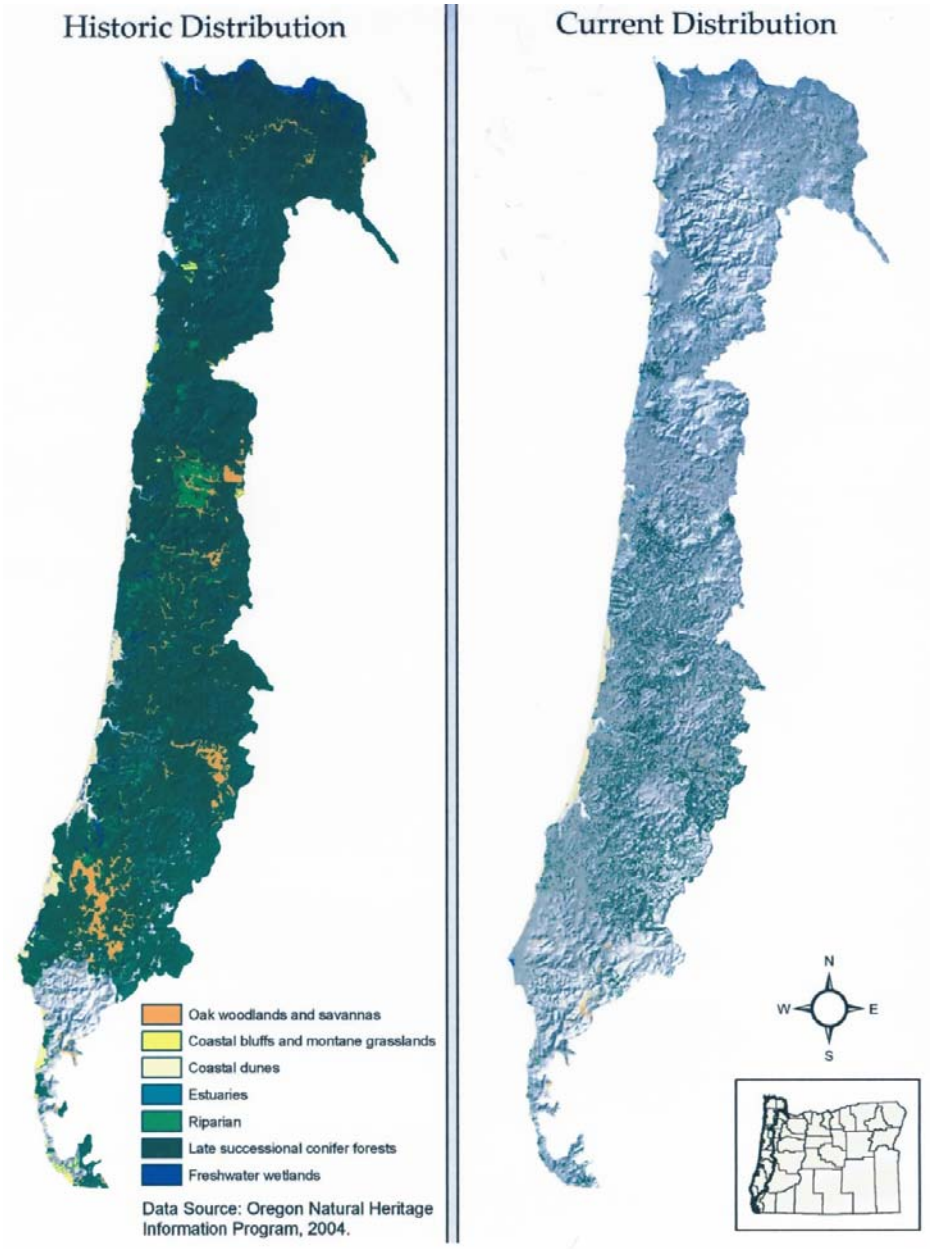
The project area sits in the middle of a landscape heavily altered by human activities. Commercial timber operations are adjacent to the Fort Clatsop unit. An aerial view of the surrounding landscape reveals a patchwork of logged forests, agricultural clearings, and urban and rural development. This has resulted in a loss of overall species and habitat diversity across the landscape. Forests with late-seral characteristics are increasingly rare within this broader landscape; there are very few examples of intact ancient spruce forest left in our area. Two such stands nearby are at Ecola State Park in Oregon and Cape Disappointment State Park in Washington (which is within Lewis and Clark NHP's legislative boundary).These forests serve as models for the desired future condition.

Other than these relatively small preserves, the vast majority of timberland in Clatsop County has been and continues to be intensively managed for short-rotation timber production. Over seventy percent of the total land area in the county is managed by the Oregon Department of Forestry or private timber companies, which continue to manage the majority of their land for timber harvest goals. Ninety-six percent of original coastal temperate forests in Oregon have been logged (Noss 1995). Development pressure is also reducing the amount of native forests in the county. These land uses have resulted in a landscape where old, complex forest habitat is becoming increasingly rare. Because of this, there is a pressing need to provide quality late seral forest habitat in the area.

Within this regional context, the small percentage of forest land within the Fort Clatsop unit is of critical importance for conservation and restoration. There is an opportunity here to change the trajectory of these second and third growth tree plantations away from monocultures of low ecological value towards fully functioning, dynamic, resilient late seral ecosystems. In both the near and far future, these stands would serve as both refugia and sources of late-seral dependent taxa.

Figure 3 displays the tremendous loss of late seral habitat throughout the western Oregon coast range since the onset of industrial logging (ORNHIC 2004):

Figure 3: Historic vs. Current Habitat Distribution



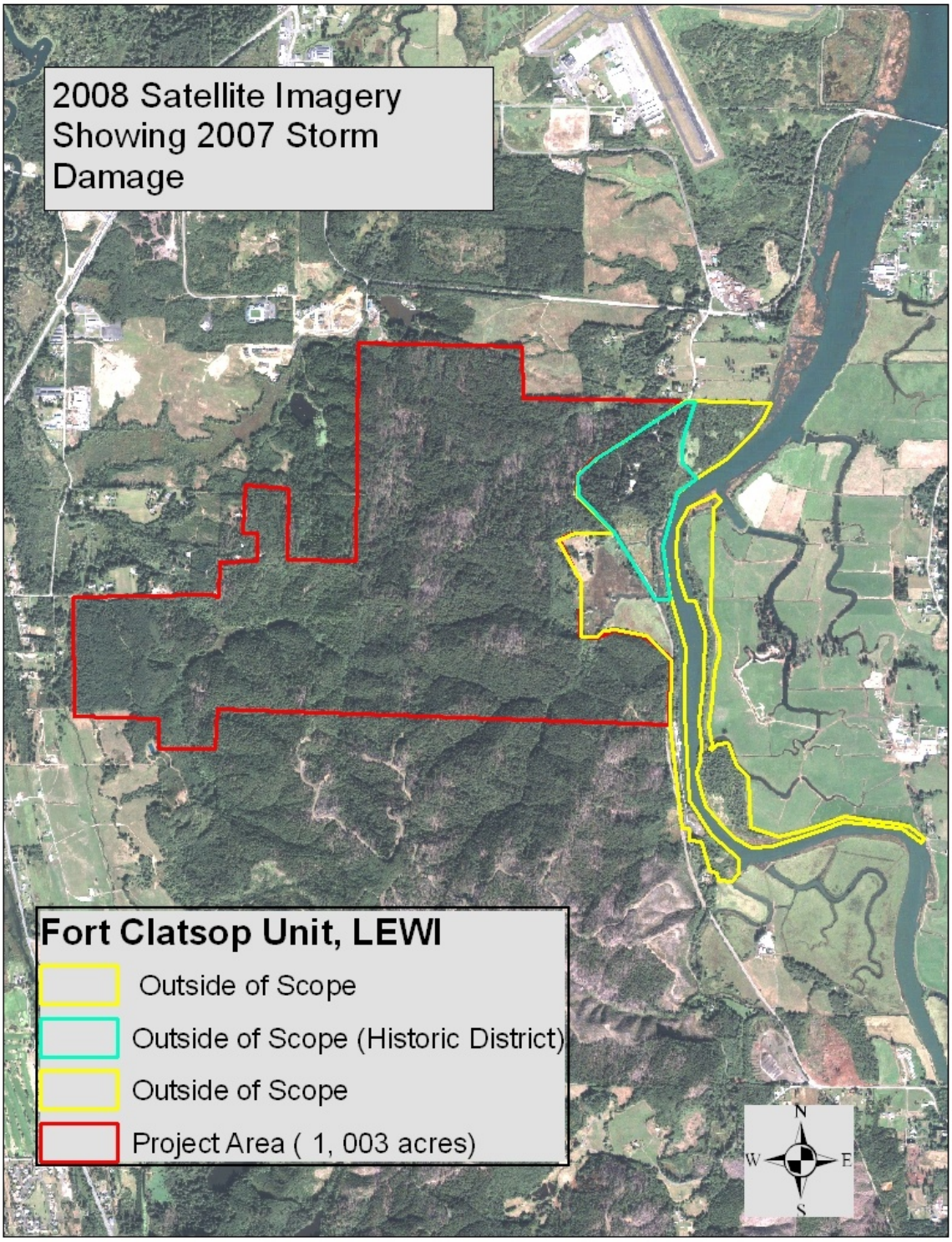
PROJECT AREA

The proposed forest restoration and management plan (FRMP) covers the recently acquired forested portions of the Fort Clatsop unit of Lewis and Clark National Historical Park. This includes the forest west of the original memorial which was acquired from Weyerhaeuser, and additional acres acquired in subsequent acquisitions from private landowners, for a total of 1,003 forested acres.

The 85 acres of the original 125-acre Fort Clatsop National Memorial (figure 5) that are east of the Fort Clatsop Road are not within the scope of this plan. This acreage will continue to be managed as a National Historic District, and thinning will continue as authorized under the Fire Management Plan. Estuaries and floodplain areas along the Lewis and Clark River are also beyond the scope of this plan - land management at the Otter Point Restoration Site is guided by the Otter Point E.A. (2010), and at Netul Landing by the River Day Use Area E.A. (2002). Future work at other estuarine sites such as South Clatsop Slough will be addressed in other plans. No other Lewis and Clark NHP park units (Cape Disappointment, Station Camp, Dismal Nitch, Sunset Beach, Yeon, and Salt Works) are addressed in this plan. These units have different habitats, management, and/or Desired Future Conditions than those outlined in this plan. This FRMP is primarily intended to guide forest vegetation management in the Fort Clatsop unit for the next 20 years. This is based on an assumption of treating and monitoring approximately 100 acres/year for the first 10 years of the plan, and then performing monitoring and additional smaller treatments as needed for the next 10 years. At this point the plan will be revisited, and revised and updated as needed.

Figure 4: Location of the Fort Clatsop Unit of Lewis and Clark National Historical Park

Figure 5: Project Area within the Fort Clatsop Unit



PROJECT OBJECTIVES

Based on an analysis of historic and existing conditions, the park has developed the following measurable objectives tied to the project goals described above.

Goal 1. Manage forests for the development of historical conditions described in Table 2.

Goal 2. Increase Visitor Understanding of Forest Ecology and Development (education, interpretation, youth involvement, waysides, participation in research and field treatments, etc.)

Goal 3. Adaptively manage the resources in order to respond to new challenges and improve management practices as experience is gained and knowledge evolves

Table 2: Objectives specific to the three goals:

Goal 1: Forest Characteristics	Objective 1-1: Enhance forest structural complexity through application of variable density thinning (applying a variety of thinning treatments and untreated areas across the landscape to create heterogeneity on a landscape scale) and other techniques designed to accelerate stand development by truncating the competitive exclusion stage of forest development
	Objective 1-2: Reintroduce the range of plant species made locally rare under previous management
	Objective 1-3: Increase diameter growth rates to speed development of large trees and to reduce windthrow risk by decreasing the ratio between tree height and trunk diameter (H:D ratio)
	Objective 1-4: Encourage the development of multiple canopy layers
	Objective 1-5: Increase the number and size of snags and downed logs and forest floor biomass
	Objective 1-6: Stimulate the re-initiation of understory plants through overstory thinning
	Objective 1-7: Retain existing snags and down wood where possible to preserve existing habitat structures
	Objective 1-8: Create additional snags and downed wood to recruit these structures where they are lacking or under represented
Goal 2: Increase Visitor Understanding	Objective 2-1: create two new loop trails to enable visitors to access multiple forest developmental stages & learn about forest ecology and active forest restoration *in situ*
	Objective 2-2: conduct ranger-led walks interpreting work-in-progress
	Objective 2-3: develop signage explaining different logging histories, methods, and forest developmental pathways
	Objective 2-4: integrate project work into existing educational programs concerning watershed health

	Objective 2-5: engage youth in restoration activities such as re-planting native species and invasive species control
Goal 3: Adaptive Management	Objective 3-1: Develop a monitoring plan to assess effectiveness of treatments at directing stands toward the desired future condition
	Objective 3-2: Incorporate monitoring findings into management practices
	Objective 3-3: Continue to incorporate the best available science and practices by collaborating with other groups conducting forest restoration, and staying abreast of the latest scientific literature on ecology and silviculture

RELATED PLANS FOR THE FORT CLATSOP UNIT

This plan provides direction for forest lands within the Fort Clatsop unit of Lewis and Clark NHP. It does not include the developed area surrounding the fort or wetlands and riparian areas along to the Lewis and Clark River.

In the developed areas near the fort, the Fire Management Plan will guide forest management actions. In wetlands and riparian areas along the Lewis and Clark River, the Otter Point EA (2010) and the River Day Use Area EA (2002) will guide management. In all other forest lands, this plan will guide management.

This project is proposed within the context of several pieces of law and policy which provide a framework for our actions. The park has developed this proposal in accordance with the laws, policies, and regulations discussed in the NPS Guidance Section above.

ISSUES AND IMPACT TOPICS

Scoping

A list of issues and concerns related to improvements to the project were identified through park internal scoping and through the public scoping process. Internal scoping involved an interdisciplinary team of NPS staff who determined potential issues and impact topics.

Initial research and development for this project was begun in 2006. Based on this, a draft restoration plan was written and on February 1, 2007, a press release seeking public comments on the draft plan was sent to the local media. Emails and hardcopies of this request for comments were also sent out to interested individuals, organizations, and agencies. Throughout the scoping and development phases of this management plan, a number of key issues and concerns have been identified as being particularly important with regard to the forests in the Fort Clatsop unit. The resulting communications led to this list of key issues and concerns:

- A well thought-out plan to manage the forests in the Fort Clatsop unit.
- Scarcity of late-successional forest in the current landscape has led to a decrease in biodiversity and habitat availability for species that historically were abundant in the area.
- The restoration of the natural landscape including vegetation and wildlife habitat degraded by past management activities.
- Protection of natural resources including air, water, soil, plants and animals.
- Fires, including prescribed fires, and their potential spread onto adjacent private land.
- Protection of cultural resources, and inclusion of Native American tribes in archaeological and conservation activities.
- Safety of visitors, staff, and adjacent property owners.
- Effects on visitor use.
- Preservation of the wilderness qualities found within the park.
- The cumulative effects of actions proposed in management with respect to potential watershed and landscape level impacts.
- Maintenance of wildlife habitat in both the short and long term within the context of proposed actions.
- Loss of elk habitat in the region as human development encroaches on areas used by elk.

Issues and Impact Topics Identified for Further Analysis

The impact topics that have been included in this assessment are:

Physical Environment (geology, soils, and topography). The park's physical resources are key components of the park's environment and are essential to the health of the ecosystem. Changes to the physical environment could potentially affect biological and physical components of the forest, and the organisms that inhabit it. The alternatives and restoration methods analyzed in this environmental assessment may affect the physical environment of the forest ecosystems, specifically geology, water quality, hydrology, and soils. The analysis described in this assessment considers the impacts of each of the alternatives on these physical components of the forest ecosystem.

Water Quality. Creeks and streams are within the project area. Mitigation measures against impacts to water quality are addressed, and potential impacts to water quality under the proposed alternatives area analyzed in this document.

Vegetation. This plan proposes to alter the vegetation composition and structure of the forested areas of the Fort Clatsop unit over the next 20 years. The alternatives analyzed in this document will have varying degrees of impact to both native and non-native plant populations and successional pathways. The analysis described in this assessment considers the impacts of each of the alternatives on vegetation within the project area.

Wildlife. Native wildlife species are an integral part of the park's environment. It is part of the NPS mission to protect these resources, and therefore important to identify and analyze any potential impacts (adverse or beneficial) that could affect these resources. The alternatives and restoration methods analyzed in this environmental assessment may affect the biological and natural resources of the forest habitat, including habitat for amphibians, birds, bats, elk, and other mammals. The analysis described in this assessment considers the impacts of each of the alternatives on wildlife species within the project area.

Threatened, Endangered and Sensitive Species. The Federal Endangered Species Act prohibits harm to any species of fauna or flora listed by the U.S. Fish and Wildlife Service (USFWS) as being threatened or endangered. Such harm includes not only direct injury or mortality, but also disrupting the habitat on which these species depend. There are several threatened, endangered, or sensitive species that reside within or near the park, including thirteen salmonids. This impact topic is included in this analysis.

Soundscape. Noise is defined as unwanted or unnatural sound. Thinning activities can involve the use of noise-generating mechanical tools and devices with engines, such as chain saws, trucks, and chippers. Each of these devices, in particular chain saws at close range, are loud. Therefore, this impact topic is included in this analysis.

Visitor Use and Experience/ Visual Resources. The NPS Management Policies state that the "enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks." Aesthetics is considered part of the visitor experience.

Maintaining scenery of great natural beauty is a key component in enhancing visitor experience. Analysis of all potential impacts to recreation and visitor experience, including aesthetics and education, is provided in this document.

Socioeconomics. NEPA requires an analysis of impacts to the "human environment," which includes economic, social, and demographic elements in the affected area. The park has direct and indirect impacts on the regional economy.

Human Health and Safety. The health and safety of visitors, staff, and contractors is of utmost importance to the National Park Service. Therefore, impacts to human health and safety are addressed in this analysis.

Historical and Cultural Resources. Through legislation the NPS is charged with the protection and management of historical and cultural resources in its custody. Impacts to these resources therefore are identified and analyzed in this document.

Impact Topics Considered but Dismissed

Environmental Justice. Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, requires all federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. Forest restoration projects at the Lewis and Clark National Historical Park are expected to have no direct or indirect impacts on minority or low income populations or communities. Environmental justice considerations, therefore, were not included for further analysis in this environmental assessment.

Waste Management. None of the alternatives would generate noteworthy quantities of either hazardous or solid waste that need to be disposed of in hazardous waste or general sanitary landfills. Therefore this impact topic is dropped from additional consideration.

Transportation. None of the alternatives would substantially affect road, railroad, water-based, or aerial transportation in and around the park. Therefore, this topic is dismissed from any further analysis.

Utilities. Generally, some kinds of projects, especially those involving construction, may temporarily impact above and below-ground telephone, electrical, natural gas, water, and sewer lines and cables, potentially disrupting service to customers. Other proposed actions may exert a substantial, long-term demand on telephone, electrical, natural gas, water, and sewage infrastructure, sources, and service, thereby compromising existing service levels or causing a need for new facilities to be constructed. None of the alternatives will cause any of these effects to any extent, and therefore utilities are eliminated from any additional analysis.

Resource Conservation, Including Energy, and Pollution Prevention. The NPS's Guiding Principles of Sustainable Design provides a basis for achieving sustainability in facility planning and design, emphasizes the importance of biodiversity, and encourages responsible decisions. The guidebook articulates principles to be used such as resource conservation and recycling. Proposed project actions would not minimize or add to resource conservation or pollution prevention within Lewis and Clark NHP and, therefore, this impact topic is not evaluated further in this EA.

Resources Not in the Project Area. The following topics are not further addressed in this document because there are no potential effects to these resources, which are not in the project area:

- Wilderness
- Designated ecologically significant or critical areas
- Wild or scenic rivers
- Floodplains
- Designated coastal zones
- Indian Trust Resources
- Prime and unique agriculture lands

- Sites listed on US Department of Interior's National Registry of Natural Landmarks
- Sole or principal drinking water aquifers

In addition, there are no potential conflicts between the project and land use plans, policies, or controls (including state, local, or Native American) for the project area.

CHAPTER 2: ALTERNATIVES

INTRODUCTION

Reasonable alternatives, including the No Action alternative were evaluated during the NEPA process. Possible alternatives include a No Action alternative as required under NEPA (Alternative 1), restoration without removal of biomass (Alternative 2) and restoration with biomass removal permitted under strictly constrained ecological conditions (Alternative 3).

ALTERNATIVE 1: NO-ACTION ALTERNATIVE

The No-Action Alternative is mandated under the National Environmental Policy Act and is designed to serve as the basis for comparison of proposed actions. Under this alternative the forests at Lewis and Clark NHP would largely be left to develop with minimal intervention. Present activities within the project area include: control of invasives, especially holly and ivy, management of forest fuels under the Lewis and Clark NHP Fire Plan, hazard tree removal, and trail maintenance. These activities would continue under the No-Action alternative.

If this alternative is selected, the opportunity to meet objectives to improve habitat, biodiversity, and other forest characteristics would be limited.

FEATURES COMMON TO ACTION ALTERNATIVES (ALTERNATIVE 2 AND ALTERNATIVE 3)

Accelerated Development of "Old Growth" or Late Successional Forests

A common focus of all action alternatives is managing for the desired future condition of late successional forests. Late successional forests are fundamentally different from younger forest types and research has shown that they play a number of key ecological roles (Franklin and Spies 1991). A late successional landscape is one in which a variety of age –classes can be found. Landscape level complexity arises from a mosaic of old growth, open meadows, shrublands, and younger stands. In turn, this complex landscape is a result of natural disturbance; in this part of the world, this has traditionally been wind combined with occasional catastrophic fires.

What sets late seral forests apart is not simply their age but rather the structural complexity that arises due to the presence of large trees, large snags, large volume of downed wood, and a wide diversity of tree sizes (Franklin et al. 2005). This complexity results in the ability of these forests to support high levels of biodiversity and fill a number of key ecological functions such as nutrient retention, erosion control, and water purification (Franklin and Spies 1991). Late successional forests also would help achieve Lewis and Clark NHP's goal of recreating the atmosphere surrounding the Lewis and Clark expedition. It would take many years, beyond the 20 year life of this plan, to achieve this goal. However, interim targets of a more abundant and diverse understory, increased LWD and snags, successful reintroduction of native species, smaller height: diameter ratios, etc. would be apparent and measurable early on in the

implementation of this plan.

While this management plan is intended to guide forest restoration at Lewis and Clark NHP for the next 20 years, forests with the desired conditions will not be achieved until much later, perhaps decades after the treatments

Development of Prescriptions

While this Plan establishes the framework for forest restoration activities, it does not outline stand specific strategies for the forests in the Fort Clatsop Unit. In order to develop strategies to restore a particular stand, accurate data about current stand conditions are essential. Data such as stand diameter/height distribution, species composition, density, age, and history are available from Weyerhaeuser stand records, but this information is more than ten years old and does not reflect recent changes in stand conditions, particularly after the 2007 wind storm. Further stand surveys will be conducted prior to prescription development. Measurements of tree height, diameter, live crown ratio, height:diameter ratio, and tree density will be collected using variable radius plots established using a keyhole prism or Releskop. Cruise data will be used to characterize the existing stand conditions, describe baseline untreated conditions, and estimate numbers, sizes and species of trees to be felled and retained to accomplish restoration objectives.

Prescription development will include project prioritization and planning, objectives, and best management practices. A number of thinning techniques will be employed, depending upon the composition of individual stands. If information gathered during cruising and prescription development changes the assessment of impacts, additional compliance will take place.

Creation of gaps and patches

All action alternatives would focus on working with the existing forest stands, not replacing them outright. This would be accomplished by thinning some of the trees within a stand. Thinning works because only a limited amount of resources (primarily light, water, nutrients) are available within a given area, and removing some trees reduces competition and increases the relative abundance of resources to remaining trees and understory vegetation (Smith et al. 1997). This results in fewer, larger, stronger trees.

Thinning treatments are more effective early in the life of a stand before growth is dramatically slowed by competition. Restoration treatments during the first 10 years of the plan would focus more on thinning to maximize the effectiveness of treatments. Thinning may still be implemented through the duration of the plan but the emphasis would be on treating stands as soon as possible then following up as needed.

Thinning has been shown to facilitate the development of the late successional characteristics that have been identified as the desired future condition of forests under this plan (Zenner 2005, Chan et al. 2006). The primary reason that thinning is able to speed the development of diverse understories, multi-layered canopies, and larger trees is that thinning works to shorten the competitive exclusion stage of forest development (DeBell et al. 1997). Competitive exclusion occurs when densely growing trees effectively capture all the available light and the ensuing

competition for resources causes trees to stagnate in growth and eventually die. This stage of forest development is characterized by few or no understory plants, reduced tree growth, and increased mortality; these characteristics may persist for long periods of time (Franklin et al. 2002). Development of understory plants and multiple canopy layers is particularly slow in stands with a large western hemlock component (Stewart 1988). As most stands in the Fort Clatsop unit feature hemlock as a major stand component, there is considerable potential for thinning to improve understory growing conditions. Studies have shown that understory composition in thinned stands is closer to old-growth understory composition compared to un-thinned stands (Tappeiner 1997, Muir et al. 2002). Thinning conducted with specific ecological objectives, instead of conventional timber production objectives, has the potential to be even more effective in promoting biodiversity and the development of late successional characteristics. This is because thinning treatments can be designed to favor ecological elements such as wildlife trees, gaps, and snags that are ordinarily selected against in production forests because they do not maximize the commercial value of the trees remaining in the stand. While evidence supporting forest restoration in the Sitka spruce zone is limited, the growing consensus on forest restoration is that thinning does have a beneficial impact in young over-dense stands across the region (Churchill 2003).

Due to the range of forest conditions present in the Fort Clatsop unit, a number of different thinning techniques would be necessary for restoration under the action alternatives. One of the main techniques being used in forest restoration in the Pacific Northwest is called Variable Density Thinning (VDT) (Carey et al. 1999). Variable density thinning applies a variety of thinning levels to simulate the structural complexity and spatial heterogeneity that are characteristic of old-growth forests. It has been described as "thinning with skips and gaps" (Harrington 2005). Skips are areas of no treatment designed to limit treatment impacts while gaps are areas cleared to simulate canopy openings resulting from windthrow or other disturbance. Both skips and gaps are designed to further increase the variability present after treatment. Sizes as well as the proportion of a stand devoted to skips/gaps can be tailored to meet local conditions and objectives. Overall, ongoing research continues to stress the importance of variability in thinning intensities when trying to achieve ecological objectives (Carey et al. 1999, Garman 2003, Muir et al. 2002, Franklin et al. 2002, Harrington 2005).

No treatment areas ("skips") would occupy approximately 20 percent of the area in each timber type/age class. These areas would function as quiet areas for wildlife during restoration activities and would also serve as refugia for ground mosses and fungi that could be disturbed during active treatment. The Oregon Department of Forestry strongly recommends leaving undisturbed areas for the preservation of intact populations of invertebrates and soil organisms, which are essential to decompositional processes (ODF 2008). No action areas would also serve as the basis for comparison during ongoing forest monitoring.

Because of the present condition of many of the stands, thinning may need to be conducted over several intervals in order to achieve restoration objectives while minimizing the risk of windthrow. Periodic treatment would be particularly important in the dense stands with greater wind exposure as these areas are most prone to wind damage. Multiple rounds of restoration treatments would also be necessary to create larger snags and downed logs as trees large enough to create these structures are currently too rare within the Fort Clatsop unit to meet desired

abundance or size criteria.

Under the action alternatives, thinning would mainly be directed at removing western hemlock and Sitka spruce as these two species are the most common in stands at the Fort Clatsop unit. Douglas-fir would also be thinned in the few stands where it is a major component. Generally hardwoods and minor species such as red alder, bigleaf maple, and western redcedar would be retained. Red alder may be thinned in stands where it is very abundant in order to create a diversity of snag and dead wood types. However, thinning of alder would generally be unnecessary due to its relatively short life span and its importance from a biodiversity standpoint. Maintaining minor forest species is important not only for plant biodiversity; hardwoods in particular are hosts to a great range of insects, arthropods, and epiphytic mosses and lichens (Neitlich and McCune 1997, Muir et al. 2002).

No old growth trees of any species would be cut. Under the preferred alternative, the largest trees removed would not exceed 20 inches in diameter at breast height. No trees would be felled towards residual trees or trees of outstanding character (deformed trees, large hardwoods, etc.)

Implementation Timeline

While this management plan is intended to guide forest restoration at Lewis and Clark National Historical Park for the next 20 years, thinning treatments are more effective early in the life of a stand before growth is dramatically slowed by competition. Restoration treatments during the first 10 years of the plan will focus more on thinning to maximize the effectiveness of treatments. Thinning may still be implemented through the duration of the plan but the emphasis will be on treating stands as soon as possible then following up as needed. It is anticipated that treatments will need to continue after this plan has expired, potentially for the next 60 to 80 years. Because it is difficult to project this far into the future, this plan intentionally expires after a 20 year period, at which point we recommend reviewing the progress to date, and drafting a new plan for the next 20 year period using adaptive management. Treatment will stop when monitoring indicates that the forest ecosystem has gained enough structural and ecological complexity that it will be a naturally balanced, integrated, self-perpetuating system with no further thinning treatments required.

Fungal seeding for biodiversity and protection from disease

With all thinning treatments, chainsaws and other cutting equipment would be lubricated with "mycospored" chainsaw oil. This is an environmentally friendly, biodegradable lubricant which has been infused with thousands of spores of desirable fungi which are widespread throughout the Pacific Northwest and occur naturally in the Fort Clatsop unit (such as oyster mushrooms and "turkey tails", both of which are not only beneficial decomposers but are harvested for their edible and medicinal qualities as well). As the wood is being cut, the spore-mass infused oil disperses mushroom spores into the cut faces of wood, and upon germination of spores the fungus accelerates the decomposition of stumps and brush. These desirable species also limit the spread of undesirable wood-rots such as anossum root rot by outcompeting them for space.

Use of Landscape Design and Low-Impact Actions near High Use Visitor Areas

One of the primary purposes of this plan is to create, for visitors, an experience of forests representative of those in the pre-contact Clatsop Indian homeland and seen by the Expedition. In high-use areas, the park would use landscape design to re-create the "look" as well as the structure and function of historic forests. In these areas, the park would also use treatments with a low visual impact, such as pulling trees over rather than cutting and leaving a stump or chain-sawed butt-end.

Creation of snags and downed trees

Dead wood in the form of both standing snags and downed logs is another feature common to all action alternatives. Large pieces of dead wood are one of the defining characteristic of old-growth forests and provide a number of ecological functions ranging from water retention to nitrogen fixation to aiding tree establishment (Franklin and Spies 1991). While dead wood of all sizes play some role in forest ecosystems, larger pieces above 20 inches in diameter are particularly important due to their longevity (Nelson 1988). Many species such as woodpeckers and other cavity nesters require larger snags in order to construct their nests (Aubry & Raley 2002). Because of the importance of large dead wood, creating effective snags and logs would necessitate cutting larger trees once they are available. Another possibility is to bind multiple smaller logs together into one unit to replicate a larger diameter downed log.

Specific targets for snag and CWD abundance vary considerably in the published literature for the Oregon Coast. Spies (1988) and Nonaka (2003) both documented high densities of snags in the forests of the Oregon Coast Range. One recommended target is to provide at least 36 snags over 10 inches DBH per acre and 10% cover of CWD (Mellen et al. 2006).

Felled trees and slash would not be burned. Felled trees that are not removed offsite would be limbed, bucked, and lopped to get the wood in contact with the forest floor. Smaller diameter trees may be bundled together to create wildlife habitat. Fuel residues created by disturbed vegetation or slash from felled trees would be lopped, scattered and left on-site. Where roads are available and accessible by heavy equipment, felled woody debris within 50 feet of roads could be chipped and scattered.

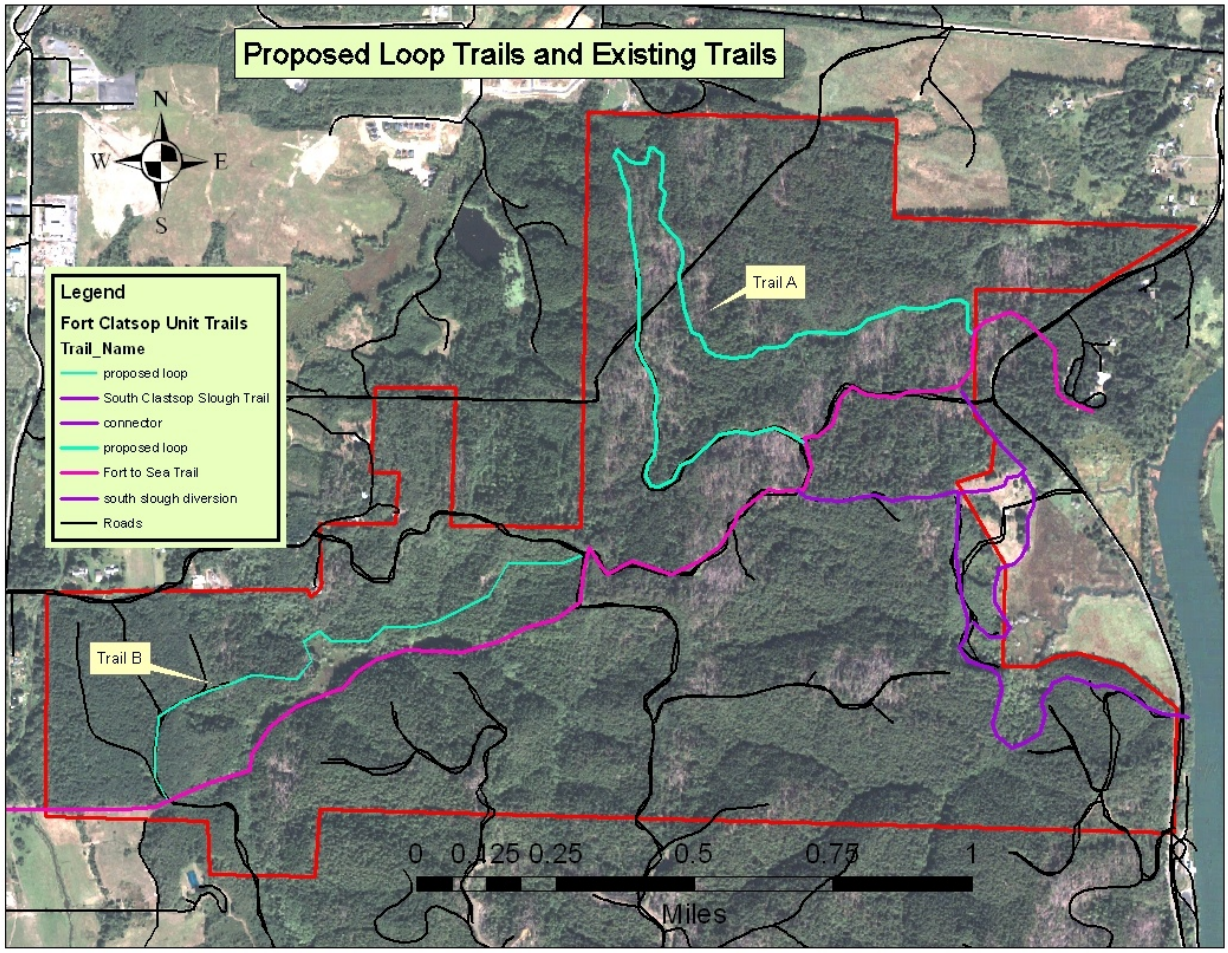
Planting of under-represented species

Planting of trees and other native plant species normally found in the area is another feature common to all action alternatives. Reintroduction of some plant species is necessary since many areas have very few plant species and recolonization is likely to be slow. The main tree species to be planted include western redcedar, Sitka spruce, vine maple, bigleaf maple, and yew. All plantings would be inoculated by dipping into a mycorrhizal solution, which has been shown to positively affect plant growth and survival (Stamets 2005). Planting activities may require some initial clearing of ground vegetation to establish desired species. Herbivory mitigation measures such as mesh tree shelters may also be necessary to establish some species.

Conversion of roads and tracks to trails

Increasing Visitor Understanding of Forest Ecology and Development is one of the primary goals of this plan; all action alternatives include objectives designed to meet this goal. One of these objectives is to build new trails in project area. Two new loop trails would be added to the unit, increasing opportunities for visitors to access areas of the park which contain forest stands in various stages of development and treatments. The two new proposed trail loops are shown on the map below:

Figure 6: Proposed Trails



Trail A, in the northern part of the unit, would be approximately 2 ½ miles in length and six feet wide. This trail would begin on an old road bed which would be partially decommissioned by addressing issues with plugged culverts and possibly resurfacing. From here, the trail would wind around one of the only stands of mature big leaf maples in the park, past nurse logs and blowdown, along a creek, and on through some of the most mature (approx. 60 year old) trees in the project area. This trail would provide ample opportunities for visitors and school groups to learn about forest developmental pathways, invasive species issues, restoration forestry tools, the importance of woody debris, and a myriad of other ecological subjects.

Trail B would split off of the Fort to Sea Trail in the southwestern corner of the project area, and would be approximately 1 mile long and six feet wide. This trail would provide access to yet another suite of forest habitats, including freshwater wetlands and dense brush patches. In addition to increasing visitor opportunities to get up-close experience of different habitats, providing a loop trail on the Fort to Sea would encourage more hiking of the original Fort to Sea, since it would no longer simply be an "out and back" option.

An added benefit of building these trails would be creating easier access for hand crews to conduct thinning treatments in nearby stands.

In addition to new trails, at least one interpretive panel would be designed and placed in one of the existing kiosks, which would explain the forest restoration project. Interpretive rangers would integrate discussions of forest ecology and restoration into existing hikes and programs, and develop additional hikes and programs specifically addressing the restoration plan.

Best Management Practices for tools and equipment

Equipment, both hand tools and heavy equipment, would be inspected daily to check for leaks. Equipment that may leak lubricants or fuels would not be used until leaks are repaired. All equipment would be stored, serviced and fueled outside of riparian areas and away from stream crossings. A spill plan and materials for spill containment would be available to onsite personnel and all personnel shall know how to use them. In the event of a spill, work would be stopped immediately, clean up would begin and the appropriate authorities would be notified. Petroleum products, chemicals, hazardous materials, or water contaminated by these materials would not be allowed to enter flowing waters.

All vehicles and equipment utilized in this project will be cleaned prior to entering park to prevent transmission of exotic species, i.e. plants, animals, or pathogens. Removal of all vegetative matter or mud from the undercarriage or tracks of vehicles and equipment is sufficient for this purpose. If vehicles or equipment travel to known infected areas during project implementation, they must be cleaned before re-entering the park.

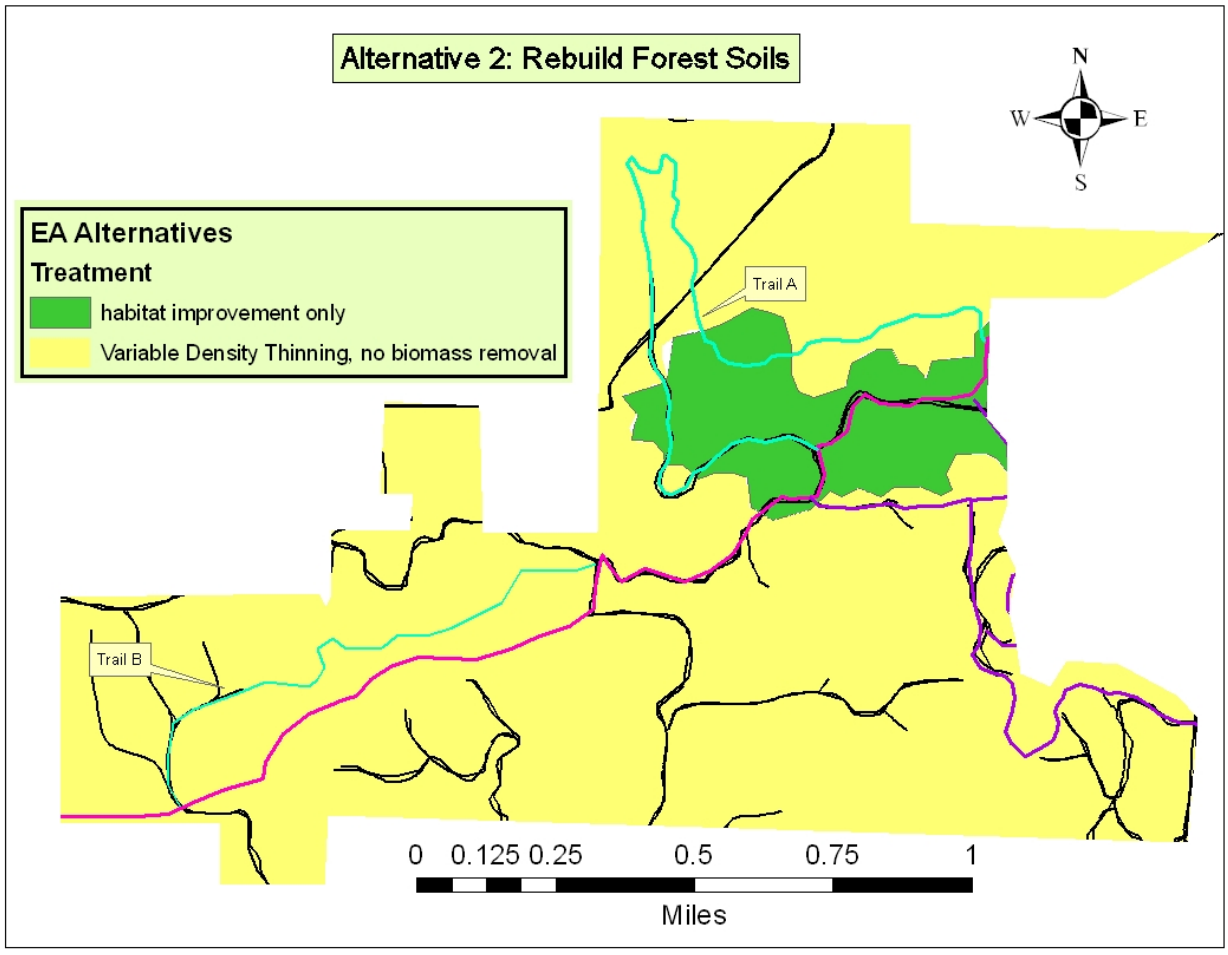
Monitoring

Another element common to all alternatives is the monitoring of forests and any implemented projects. Monitoring is necessary to not only assess success of treatments but also to keep track of potential problems such as invasive species or maintenance needs. Monitoring would allow us to integrate new information into management plans and allow for adaptive management if unexpected results are observed. Monitoring would also add to the base of scientific knowledge on applications of silviculture to promote late successional characteristics. LIDAR (Light Detection and Ranging) technology is increasingly being utilized as a tool to measure long term changes in vegetation composition, and is one method which would be employed to monitor success of treatments over long intervals. Plots would also be set up on the ground, to both field – check the LIDAR data, and to provide more fine scale information and detect short term changes. Data collected during monitoring efforts will be analyzed and used to inform ongoing management decisions.

ALTERNATIVE 2: RESTORATION WITH NO BIOMASS REMOVAL

Under this alternative, no biomass removal would occur in the project area. Thinning without removal would be conducted on 680 acres, habitat improvement only (snag creation, native plantings, etc.) would be conducted on 90 acres, and 20% of the project area would remain untreated. All thinned trees, branches, and slash would remain on site. Thinning would be accomplished through a combination of cut/leave, lop/scatter, and girdle/top to produce downed logs and standing snags. Chipping and spreading could be conducted in areas close to roads accessible to the chipper. Large branches and small tree boles could either be piled on roads as part of the decommissioning process or chipped and spread to control erosion from road beds. Chips could also be scattered back onto the forest floor, and piled around plantings as a mulch.

Figure 7: Alternative 2, Restoration of Fort Clatsop unit forests with the use of existing forest roads and trails, with all biomass left onsite



This alternative was considered due to scientific evidence that repeated biomass removal can deplete soils by removing essential nutrients, damaging soil structure, and negatively impacting soil microfauna (Luoma 1999). The soils in old growth western Oregon forests have deep organic layers comprised of dead biomass from fallen trees, leaf litter, and other vegetative

inputs, and an incredibly rich community of fungi, bacteria, arthropods, and insects which feed on it. It is in this organic layer that nutrients are cycled, nitrogen is made available, and carbon is stored. Repeated clearcutting, such as has occurred in the past in these stands, deprives the ecosystem of large, old logs, which have been found to actually contain more living biomass (in the form of bacterial, fungal, and arthropod decomposers) than live standing trees; while only about 10% of a living tree is living cells, as much as 35% of the biomass in a dead tree may be live fungal cells alone (Harmon 1987). Tree trunks also act as shelter and habitat for amphibians and small mammals.

Under this alternative, all of the dead plant material generated from harvest (boles, branches, roots, needles, etc.) would be kept on site. This would benefit long term soil formation, nutrient retention, and microfauna abundance and diversity.

The eastern portion of the Fort to Sea Trail and two forest access roads in the southwestern portion of the unit could be driven on, and equipment such as chippers could be transported on them. The remainder of the treatment areas could be accessed on foot by handcrews. The new trail loops proposed under this plan would provide easier access into some of the areas which would need thinning treatments. Areas away from trails and roads would need to be accessed cross-country on foot.

In order to achieve the desired forest conditions, multiple restoration treatments would be applied to stands where needed. Initial treatments would be focused on the more intensive thinning strategies in order to apply these treatments earlier in the life of a stand where they would be most effective. Follow up treatments may also include additional thinning especially in areas prone to windthrow where thinning targets cannot be met in a single treatment due to wind risk. Additional treatments would also include lower intensity activities focused on creating snags, CWD, and planting to increase the biodiversity of both overstory and understory species. Additional habitat oriented activities, such as inoculating trees with fungi and carving out tree cavities, would also be possible once trees larger than 20 inches DBH can be grown.

Forest restoration activities under Alternative 2 are anticipated to take place throughout the 20 year life of this plan. As time progresses, forest restoration would focus more on lighter thinning to create specific habitat improvements such as large snags, downed logs, and to promote forest biodiversity.

Alternative 2 would begin to provide the management tools necessary to accomplish the park's forest development and habitat improvement goals. Thinning options under this alternative would be limited by the total restriction on any biomass removal. It would mean that management options for the many densely forested stands would be drastically reduced because some biomass removal may be desirable in order to prevent large accumulations of downed trees, which could keep us from achieving some of the objectives outlined in this plan.

Large accumulations of downed wood could be an impediment to wildlife passage, particularly elk. Heavy CWD loads could hamper understory development. These are unknown variables which will be captured through long term monitoring. Not allowing any biomass removal would place some restrictions on the adaptive management strategy by eliminating biomass removal as

an option for changing management techniques to respond to future disturbances such as catastrophic windthrow, or insect or disease outbreaks. After the windstorm of 2007, the park removed 40 truckloads of blown down trees and woody debris just to restore access to the Fort to Sea trail. In spite of these drawbacks in meeting the objectives, this alternative would provide a minimum level of management options needed to accomplish most of the project goals.

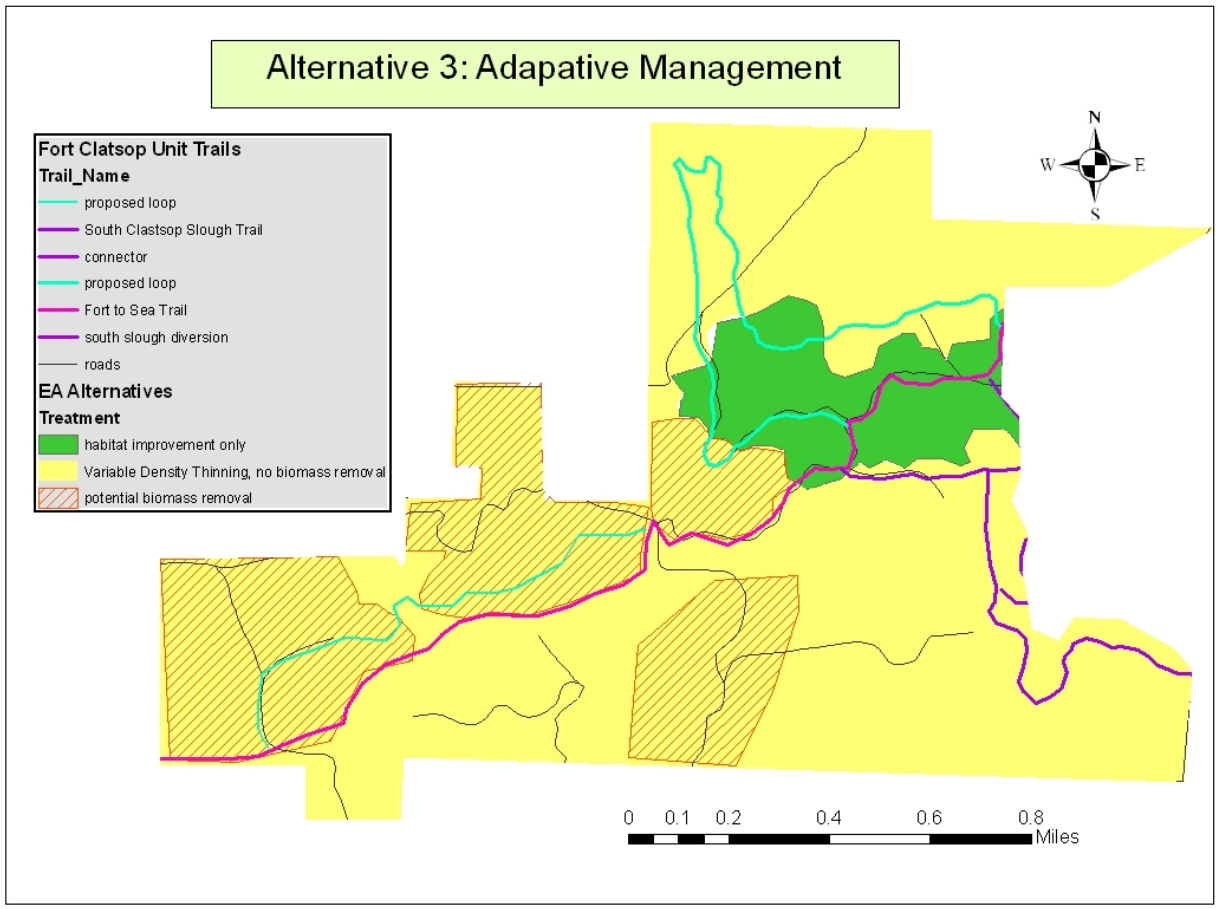
ALTERNATIVE 3: ADAPTIVE MANAGEMENT

Under Alternative 3 alternative, thinning including biomass removal would be possible on up to 290 acres of the 1003 forested acres of the Fort Clatsop Unit. This acreage was arrived at by looking at the proximity of densely stocked stands to usable roads. On these acres, Alternative 3 provides for adaptive management by allowing biomass removal under one of three conditions on this acreage:

1. to create research plots;
2. to stimulate the re-initiation of understory plants, if monitoring indicates that biomass removal is necessary to achieve this objective;
3. to manage unanticipated fire, insect, or disease outbreaks.

Alternative 3 contains the same actions as Alternative 2 on 713 of the 1003 forested acres of the Fort Clatsop Unit. Thinning without removal will still occur on 423 acres and 90 acres would receive habitat improvement only (plantings, snag creation, etc). The stands were selected for "habitat improvement only" because they are some of the oldest, least densely stocked stands in the park and it is not anticipated that biomass removal would be needed.

Figure 8: Alternative 3, Adaptive Management



Conditions that would lead to biomass removal

1. To create research plots.

Most of the existing scientific literature regarding restoration forestry is based on Douglas fir dominated ecosystems and on thinning techniques which employ biomass removal. The long term effect of removing biomass early on in stand development is one of the key uncertainties in restoration silviculture (Churchill, 2007). Under Alternative 3, research plots can be established to compare the effects of removal versus no removal in coastal Sitka spruce forests. The park is ideally suited for long term ecological monitoring of this sort, and the results will provide valuable information to guide future restoration efforts in the region. The creation of research plots would help the park better meet the plan's objectives of developing a monitoring plan to assess effectiveness of treatments (Objective 3-1), incorporating monitoring findings into management practices (Objective 3-2), and incorporating the best available science and practices (Objective 3-3).

The exact size of the research plots will be determined by the specific silvicultural prescriptions. For reference, the forest vegetation monitoring protocol for the North Coast and Cascades Network of the Pacific West Region calls for 12 plots of one hectare each, approximately 30 acres.

2. To stimulate the re-initiation of understory plants, if monitoring during the plan indicates that biomass removal is necessary to achieve this objective.

The accumulation of large amounts of CWD in some areas may prohibit the achievement of Objective 1-6: Stimulate the re-initiation of understory plants through overstory thinning. The monitoring program will provide data which will inform management if this goal is being met. If not, this Alternative will allow for the removal of some of this CWD and/or standing biomass (living trees) once all ecological targets are met. In areas where biomass is removed, monitoring will enable scientific study of the comparative effects of these treatments versus thinning without biomass removal.

3. To manage unanticipated fire, insect epidemics, or disease outbreaks.

As discussed in detail in the Affected Environment section, fires and disease outbreaks are unlikely in the project area. In temperate coastal rainforests, fires are very uncommon, and fire danger goes down significantly after the first few years following blowdown (Christiansen 1991). However, Oregon Department of Forestry (ODF) scientists predict forests in Oregon will be increasingly vulnerable to insect epidemics and large, intense fires because of climate change (Oregon Forest Resources Institute 2006). Alternative 3 would give managers the flexibility to deal with them in the most ecologically responsible way possible if they do occur.

Biomass removal under this condition would only occur when and where it has been determined to be ecological beneficial to address fire, insect epidemics, or disease outbreaks. It is possible that no biomass removal will occur under this condition. If it is found to be beneficial in some cases, the areas where it would be allowed are based on proximity to access roads. If removal of

biomass beyond the 290 acres identified in Alternative 3 is necessary to prevent the spread of fire, insect, or disease, further compliance will be performed.

Throughout Clatsop County, many stands were salvage logged after the December 2007 storm. The purpose of salvaging is primarily to harvest wood while it is still marketable, before it begins to decay. Because the NPS mission does not include harvesting timber for profit, the concern for market value does not apply to Lewis and Clark NHP land. Rather, ecological conditions will guide park managers after a fire, insect epidemic or disease outbreak.

Extent of Biomass Removal

A diameter cap of 20" would be imposed on any logs removed from the forest. While trees of larger diameter may be felled under certain prescriptions, these larger stems would be retained on site to be used as large woody debris.

A variety of thinning treatments would be applied on the acreage with biomass removal, due to the variety of stand ages and types. Prescriptions would be based on the results of an updated forest inventory. The Weyerhauser data from 2000 indicates a large range in the current density of these stands, from 133 stems/acre to over 800 stems/acre. While the specific prescriptions have not yet been determined, a thinning treatment which leaves 150 trees/acre is considered heavy and would represent the upper limit of any thinning which would occur. A lighter thinning treatment would normally be employed.

In a similar forest restoration plan being implemented by The Nature Conservancy and the Willapa National Wildlife Refuge in the same ecosystem type in Washington, models projected a conservative estimate of approximately 7 mbf (thousand board feet) /acre being generated from thinning in 25-35 year old stands, roughly comparable to the stands within the 290 acres identified in the Fort Clatsop unit.

Biomass removal could occur only along the following existing road corridors: Perkins Road, Perkins Access roads, the Ridge Road, and Fort Clatsop Road. The Ridge Road is currently in a state of abandonment, and improvements would be needed to allow heavy equipment use. Resurfacing would be required to drive vehicles and equipment on it. After thinning treatments along the road corridors are complete, Ridge Road would be allowed to naturally revegetate with grasses and forbs, but would be kept free of brambles to allow emergency access. The Perkins and Perkins Access Roads would continue to be maintained as usable access roads.

If biomass is removed during restoration treatments it could be used in a number of different ways. It could be chipped and transported to the park nursery where it would be available for various planting projects. Chipping biomass for use in co-generation energy plants is another viable option; there are currently plans underway to construct a co-generation plant in Astoria. Tribal acquisition of selected materials for beneficial uses would also be considered. Trees removed during forest restoration treatments could also be used locally within the park as large woody debris in ongoing estuary and stream restoration projects, and used for firewood for interpretive programs at the fort.

Like previous action alternatives, restoration methodology would shift over the course of the 20 year life of this forest plan. Earlier treatments would focus on thinning only and creating research plots. Monitoring results would be used to determine if any biomass removal is necessary, beyond the creation of research plots. The majority of thinning would occur over the first ten years of the plan. Alternative 3 would provide the greatest flexibility in forest management options and would provide the greatest potential to meet the park's forest development goals. Wildlife habitat goals would also be accomplished under this alternative, as targets for CWD and snags would be met before any biomass was removed. The park's potential to adapt management practices to unforeseen scenarios would be increased under this alternative.

MITIGATION MEASURES

Natural Disturbance Regimes

All alternatives recognize the importance of natural disturbance and generally allow areas affected by wind or other natural processes to develop with minimal intervention. This would include not salvaging trees after blowdown or fire, except in extreme cases where the blowdown has left so much coarse woody debris near roads or trails that some biomass must be removed for safety, fire hazard, or access reasons. Opportunities created by disturbance can be used to meet management objectives through actions such as planting to reintroduce rare species. Under extreme circumstances actions, it may be necessary to respond to levels of disturbance that threaten the park's ability to meet the goals proposed in this plan. Events like large scale insect or disease outbreak or widespread blowdown that threaten the ability of the park to meet its goals would require an appropriate management response. For example, after the windstorm of December 2007, over 40 log truck loads of blowdown had to be removed in order to re-open access along roads and trails within the park. This plan will allow for continued flexibility in such cases. Because of the relatively small size of the park and its close proximity to other land owners, complete suppression of all wildfires will continue as part of the Fire Management Plan.

Geology, Soils, Topography

Potential impacts to soils by all action alternatives would be mitigated by limiting the amount of ground disturbance. This would involve minimizing ground harvesting and where possible re-using skidder trails and landings left from previous forest operations. Where material is to be removed, uphill cable yarding would be used where possible as it has been shown to have less impact than ground operations or downhill yarding (Kellogg 2002). Logs would not be yarded through streams or wetland areas to limit erosion. If logs must cross streams or sensitive areas all logs would be fully suspended through the entire buffer area consistent with local forest regulations and best management practices. Roads used during any management alternative would be maintained to current standards for limiting erosion. Slash from biomass removal activities would be spread over disturbed areas to minimize further compaction. Slash would also be chipped and spread to minimize erosion and speed re-establishment of vegetation. To further limit impacts to soils, restoration activities that could cause soil compaction would be suspended from October 1st to May 1st as well as any time soils are waterlogged and particularly prone to compaction (Dan Goody, ODF personal communication).

Water Quality

Water quality impacts under action alternatives could result from road related sediment and erosion. Maintaining roads to current standards would be essential to mitigate the potential for roads to impact water resources. Mitigation measures would include the establishment of stream buffers to limit actions near steams, as well as sediment control measures and adequate road drainage. Action alternatives that include removal of stream crossings and old roads would lead to a long term improvement in downstream water quality by restoring historic stream channels and decreasing the potential for a mass release of road fill.

Floodplains and Wetlands

Potential impacts to floodplains and wetlands would primarily be avoided under action alternatives by drastically limiting the types of activities allowed in these sensitive areas. No machinery would be used within wetlands, floodplains, or riparian buffers. Biomass removal would also not take place and no trees would be yarded across these areas. Restoration actions would be limited to meeting dead wood targets and planting in these areas.

Air Quality

Action alternatives would have minimal impacts to air quality. There may be some short term localized impacts resulting from machinery used during biomass removal or road decommissioning. Mitigation of potential impacts would primarily be focused on using machinery only when necessary and preventing unnecessary idling.

Slash burning is included in the Fort Clatsop Fire Management Plan of 2004 but is currently limited to the area within the original 125 acres around the visitor center and fort replica. This plan will be updated in 2011. If burning were to occur, it would comply with Fire Plan guidelines and follow all local regulations to limit smoke impacts to air quality. Additional slash burning is not called for under this plan and any fuels concerns associated with slash would be mitigated by chipping small material for use in erosion control and road rehabilitation.

Visitor Use and Experience

Active management proposed under the action alternatives does have the potential to temporarily adversely impact visitor use and experience. Areas surrounding active projects may need to be closed to visitors; however project planning can help to minimize the frequency of closures. Buffers of two tree heights around trails would be necessary to ensure the continued safety of park visitors. Lower intensity vegetation management would still be possible in buffer areas but standing snags would not be created within the two tree height zone to prevent the creation of hazardous conditions. Buffers would also be expanded in areas where visual or noise impacts from active projects could be detrimental to visitor use and experience. Lower intensity treatment options, such as girdling and topping trees without using power saws, would be used in areas where sound impacts are a concern. Temporary disruptions to visitor experience would be an educational opportunity to inform the public about forest restoration as well as the uniqueness and importance of old-growth forests.

Visual Resources

Forest restoration activities could have temporary impacts to the visual surroundings primarily resulting from disturbance to vegetation. Impacts would likely be short term and mitigation measures such as planting and leaving buffer areas around visually sensitive areas would likely eliminate most impacts to visual resources. Additional visual impacts could arise from excessive windthrow. Potential windthrow impacts would be minimized by using several lighter thinning treatments as opposed to a single heavy application.

Wildlife and Plants

Impacts to park ecological resources would occur under action alternatives but would primarily be short-term. Restoration activities involving machinery would be curtailed during sensitive times of the year to eliminate the potential to adversely impact wildlife. In addition, surveys conducted prior to project implementation would be used to identify sensitive areas or species of concern. Small mammal surveys are especially important since there is no recent data on bat species in the park, and 5 bats documented during 1940 surveys are federal species of concern (SOC). There is also very little data on vole presence; the white-footed vole - a federal species of concern - was also documented here in 1940, but has not been reported since.

Skips and areas of no treatment would be targeted to most effectively keep management activities away from areas where they may have an adverse impact. No treatment areas would also function as an additional mitigation measure against impacts to ecological resources by providing larger areas for wildlife to temporarily avoid human caused disturbance. Careful project planning can be used to group active projects together to limit disturbance to large areas of the park simultaneously.

Disturbance and damage to vegetation would result from thinning and biomass removal activities. Skips within thinned areas would act as one mitigation measure that would maintain areas without disturbance to vegetation. Damage to standing trees can also be minimized by effective project planning that allows for felling and yarding corridors that minimize maneuvering of cut stems.

While fungal diseases are a natural cause of tree mortality, damage to trees and cut stump surfaces may increase the potential for fungal pathogens to infect remaining live trees (Thies and Goheen 2002). Annosum root rot (*Heterobasidion annosum*) is a common pathogen which spreads from dead to live trees, killing them by rotting the roots and trunk wood. To prevent the spread of annosum root rot, trees would be cut with sporulated chainsaw oil which contains desirable native fungi; this has been shown to be effective in preventing the spread of undesirable pathogens through competition (Stamets 2005). Thinning during wet seasons has also been shown to limit the infection of cut spruce stumps in coastal forests (Morrison and Johnson 1999). Fungal disease risk is further reduced when thinning small diameter trees since the residual stumps are not large enough to sustain fungal infections (Edmonds 2000). Some fungal infection would be desirable, in accordance with project goals of encouraging natural ecosystem processes.

Although the park lies in an area known for its high rainfall, periodic summer drought conditions may occasionally raise fire risk levels sufficiently to warrant temporary fire closures.

Cultural Resources

Action alternatives could have adverse impacts to undocumented cultural resources. Potential impacts to cultural resources would be mitigated by surveying and monitoring areas if ground disturbance is anticipated. Cultural resources identified during surveys will be documented and either removed or left *in situ* upon consultation with cultural resource specialists.

PRELIMINARY OPTIONS CONSIDERED BUT DISMISSED

In addition to the options selected for analysis, four other alternatives were considered but ultimately rejected from further consideration.

Dismissed Alternative 1: Treat only areas adjacent to trails and other visitor facilities.

One alternative considered but rejected would have focused restoration activities only along the visible corridor accessible to visitors. In the long run this option would have maximized the visitor perception of being in an old-growth forest but would have caused considerable disruptions to the visitor experience in the short term.

This alternative would have treated only a small portion of the unit. Many areas that would have benefited from thinning would be left in an impaired state. This alternative would only have achieved restoration objectives over a small portion of the park. This alternative would not have satisfied NPS policy to restore resources unless otherwise directed by Congress.

Dismissed Alternative 2: Treat only areas protected from wind storms.

Consideration was also given for an alternative that limited treatment to sheltered areas most likely to mature into old-growth. This alternative would have mimicked one pattern seen in coastal areas where the oldest forests are found in areas protected from wind and other disturbances. However, limiting treatment to only a small portion of the landscape would have left much of the park still more closely resembling a production forest and would not have met a number of key restoration objectives. Many of the areas exposed to wind storms are stocked with western hemlock and are most in need of treatment.

Scientific evidence suggests that without intervention, such as thinning and re-planting, these stands could stay locked in a repeating pattern. In this pattern, over-dense stands of western hemlock are toppled by wind storms. After the wind storm, western hemlock germinates and grows into dense replacement stands of tall, thin trees with wind catching crowns. After 30 years or more, the replacement stands become susceptible to wind throw and the pattern repeats itself. To break this pattern, the park would need to take actions that would either thin hemlock at an early life stage, so that the trees put on substantial girth rather than just height or that would introduce other species, such as spruce and cedar, to the hemlock stand. Downed and decaying trees left in hemlock stands after the 2007 windstorm might help to break this pattern. The downed and decaying trees might prevent dense regeneration and lead naturally to a less densely stocked stand of trees with favorable girth to height ratios.

Dismissed Alternative 3: Remove biomass to defray costs of treatment

Another alternative considered was utilizing a more traditional timber-harvesting method in which the majority of thinned trees would be removed off-site. This treatment is used at the Nature Conservancy's Ellsworth Creek Preserve, and the Willapa National Wildlife Refuge and Redwood National Park in order to defray the costs of treatment. This alternative was dismissed for the following reasons.

The Fort Clatsop Unit is a relatively small park unit that is used by approximately 220,000 visitors each year, both seasonal out-of-town visitors, and residents that use the park's trail network. Use or evidence of mechanical treatments in the Fort Clatsop Unit could impact visitor experience and perhaps even visitor numbers. In contrast, Redwood National Park contains more than 90 times the land area as the Fort Clatsop Unit (112,000 acres), but only receives twice as many visitors (438,000). Similarly Ellsworth Creek Preserve and the adjacent Willapa National Wildlife Refuge contain 15,000 acres. Most of the acreage being treated at Ellsworth/Willapa is not near a trail network or heavily used visitor area.

At Fort Clatsop, the unit's small size and trail network also makes non-mechanical treatments very feasible. Such non-mechanical treatment would not be feasible in larger areas. If Lewis and Clark NHP contained significant forest acreage a suitable distance away from heavily used visitor areas, and these areas could only reasonably be treated effectively through cost recovery contracts, the park would consider this alternative.

Dismissed Alternative 4: Remove wind thrown trees to assist with regeneration.

This alternative was proposed by a few attendees at the scoping meeting for the concurrent fire plan. Two of the attendees had seen the 185 acres of wind thrown trees from the 2007 storm and thought that removing material in the wind throw area, a common practice on industrial timber lands to recover marketable wood and enhance regeneration, would help with replanting desired species such as cedar and spruce. This alternative was considered, but ultimately dismissed for several reasons.

Removing biomass would not necessarily lead to desirable conditions for regeneration. As noted in the discussion of dismissed alternative 2, removal of biomass could lead to much denser regeneration than is desired under this plan. This is because downed trees limit the area available for regeneration. If the park were to remove biomass after a wind event, it is likely that the new stand would be very dense and require intervention at one or more additional points in time. Under this case, the park would need to intervene not only after wind throw, but to thin and perhaps to plant or thin a second time.

Removing wind thrown trees would not shift the balance from hemlock to spruce or cedar. Informal cruises by foresters in 2008 suggested that cedar might have been rare at this location and that there is a sufficient number of spruce to seed in naturally if gaps could be created (B. Lecture, T. Kollasch, personal communications, July 2009). If spruce does not seed in sufficiently, hand planting might be necessary. While planting in the wind throw area might be more difficult, it offers some advantages: The wind thrown trees limit access to by elk and deer that graze on young cedar.

Removal of wind thrown trees may also perpetuate the even-aged nature of the park's forests. The largest challenge with the existing forests is not species composition; it is the fact that stands are even-aged. The stand maps included in the plan show that the park's forests consist of more than a dozen different stands with slightly different compositions. Action is most needed to create uneven-aged stands, not to drastically change the mix of species. Removing wind thrown

trees, especially in cases where removal would leave a bare stand of 20-30 acres, would result in another even-aged stand regenerating. Making this stand uneven-aged would require multiple interventions.

Removing wind thrown trees would not satisfy one of this plan's needs and objectives: restoration of the forest floor. The park's soils have much less organic material and dead and downed wood than an unmanaged forest has. To restore the forest floor, it is most effective to leave downed trees to decompose in place.

Because the Fort Clatsop Unit is a small area, it is feasible to treat it without using cost recovery contracts. As discussed above. the Fort Clatsop Unit is a relatively small park unit that is used by approximately 220,000 visitors each year, both seasonal out-of-town visitors, and residents that use the park's trail network. Use or evidence of mechanical treatments in the Fort Clatsop to remove wind thrown trees could impact visitor experience and perhaps even visitor numbers.

IDENTIFICATION OF PREFERRED ALTERNATIVE AND ENVIRONMENTALLY PREFERRED ALTERNATIVE

Action alternatives selected for analysis must meet all objectives to a large degree. Action alternatives must also address the stated purpose of taking action and resolve the need for action. Alternatives that did not meet the plan objectives were dismissed from further analysis (see the *Alternatives Considered but Dismissed* section above). All action alternatives would meet all objectives to a large degree and address the project's stated purpose and need.

Comparison of Alternatives

Table 3: Comparison of Alternatives

Action	**Untreated Areas (% of unit)**	**Habitat Improvement Only (acres)**	**Thin Without Removal (Acres)**	**Possible Biomass Removal (Acres)**	**Biomass Removal Possible (Acres/year)**
Alternative 1 (No Action)	100%	0	0	0	0
Alternative 2	20% (200 acres)	90	713	0	0
Alternative 3	20% (200 acres)	90	423	290	0 to 100

Table 4: Impact Summary

Impact Topic	**No Action**	**Alternative 2**	**Alternative 3**
Geology, Soils, and Topography	Minor adverse long-term impacts dependent on severity of road failures, could be moderate adverse in small areas	Minor adverse short term from compaction and or erosion related to thinning operations. Moderate beneficial long term from building soils.	Minor adverse short term from compaction and or erosion related to thinning operations. Moderate beneficial long term from building soils
Water Quality	Minor, adverse short-term on surface waters. Long-term impacts dependent on severity of future road failures; could be moderate, adverse	Negligible to minor adverse short-term, from possible siltation related to restoration activities; moderate beneficial long term from improved ecosystem function and water retention in older forests	Negligible to minor adverse short-term, from possible siltation related to restoration activities; moderate beneficial long term from improved ecosystem function and water retention in older forests

Impact Topic	No Action	Alternative 2	Alternative 3
Ecological Resources (Plants and Wildlife)	Negligible, short-term, direct impacts to ecological resources. Long-term impacts could be moderate, adverse due to current stand conditions and windthrow risk.	Negligible short-term, adverse impacts to ecological resources from disturbance during thinning operations. Beneficial long term from increased habitats and biodiversity	Negligible short-term, adverse impacts to ecological resources from disturbance during thinning operations. Beneficial long term from increased habitats and biodiversity
Visitor Experience & Sound	Negligible, short-term, direct impacts to visitor experience. Long-term impacts could be moderate, adverse depending on severity and location of windthrow	Minor adverse short-term impacts to the visitor experience. Long-term impacts beneficial as stands develop more windfirmness after treatment	Minor adverse short-term impacts to the visitor experience. Long-term impacts beneficial as stands develop more windfirmness after treatment
Air Quality	Negligible	Negligible short-term, adverse impacts to air quality from use of chainsaws.	Negligible short-term, adverse impacts to air quality from use of chainsaws.
Visual and Scenic Resources	Negligible short-term impacts. Long-term impacts could be moderate, adverse depending on the severity of wind damage	Minor adverse short term impacts. Beneficial long term as vegetation reinitiates, windthrow risk is reduced, and a more natural looking, aesthetically pleasing forest develops	Minor adverse short term impacts. Beneficial long term as vegetation reinitiates, windthrow risk is reduced, and a more natural looking, aesthetically pleasing forest develops
Human Health and Safety	Negligible. Possibly adverse, depending upon severity of wind damage	Moderate positive long term from increased exercise opportunities with new trails	Moderate positive long term from increased exercise opportunities with new trails

Impact Topic	No Action	Alternative 2	Alternative 3
Cultural Resources	Negligible	Potential for adverse impacts to unidentified cultural features, which will be mitigated by pre-work surveys or on-site monitors. Positive long-term impacts from restoration of native landscape	Potential for adverse impacts to unidentified cultural features, which will be mitigated by pre-work surveys or on-site monitors. Positive long-term impacts from restoration of native landscape
Socioeconomics	Negligible	Potential for some work for local fellers would be Minor positive short term	Potential for some work for local fellers would be Minor positive short term

Environmentally Preferred Alternative

The CEQ Regulations implementing NEPA and the NPS NEPA guidelines require that "the alternative or alternatives which were considered to be environmentally preferable" be identified (Council on Environmental Quality Regulations, Section 1505.2). Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative that best protects, preserves, and enhances historic, cultural, and natural resources.

The Council on Environmental Quality defines the environmentally preferred alternative as "…the alternative that will promote the national environmental policy as expressed in the National Environmental Policy Act's §101." Section 101 of the National Environmental Policy Act states that "… it is the continuing responsibility of the Federal Government to:

- Criteria 1- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Criteria 2- Assure for all generations safe, healthful, productive, and aesthetically and culturally pleasing surroundings.
- Criteria 3- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.
- Criteria 4- Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
- Criteria 5- Achieve a balance between population and resource use that will permit high standards of living and wide sharing of life's amenities.
- Criteria 6- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Among the options considered, Alternative 3 best fulfills the NEPA criteria. Proposed actions under Alternative 3 best satisfy criteria 1, 2, and 6 by working to restore natural forest conditions

while addressing the potential for road failures to impact water resources in the future. Alternative 3 also best meets criteria 3 by including the option to remove biomass if it is determined to be beneficial, thus attaining the widest range of benefits without compromising environmental responsibilities. While all alternatives would preserve historic, cultural and natural aspects of our heritage, Alternative 3 would best preserve future choices by not committing the entire park to a single management strategy. Instead, Alternative 3 focuses on areas with the greatest potential for benefits under existing knowledge, and leaves options open for future generations. Lastly, the preferred alternative meets criteria 6 by committing to retain as much biomass as possible on site to contribute to nutrient cycling, while working to improve the quality of natural resources within the Park.

Conclusion

The National Park Service has determined that the environmentally preferred alternative for this project is Alternative 3, Adaptive Management. Alternative 3 was selected as the Preferred Alternative because it provided the greatest ability to meet Park goals and objectives while minimizing the potential negative impact to the Park environment. It also allows for the greatest flexibility and adaptive management to react to changing future conditions.

CHAPTER 3: AFFECTED ENVIRONMENT

INTRODUCTION

This chapter describes the environment expected to be affected by the alternatives proposed in this plan. It is organized by impact topics, which allows a standardized comparison among alternatives, based on issues.

The resource descriptions provided in this chapter serve as a baseline with which to compare the potential effects of the management actions considered in this EA.

Topics addressed in this section, and subsequently analyzed in the Environmental Consequences section, were selected based on their relevance as indicated by on-site visits, secondary sources documents, regulatory agency input, and information from NPS personnel.

GEOLOGY, SOILS, AND TOPOGRAPHY

The project vicinity is within the Astoria Basin, which includes Clatsop County and northernmost Tillamook County. Elevation ranges from sea level to approximately 360 ft at the Fort to Sea Trail overlook. Topography is varied with lower elevation areas having moderate slopes (0-30 percent) and areas along Clatsop ridge generally having much steeper slopes (30-70 percent).

Geology of Lewis and Clark NHP generally consists of a stratum of older Cenozoic marine and estuarine sedimentary rocks with minor volcanic rocks covered by a layer of post-early Miocene marine sedimentary and minor volcanic rocks. The Astoria Formation of sandstone and siltstone intertwines with basalt flows and submarine breccias. The western edge of the Columbia River Basalt Flow is also located in the area.

According to Natural Resource Conservation Service data, soils in the project area primarily belong to the Templeton, Ecola, and Walluski soil types. All soils are characterized by low strength and are prone to rutting.

WATER RESOURCES

Aquatic systems within the area surrounding the park have been greatly altered. The Lewis and Clark River has been extensively diked, reducing or eliminating fertile floodplains. These past floodplains are now used for agriculture, dairy and rural and industrial development. Other potential impacts consist of pesticide and fertilizer use, illegal dumping of household and industrial rubbish and toxic waste, and soil erosion from forest management activities.

Infrequent sampling by the Oregon DEQ indicates that the Lewis and Clark River and Youngs Bay has aluminum, dissolved oxygen and fecal coliform levels that do not meet state water

quality level standards (NPS 1994). The park has developed a water quality inventory and monitoring program in conjunction with the Water Resources Division, United States Geological Survey (USGS), and Oregon Department of Environmental Quality, A historic spring flows for approximately nine months of the year and is the source for a small stream which flows to the Lewis and Clark River. It is believed to have been one of the water sources for the Lewis and Clark party while they wintered at Fort Clatsop.

Additional water resources in the project area include three fish bearing tributaries (Colewort Creek, Alder Creek, and Hansen Creek) to the Lewis and Clark River, one fish bearing tributary to the Skipanon River (Perkins Creek), and numerous small headwater streams and springs.

VEGETATION

Lewis and Clark NHP is located within the Sitka Spruce Zone as defined by Franklin and Dyrness (1973). This vegetation zone is found along the west coast from northern California to southeastern Alaska. Sitka spruce is the most common tree species but western hemlock, western redcedar, red alder and Douglas-fir are major components in this zone. Minor species include Pacific silver fir, grand fir, shore pine, western white pine, and big leaf maple.

The project area is composed primarily of second and third growth western hemlock, Sitka spruce, and Douglas fir. The understory is depauperate in most stands due to competitive exclusion. It is likely that forests within the project area would have contained a higher percentage of bigleaf maple, Pacific yew, and western redcedar before they were logged.

In 2010, Lewis and Clark NHP completed a comprehensive vascular plant inventory, bringing the total number of vascular species recorded in the park to 467. To date, 359 species of vascular plants have been documented within the Fort Clatsop unit. Seventy three species of non-vascular plants (mosses and liverworts) have been identified, but a comprehensive survey of all of the newly acquired lands has not been completed. Lewis and Clark NHP maintains an herbarium collection of Park flora.

Presently there are no known vegetative or fungal species listed as Threatened or Endangered. Two estuarine intertidal vascular plant species, *Lilaea scilloides* and *Samolus valerandi* ssp *parviflorus*, are considered taxa of conservation concern by the Oregon Natural Heritage Program (ORNHIC). Neither species occurs in forested wetlands. One park liverwort, *Diplophyllum albicans*, is an ORNHIC taxa of conservation concern. In 2000 Christy noted it as "not abundant in the Memorial, occurring in a small patch along the trail between the Canoe Landing and the picnic area ... [however] it is not rare regionally and probably does not warrant special management concern by NPS." Two mosses which occur in a forested wetland within the project area, *Sphagnum pacificum* and *S. girgensohnii*, were considered for conservation concern status, but have not been added to ORNHIC lists. *Sphagnum girgensohnii* is known in Oregon from one other site in the western Cascades in Linn County, and from three unverified reports in the Wallowa Mountains. Forested swamp is typical habitat for *S. girgensohnii* in other parts of the country, but is rare in Oregon. Its presence in the park may be attributed to the high precipitation received at this site. *Sphagnum pacificum* is more typical of open peat lands. It occurs in nearby Gearhart Bog, and three other localities farther south, but is otherwise at the

southern end of its range (Christy 2000).

The Fort Clatsop unit of Lewis and Clark NHP features a rich diversity of fungi and lichen species. Park surveys, while not comprehensive, have identified 111 fungi and 57 lichen species within the park. Hardwood and riparian areas in the park have particularly high lichen diversity. Forest areas in the Park with old remnant spruce trees are also hotspots of lichen diversity. One lichen species found during lichen surveys, *Usnea longissima*, is considered a taxa of conservation concern by the Oregon Natural Heritage Program. One fungi species observed within the Park, *Tylopolis pseudoscaber*, was formerly listed as an Oregon State Survey and Manage species. No other fungi or lichen species known to occur in the Fort Clatsop unit are identified as species with an elevated conservation status.

Non-native invasive plant species are a significant problem throughout the project area. Holly and English ivy are particularly problematic, as they thrive within shaded canopy cover. European mountain ash, Scotch broom, European honeysuckle, and herb Robert are other problematic invasives in the unit.

INSECTS, FUNGI AND DISEASE

The interactions between fungi, insects, animals, and abiotic disturbance agents play critical roles in shaping forest structure and creating complex, diverse ecosystems (Edmonds et al. 2000). In order to achieve the given management objectives within the project area, it is essential to understand these agents and work with them, as opposed to viewing them as threats. While these agents result in significant losses to timber value in spruce/hemlock forests (Ruth and Harris 1979), most of them are naturally occurring components of our coastal forest ecosystems.

Swiss needle cast, caused by the fungus *Phaeocrytopus gaeumannii*, is native to Pacific Coast forests and while long considered innocuous, it has become a major concern in Douglas-fir plantations within approximately 18 miles of the coast in Oregon and Washington in the last few decades (Thies and Goheen 2002). During wet springs when adequate moisture is present, the fungus germinates, infects needles on Douglas-fir trees, and causes them to yellow and drop prematurely. Although it rarely kills trees outright, Swiss needle cast can reduce growth rates by up to 35% and make trees more susceptible to other agents of mortality (Holmberg et. al. 2006). While the causes of the recent increase are not fully known, the large-scale replacement of spruce-hemlock forests with pure Douglas-fir plantations is thought to be a chief factor (Thies and Goheen 2002). In young plantations with more western hemlock, infection levels are generally lower and tend to vary more from tree to tree. Because treatments under this plan target Douglas fir for removal, the incidence of this disease should decrease over time.

Annosus root rot, caused by the fungus *Heterobasidion annosum*, is a common pathogen in western hemlock and Sitka spruce. It produces a dark brown conk and brown-heart rot that weakens the bole of trees and typically leads to stem breakage or mortality from bark beetles or other agents. It spreads through root graft and pervasive aerial spores that germinate readily on live bare wood, such as fresh stump surfaces, bole exposure from logging damage, or top or major branch breakage. It grows slowly, however, and effects are usually not noticeable until trees reach at least 120 years old (Thies and Goheen 2002). Combined with wind, it is probably

the largest cause of tree mortality and snag recruitment for mature western hemlock in this forest type and a major limiting factor on the development of large, old hemlocks and to a lesser extent Sitka Spruce. Thinning has been shown to significantly increase infection levels as spores germinate on cut stumps and spread through root grafts to live trees (Edmonds et al. 2000). In stands heavily dominated by hemlock, this poses a challenge to the long-term goal of developing old growth structure (Thies and Goheen 2002). This threat will be mitigated by the use of sporulated chainsaw oil, which will inoculate cut stumps with desirable native fungi species that will compete against the Annosus root rot. This should lessen the extent of infection, while still retaining some Annosus as a natural component of a native coastal forest.

Hemlock dwarf mistletoe (*Arceuthobium tsugense*) is a vascular, parasitic plant that affects western hemlock, and occasionally Sitka Spruce and Douglas-fir, in this forest type. Mature female plants forcibly discharge seeds an average of 15 feet, and the sticky seeds adhere to branches and stems of new hosts. The flowers, fruits, and seeds are a source of food for several invertebrates and bird species, and birds can spread the seeds. Seeds then germinate and the roots mechanically enter host tissues to extract water, nutrients, and sugars. Host branches usually respond with swelling and by producing a "witch's broom" that may grow to weigh several hundred pounds in older trees and provide preferred nesting platforms for marbled murrelets and other species (Thies & Goheen 2002). Young western hemlock trees that are lightly infected (less than 1/3 of branches infected), and that are free to grow in the open, can outgrow dwarf mistletoe infection and leave the dwarf mistletoe in the lower crown. Severe infestations cause growth loss, reduction in wood quality, and an increase in mortality. Damage is more serious in stands over 100 years of age than in younger stands.

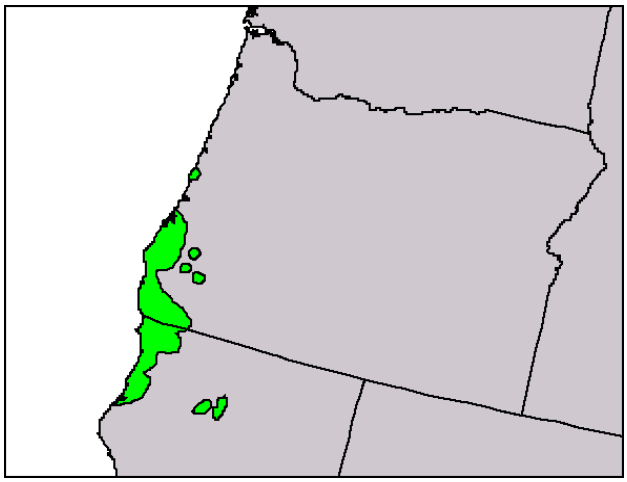
Sitka spruce is susceptible to the white pine weevil (previously known as the Sitka spruce weevil *Pissodes strobi)*. The weevil lays its eggs on the terminal shoot, and larvae then mine the phloem and girdle the leader, causing it to die and curl. Damaged trees are often overtopped and suppressed by other species. Surviving spruce may have forked and crooked tops and a bushy appearance. Weevil infection is highest in warmer, drier areas, while areas immediately adjacent to the coast are low hazard due to cool climate (Holmberg et al. 2006). Weevil populations and attack rates typically stabilize and begin to decline as trees reach heights of 30 feet.

Mature western hemlock stands are susceptible to epidemics of the hemlock looper (*Lambdina fiscellaria lugubrosa*), a defoliating caterpillar. Outbreaks typically occur in old hemlock stands, but recently have occurred in 60 year old second growth (Holmberg et al. 2006). Outbreaks last 3-4 years and can kill large areas of stands dominated by western hemlock (Edmonds et al. 2002). Other conifers within these stands are also heavily fed upon and can die as well. Recent anecdotal observations indicate that stands whose vigor has been enhanced by thinning are relatively resistant to surrounding epidemics (Holmberg et al. 2006). As the hemlock dominated forests mature, an outbreak is possible and could result in large-scale mortality. It is also unknown what the effects of climate change will be on the lifecycle dynamics of the looper and other invertebrates that cause tree mortality.

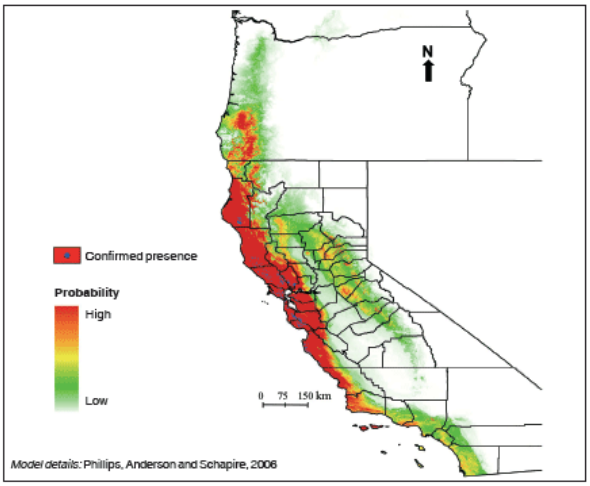
Two non-native forest pathogens, Sudden Oak Death (SOD) and Port Orford Cedar Root Disease, have had devastating effects on some forests in southern Oregon. SOD is a fungus-like pathogen (*Phytophthora ramorum*) that infects the wood of and kills species within the *Quercus*

(oak) genus. It also infests the leaves and stems of other native forest shrubs and trees, some of which are present in the project area, but does not kill them. Because there are no oaks within the Fort Clatsop unit, SOD is not currently an issue. Port Orford Cedar Root disease is caused by the fungus *Phytophthora lateralis.* It infests the roots of and kills Port Orford cedars (*Chamaecyparis lawsoniana*) which are endemic to a small area of southern Oregon and northern California. There are a few Port Orford cedars planted as ornamentals within the park, around the area of the Fort and Visitor Center. Some of these are showing signs of the disease. Fortunately the pathogen does not affect trees in other genera, so there is no concern of the disease spreading in this area. It is possible that the range of these pathogens and their hosts could expand with climate change, so it will be important to monitor for this in the future. Because Lewis and Clark NHP is far removed from the current ranges of the host species, there should be ample advance warning if the diseases ever begin to migrate in this direction, and at such time rigorous surveillance would be implemented under our ongoing "Early Detection, Rapid Response (EDRR)" invasive species program. The EDRR program is a regional, cooperative effort to locate, identify, and eradicate invasive species that have not yet become extensive problems in the county.

Figure 9: Current Distribution of Known Range of Port Orford Cedar and Modeled Potential SOD Infestations



Port Orford Cedar Distribution map
(USGS 1999)



Projected SOD distribution map
(Phillips, Anderson, and Shapire 2006)

Forest stands at the Fort Clatsop unit are predominantly in the competitive exclusion stage of forest development with little to no understory development and slow growth of existing trees. Without management, stand development would be extremely slow as trees continue to compete for light and suppression mortality gradually thins the stands. This process can last between 80 and 100 years depending on site productivity and natural rates of disturbance (Franklin et al. 2002). Stands could potentially show an ever slower rate of understory development due to the abundance of hemlock present in forest stands (Stewart 1988).

WILDLIFE

Lewis and Clark NHP contains a diverse collection of wildlife habitat and wildlife species. Inventories of the park's birds, insectivores, rodents, fish, reptiles and amphibians have been initiated. Little is known of the park's invertebrate species.

Mammals

Roosevelt elk played a key role in the survival of the Lewis and Clark Expedition by providing an important food source (NPS 1995). The elk population was severely depleted by 1900 but conservation efforts have been successful in re-establishing their numbers in the Fort Clatsop area. The Oregon Department of Fish and Wildlife reports their numbers are now stable in Clatsop County. Other mammals recorded at Lewis and Clark NHP include black-tail deer, cougar, black bear, raccoon, chipmunks, squirrels, beaver, mink, river otter, coyote, bobcat, weasel, skunk, rabbit, muskrats, and seven bat species. The white-footed vole, a federal Species of Concern, was documented within the Fort Clatsop Unit in 1940, but has not been found in more recent park small mammal surveys. Five bat species documented in the park are Federal Species of Concern: the Townsend's big-eared bat and long-eared, fringed, long-legged and Yuma myotis. The hoary bat and the California myotis are both Oregon State listed SV (Sensitive - vulnerable). Introduced mammals include the Norwegian rat, black rat, opossum, and nutria.

Birds

A high percentage of bird species found at Lewis and Clark NHP prefer mature to old-growth forests. These species may be remnant or isolated populations, since most of the region's old-growth had been cut by the early 1980's. Thinning densely stocked, second growth stands has been shown to increase bird species diversity, especially in western Oregon (ODF 2008).

Bird species commonly observed in the Fort Clatsop unit include woodpeckers, flycatchers, wrens, kinglets, thrushes, vireos, owls, kingfishers, swallows, sandpipers, rails, hawks, eagles, mergansers, mallards, herons, cormorants and grebes. Habitat for marbled murrelets and western snowy plovers, both federally threatened, occurs within Lewis and Clark NHP's boundary but not in the project area. Barred owls are beginning to colonize the area. This species has recently expanded its range into western Oregon, and there is strong correlative evidence for negative interspecific interactions between it and federally threatened spotted owls. The purple martin, band-tailed pigeon, harlequin duck, and olive-sided flycatcher are federal Species of Concern. Peregrine falcons, an Oregon SV species, are observed within the Fort Clatsop unit. Oregon sensitive species include olive-sided flycatchers, peregrine falcons, purple martins, red-necked grebes, black oystercatchers, rhinoceros auklets and willow flycatcher. Bald eagles, while recently federally delisted, are still listed as Threatened in Oregon. They are sited frequently along the Lewis and Clark River.

Fish

Initial fish surveys of Lewis and Clark NHP were conducted in 2002 and 2005 and a total of ten

fish species were observed within the Fort Clatsop Unit. Additional species were added after additional surveys in 2006. Despite the limited timeframe and scope of these surveys, species identified during these efforts provide a baseline for tracking fish assemblages at Lewis and Clark NHP.

Species found during the 2005 and 2006 surveys include:

Chinook salmon (*Oncorhynchus tshawytcha)*
Coho salmon (*Oncorhynchus kisutch)*
Chum Salmon (*Oncorhynchus keta)*
Steelhead Trout (*Oncorhynchus mykiss)*
Cutthroat Trout (*Oncorhynchus clarkii clarkii)*
Threespine stickleback (*Gasterosteus aculeatus)*
Riffle Sculpin (*Cottus gulosus)*
Reticulate sculpin (*Cottus perplexus)*
Coastrange sculpin (*Cottus aleuticus)*
Prickly Sculpin (*Cottus asper)*
Pacific Staghorn sculpin (*Leptocottus armatus)*
Western brook lamprey (*Lampetra richardsoni)*
Banded Killifish (*Fundulus diaphanus)*
Peamouth (*Mylocheilus caurinus)*

The following evolutionary significant units (ESUs) listed under the Endangered Species Act may inhabit or are known to inhabit Lewis and Clark NHP waters:

Chinook salmon (*Oncorhynchus tschawytcha*), Lower Columbia River ESU
Chum salmon (*Oncorhynchus keta*), Columbia River ESU
Steelhead (*Oncorhynchus mykiss*), Lower Columbia River ESU
Coho salmon (*Oncorhynchus kisutch*) Lower Columbia River ESU
Coastal cutthroat trout (*Oncorhynchus clarki clarkii*) SW Washington/Columbia River ESU
Green sturgeon (*Acipenser medirostris*)
Eulachon *(Thaleichthys pacificus)*

The following species are listed under the Oregon Endangered Species Act and may inhabit or are known to inhabit Lewis and Clark NHP waters:

Endangered Status:
Coho salmon (*Oncorhynchus kisutch*)
Chum salmon (*Oncorhynchus keta*)
Coastal Steelhead (*Oncorhynchus mykiss*) Lower Columbia River

Sensitive - vulnerable status:
Western brook lamprey (*Lampetra richardsoni*)
Coastal Cutthroat trout (*Oncorhynchus clarki clarkii*)

Amphibians and Reptiles

Amphibian surveys conducted in 2002 and 2005 confirmed the presence of 10 native amphibian species and 1 invasive. Amphibian species known to occur in the Fort Clatsop Unit of Lewis and Clark NHP include:

Pacific Chorus Frog (*Pseudacris regilla)*
Northern Red-legged Frog (*Rana aurora aurora)*
Northwestern Salamander (*Ambystoma gracile)*
Pacific Giant Salamander (*Dicamptodon tenebrosus)*
Cope's Giant Salamander (*Dicamptodon copei)*
Ensatina (*Ensatina eschscholtzii)*
Dunn's Salamander (*Plethodon dunni)*
Western Red-backed Salamander (*Plethodon vehiculum)*
Columbia Torrent Salamander (*Rhyacotriton kezeri)*
Rough-skinned Newt (*Taricha granulosa)*
Bullfrog (Invasive) (*Rana catesbeiana)*

The northern red-legged frog, Dunn's salamander and Columbia torrent salamander are all federal species of concern. Coastal populations of red-legged frogs were delisted in OR in 2009. Columbia torrent salamander is Oregon SV and Cope's giant salamander is OR SV and a Monitor species in Washington.

Copes's giant salamanders inhabit several streams in the park's Cape Disappointment unit. Furthermore, Lewis and Clark NHP is within the range of the Olympic clouded salamander which is classified as a sensitive species. The Columbia torrent salamander is Oregon SV.

Reptiles:

The January 2007 update to Lewis and Clark NHP's list of confirmed reptile species includes three species, none of which are protected or listed as having an elevated conservation status. Reptiles at Lewis and Clark NHP include:

Northern Alligator Lizard (*Elgaria coerulea)*
Northwestern Garter Snake (*Thamnophis ordinoides)*
Common Garter Snake (*Thamnophis sirtalis)*

Invertebrates:

Invertebrates have not been inventoried at Lewis and Clark NHP.

THREATENED OR ENDANGERED SPECIES:

Marbled Murrelet: Federally listed as Threatened, marbled murrelets have not been surveyed for or confirmed to occur within the Fort Clatsop unit, although suitable mature Sitka spruce-western hemlock maritime forest nest habitat exists in limited patches within the park. They have been noted within the vicinity of the park in other units. Marbled murrelets are found year-round in late-successional and old-growth forests near the western Oregon coast, but they are not common at the mouth of the Columbia River.

Northern Spotted Owl: Federally listed as Threatened. Historically, the area around Lewis and Clark NHP may have served as spotted owl habitat. Historic land practices and current presence of Barred owls have may have precluded potential presence of spotted owls. Spotted owls have been documented nesting in the Astoria unit of the Clatsop State Forest, but only in the Nehalem watershed. None have been documented in the Youngs Bay watershed, and they are not expected to occur here.

Chum Salmon (Lower Columbia River): Federally listed as Threatened, chum salmon have been documented within the park in the South Clatsop Slough estuarine restoration project. They are present as juveniles during their out-migration from mid-March through May and are expected to migrate upstream as adults from early October through mid-November.

Chinook Salmon (Lower Columbia River Fall, Upper Willamette River, Snake River): Federally listed as Threatened, Upper Columbia River Spring Chinook are listed Endangered. Recently, juvenile Chinook salmon have been documented utilizing the South Clatsop Slough restoration site. In the Lewis and Clark River, juvenile Chinook salmon out-migration occurs from mid-March through mid-June. Adult Chinook salmon upstream migration occurs from late August through October/November.

Coho Salmon (Lower Columbia River): Coho salmon have been documented in several streams within the park, including the South Clatsop Slough restoration site (Brenkman 2007, CREST 2009)..

Steelhead (Columbia and Snake River): Steelhead have been documented in the South Clatsop Slough restoration site during monitoring conducted by CREST in 2008.

Pacific Eulachon: Federally listed as Threatened. Also known as candlefish and Pacific smelt, eulochon once swam in vast numbers and were a staple food and trade good of northwest tribes. They are not known from the Lewis and Clark River and are not present in the project area.

Oregon Silverspot Butterfly: Federally listed as Threatened, the Oregon silverspot butterfly occupied early successional coastal grasslands in Clatsop County containing its host plant, nectar sources and adult courtship areas. Its historic population center on the plains is approximately five miles long and one mile wide, extending from Camp Rilea on the north to the Gearhart Golf Course on the south. Sunset Beach is within the butterfly's historic range (Gearhart Beach to Clatsop Spit). The last documented sighting of this butterfly was in 1998 near Camp Rilea, previously the population stronghold in the county (Vanbuskirk 1998). Forestlands on Clatsop

Ridge do not provide preferred habitat for this butterfly.

SPECIES OF CONCERN

Coastal Cutthroat (Columbia River): Proposed as a Federally Threatened Species in 1999, coastal cutthroat trout were transferred to a Species of Concern after more information indicated they were not as imperiled as originally suspected. They have been documented in several park streams.

Voles: The white-footed vole was historically documented at the Fort Clatsop site in 1940 (Csuti 1997), but has not been found in more recent small mammal surveys (1993, 2001). This species is most frequently found in riparian (especially alder) habitat within coniferous forests. Small clearings with forb growth may also provide important habitat. Red tree voles are found along the coast in Sitka spruce forests that contain some Douglas fir, but have not been documented in the Fort Clatsop unit.

Bats: Fringed, California and long-eared myotis, Townsend's big-eared, hoary bat, long-legged and Yuma myotis were mist-netted in coniferous forest habitat near the Fort Clatsop replica during 1995 surveys. Vouchers of these species were obtained during an earlier 1940 mammal survey at the site. A 2001 survey netted a single long-eared myotis at Clay Pit Pond.

Pacific big-eared bats have not been found within the Fort Clatsop unit. A 1958 Clatsop County record reports a Cannon Beach collection location for the species. West of the Oregon Cascades, the species is associated with moderate to older coniferous forests.

Silver-haired bats have not been found within the park. These bats occur throughout Oregon except most areas of the Columbia Basin. Their primary habitat is older Douglas fir/western hemlock forests with riparian forage areas.

Band-Tailed Pigeon: Band-tailed pigeons are present throughout the Columbia River estuary. Preferred habitats are closed-canopy forests for nesting and open-canopy forests for foraging and mineral sites. They are highly mobile and may travel 32 miles from nest locations to food or mineral sites. Band-tailed pigeons have been documented during bird surveys in the Fort Clatsop unit (Patterson 2007).

Olive-Sided Flycatcher: Olive-sided flycatchers are summer residents in coniferous forests of the Columbia River estuary. They are most frequently found in open coniferous forests with tall snags for perching. The birds have been documented during linear transect surveys in the park

Purple Martin: Purple martins are summer residents in the Columbia River estuary, nesting and feeding primarily in riparian habitats. The birds were documented on the Lewis and Clark River within the park during a 2006 survey and more recently have been noted to be nesting in piling near the park's Netul Landing site.

Harlequin Duck: Harlequin ducks inhabit surf zones of the outer coast and breed in fast moving mountain streams. They may be seen of the coast of Cape Disappointment, but do not occur in the low gradient streams of the Fort Clatsop unit.

Northern Red-Legged Frog: Numerous observation and voucher records document the occurrence of northern red-legged frogs in the Fort Clatsop unit's forest and riparian habitats (Ek 1997). Lewis and Clark NHP also has portions of wetland habitat that contain populations of red-legged frogs.

Columbia Torrent Salamander: Torrent salamanders live in very cold seeps, headwaters, and springs, foraging in adjacent moist forests. They were documented in the Fort Clatsop unit of Lewis and Clark NHP during amphibian surveys conducted in 2005 by North Coast Cascades Network Inventory and Monitoring team.

Dunn's Salamander: This woodland salamander is associated with springs and seeps. It has been documented in the Fort Clatsop unit of Lewis and Clark NHP during amphibian surveys conducted in 2005 by North Coast Cascades Network Inventory and Monitoring team.

Green Sturgeon: Green sturgeons occur in brackish and seawater salinity zones within the Columbia River estuary, but haven't been documented in the Lewis and Clark River (Bottom 1984)

River Lamprey, Pacific Lamprey: River and Pacific lamprey have not been confirmed in streams within the Fort Clatsop unit, although a 2002 fish survey of Hansen Creek netted a juvenile lamprey of unknown identity. Western Brook lamprey, listed in Oregon as Sensitive/Vulnerable, were found in a 2005 survey of Perkins Creek. Alder Creek and South Clatsop Slough are potential habitat, as is the Lewis and Clark River (Bottom 1984).

Additional Species: The following animal and plant species of concern have not been documented to occur within the project area: Steller sea lion, western snowy plover, brown pelican, short-tailed albatross, Lewis' woodpecker, mountain quail, tailed frog, Oregon coast steelhead, pink sand verbena, Saddle Mountain bitter cress, Chamber's paintbrush, Willamette Valley larkspur, frigid shootingstar, queen-of-the-forest, Saddle Mountain saxifrage, Henderson sidalcea, bristly-stemmed sidalcea and the moss species *Limbella fryei*.

CLIMATE

The climate of the park is heavily influenced by the Pacific Ocean. The marine climate is warm and dry in the summer and fall, mild and wet in the spring and winter. There is frequent coastal fog. Mean annual precipitation averages 74 inches mostly in the form of rain. There are short periods of drying under off-shore "East Winds." These periods represent the driest periods for influencing wildfire growth. Winter storms can be extreme with winds reaching 70 miles per hour in the project area.

CLIMATE CHANGE

It is very difficult to predict all of the environmental changes that will come about with climate change, although a trend towards sea-level rise and more extreme weather patterns is probable. In a 2001 report, the Intergovernmental Panel on Climate Change (IPCC) estimated the following as very likely: higher maximum temperatures over nearly all land areas, more frost-free and fewer cold days over all land areas, and more intense precipitation events. According to Oregon Department of Forestry (ODF) scientists, forests in Oregon will be increasingly vulnerable to insect epidemics and large, intense fires (Oregon Forest Resources Institute 2006). Here on the coast, patterns in ocean upwelling have an impact on local weather conditions – summer upwelling brings fog and thus increases overall summer precipitation. It is uncertain whether climate change will bring an increase or decrease in upwelling, and therefore the overall trend.

AIR QUALITY

Lewis and Clark NHP is designated a Class II Airshed. This designation was established by Congress to facilitate the implementation of air quality provisions of the Clean Air Act. It allows a moderate increase in certain air pollutants. The Clean Air Act requires that the National Park Service comply with all federal, state, and local air pollution control laws (Section 118). The state agency that manages air quality related concerns is the Oregon Department of Environmental Quality (DEQ). Clatsop County does not have county level ordinances regarding air pollution: they defer these concerns to the State DEQ.

Air quality monitoring at Lewis and Clark NHP is not conducted by the DEQ because coastal winds generally maintain clean air conditions in the area (NPS 1995). Under certain conditions, air quality occasionally can be impacted by nearby forest slash burning and from living history fires within the fort replica. Odors from pulp mills in western Washington infrequently can be detected at Lewis and Clark NHP, but such impacts are generally of short duration. Increasing industrial and urban development in the surrounding area may cause air quality problems in the future.

VISITOR USE AND EXPERIENCE

Current annual visitation averages 200,000 to 250,000. This number of people concentrated in such a small area can have a dramatic impact on the resources of the park. Very little work to date has assessed the degree of this impact. A carrying capacity study is needed, but is outside the scope of this project.

A pulse survey to derive visitor numbers was conducted for Fort Clatsop in 1986 (NPS 1995). The survey was repeated in 1987 and 1988 to identify trends and add to the information database. The survey provided park management a comprehensive look at who park visitors are, where they come from and why, and an evaluation of park services. Results showed that 60 percent visited the park because of their interest in Lewis and Clark Expedition history, 12 percent had heard about the park's programs, and another 11 percent expressed a passing interest. Approximately 70 percent were first time visitors and more than half lived outside of

Oregon; 75 percent were family groups. A considerable portion of visitation is associated with commercial tours provided by charter buses and tour ships (21,300 visits in 2003-04). An informal survey in 1992 indicated that most visitors to the Salt Works had not visited the fort replica site.

Physical limitations on visitor numbers at the Fort Clatsop unit involve the amount of space available for visitor use including: seating capacity of the auditorium and theater, parking spaces, and the number of picnic tables available. Limitations associated with the capacity of the Fort replica and Visitor Center also exist but are more related with the perception of crowded conditions and what would constitute a quality recreation experience. The potential of damage to park resources from excessive use is also a consideration.

SOUNDSCAPE

The NPS mission emphasizes the preservation and restoration of park natural resources, including natural sounds, referred to as soundscape. Due to the park's generally rural nature the natural ambient sound is generally quiet at the NHP. Heard from many of the trails, natural quiet sounds include bird calls, wildlife rustling in the underbrush, and the movement of wind in the trees and grasses. The natural quiet preserved at the park appeals to many visitors, and it contributes to the purpose of their visit. Vehicular traffic is the number one source of sound pollution in the Fort Clatsop unit. Aircraft noise is common as well, due to general aviation associated with the local airports and Coast Guard helicopter training and rescue missions. Routine ground/structure maintenance and human voices are especially prevalent in the vicinity of Fort Clatsop on a busy day.

VISUAL RESOURCES

The Lewis and Clark NHP region is characterized by a landscape of forested, hummocky ridges; steep ravines; and low-lying, long, narrow, sandy ridges with intervening streams, lakes, and marshes extending to the Pacific coast. This natural landscape is divided by U.S. 101. The natural landscape first experienced by the Lewis and Clark expedition is changing to an urbanized landscape, affecting local visual resources and regional viewsheds (NPS, 1995).

Visual resources within the project area include a variety of different views that help convey the cultural landscape of the Lewis and Clark expedition. The canoe landing features views of the Lewis and Clark River along with the associated tide flats and river bars. Views throughout much of the Park are limited by vegetation and topography, but the surrounding trees help recreate the atmosphere of being isolated in the forest. The Fort to Sea Trail overlook provides views of the Pacific Ocean and the surrounding forest; however, development has begun to intrude on visual resources. Forest restoration activities would add an additional element to visual resources by allowing a greater variety of flora and fauna to thrive, thereby increasing the quality of visual resources in the surrounding forest and improving the overall visitor experience.

SOCIOECONOMIC IMPACTS

In 2010, the park contributes approximately $2.2 million directly to the regional economy through employment wages and contracting for goods and services. A nationwide model estimates that visitors to Lewis and Clark NHP spend $10.9 million in the local economy. Many Clatsop County residents use the Park for recreational purposes, they will directly benefit from the restoration of Park habitats to their historic natural condition.

HEALTH AND SAFETY

Many local residents and visitors use the park for recreational purposes and exercise. While the park has not yet collected data on the health impacts of outdoor recreation, NPS will be partnering with health care providers and researchers to quantify these impacts in the near future. A 2011-2012 effort is proposed for Lewis and Clark NHP.

CULTURAL RESOURCES

Recent surveys suggest that the forested environment that is the subject of this EA is not likely to contain archeological resources (Horton 2010, L. O'Rourke personal communication April 2011). However, the area is within one half mile of the Lewis and Clark (Netul) River and the Columbia River Estuary shoreline, features which have a moderate to high likelihood of containing archeological resources. Areas along the river and estuary were heavily used during historic times and have characteristics similar to other sites used during the pre-contact period. Below is general overview of cultural patterns and historic events in the Columbia River estuary, followed by a specific discussion of the project area.

Ethnographic Context

The project areas lie within the Northwest Coast culture area. At the time of Euro-American contact the Lower Columbia River was occupied by various tribes speaking the common Chinookan language. The peoples ethnographically linked to the current project areas are known as the Clatsop, with lands extending from the mouth of the Columbia River (Cape Adams) south to Tillamook Head (Spier 1936), and are modern members of the Clatsop-Nehalem Confederated Tribes. Along the Lower Columbia River, the majority of ethnographies were conducted after epidemics of European-borne diseases had swept the area, and are limited in number compared to those obtained along the northern Northwest Coast (Lyman 1991:14).

At the time of Euro-American Contact, peoples in this region were engaged in a lifestyle commonly referred to as the Developed Northwest Coast Pattern (c.f. Ames and Maschner 1999). Ames and Maschner (1999:24-27; c.f. Suttles 1990) list eight distinguishing features of the Northwest Coast:

1) Semi- to fully sedentary habitations;

2) Economies based on producing and storing large amounts of seasonally available foods;

3) Food production primarily based on a few highly productive resources requiring labor

organization for exploitation, supplemented with secondary resources;

4) Economies organized around corporate households;

5) Northwest Coast peoples actively manipulating their environments to increase resource productivity;

6) Highly developed complex tool technologies specialized for hunting, fishing, plant gathering, and crafts, such as woodworking;

7) Dense populations of people, many with occupational specialization; and

8) The presence of social hierarchies with permanent leadership positions.

Groups along the Lower Columbia River followed seasonal rounds based upon resource availability, settling in peak family controlled fishing locations during the summer. Clatsop winter villages were politically and economically autonomous, ranging in size between a single residence and up to 15 or 20 houses, and located in protected areas along major river banks in valleys and along the Pacific Coastline. Kinship ties established through marriage linked villages with one another. Winter village houses were generally subterranean cedar-plank lodges with pole frames and slanted or gabled roofs.

Once split with antler wedges, planks were straightened with straight D-shaped adzes and wood-handled chisels (Beckham et al. 1988:95-96). Fireplace hearths were sunk in the floor an additional foot (ibid.:87,91,93). During the summer, houses and temporary dwellings were constructed in a simpler fashion, with matting slung over a pole frame (ibid.:94; Ray 1938:126; Silverstein 1990:538). Chinook (saltwater) and sweetwater canoes with attached prows pointing outward and upward were utilized for riverine travel (Olson 1927:19).

Stone tools, such as scrapers, projectile points, adzes, pestles, and net weights, were manufactured using chipped/flaked lithic reduction and from ground and pecked stone (Silverstein 1990:539). The majority of material goods were manufactured using bone, antler, and woodworking techniques (Matson and Coupland 1995).

Summer fishing locations often had constructed platforms jutting out over the eddies to ease in long-handled dip net use (Silverstein 1990:536). Along the shore, seine nets up to 100 feet long and 12 feet deep were utilized (Beckham et al. 1988:89). Fish traps, weirs, spears and gaff hooks rounded out the fishing technology. Aquatic resources were harvested throughout this region in bulk seasonally during species' annual migrations to be accumulated, preserved and hoarded in winter villages for later use. Larger river systems generally contained a wider diversity and abundance of aquatic resources, including salmon (Chinook, Blueback, Silver, Humpback, and Dog), Steelhead, Chub, Suckers, Lamprey eel, Sturgeon, and Smelt (Beckham et al. 1988:89). After collection, fish were stored either through drying or pit burial. Sea mammals were localized in abundance along the Pacific Coast as a result of animal migration patterns.

Wild plants were gathered by the women, and berries were collected in the late summer and fall (Beckham et al. 1988:90) primarily on the Clatsop Plains and in the estuarine areas around Youngs Bay (Suphan 1974:38). These resources were processed with mortar and pestle. During the camas harvest, entire groups of people moved to the fields, leaving their winter villages

behind. Camas was roasted for preservation in specially constructed camas ovens (ibid.:96). Hunting with bows and arrows, clubs, pitfall and deadfall traps was conducted by the men in pursuit of deer, elk, bear, cougar, wolf, assorted small mammals and wildfowl (Beckham 1988:90-91).

Women were also responsible for manufacturing twined and coiled basketry and clothing, using bone and antler needles, and a variety of raw materials. Material culture consisted of carved, woven and shaped utensils, bowls, boxes, figurines, basketry, wedges and needles, and was often decorated. Personal adornment consisted of pendants and craniums flattened with the use of cradleboards. The dead were generally interred in specially constructed grave houses (Beckham et al. 1988:93,97).

Along the Pacific Coast, local peoples were first contacted by exploring Euro-American sailing ships in the late-18th century. With the promise of profitable trade, the Russians and Americans established trading posts along southern Alaska and the Columbia River. Fort George (Fort Astoria or Clatsop) was the only major trading post established during the fur trade along the Pacific Coast at the mouth of the Columbia River. In the early-19th century the Hudson's Bay Company became the dominant company in the Pacific northwest fur trade, south of the Russians (Cole and Darling 1990:119).

Pre-Contact Period Context

This section focuses on archaeological site locations and their use, subsistence and settlement patterns, and cultural materials associated with particular phases of the Lower Columbia River culture history. Different kinds of activities were carried out at various sites, suggesting patterns of seasonal subsistence and/or settlement rounds. Therefore, cultural chronologies are based upon cumulative effects of similarities of material remains within regional divisions of the Northwest Coast culture area, one being the Lower Columbia River.

Minor (1983) constructed a culture history sequence for this area at the mouth of the Columbia River. Four cultural phases are given for the Columbia Estuary spanning between 8000 BP to the mid-19th century. These are:

1) Youngs River Complex (8000 to 6000 BP);

2) Seal Island Phase (6000 to 2000 BP);

3) Ilwaco Phase, divided into the Ilwaco I (2000 to 900 BP) and Ilwaco II (900 BP / A.D. 1050 to 1775) subphases; and

4) Ethnographic Phase (A.D. 1775 to 1851).

Youngs River Complex (8000 to 6000 BP)

Although there is considerable debate over whether people entered the New World via a land crossing through an ice-free corridor or sea-based crossing along the coast (c.f. Dixon 1999), it is agreed that they entered the United States through the northwest at approximately 15,000 BP. The period from 10,000 to 8,000 is marked by the transition from a cold and dry post-glacial

climate to one warmer and moister, with accelerated climatic warming and drying occurring between 8000 and 4000 BP. Sea levels along the coastline fluctuated in response to local environmental conditions, but became relatively stable at 6000 BP with levels close to the modern shoreline.

Located along the southwestern coast of Washington, from the Columbia to the Gray River, the Youngs River complex has been compared to the Olcott Phase (8000 to 5000 BP) in the Puget Sound region (Beckham et al. 1988: 51) north of the current project areas. Both shouldered and leaf-shaped lanceolate projectile points, stemmed scrapers, bifaces, choppers, cobble spall tools, bolas, and baked clay objects (possible netsinkers) have been identified, with most of the artifacts recovered from the Burkholder Site on Gray's River (Minor 1984, 1989:4). This period is represented by sites throughout the Northwest that indicate seasonally mobile people with a terrestrial hunting diet supplemented by floral materials (Minor et al. 1980).

Seal Island Phase (6000 to 2000 BP)

The climate becomes warmer and drier than that of the present beginning approximately at 5000 BP and the density of sites increases. Evidence of multifamily houses, large winter villages and inherited (ascribed) social status, all cultural characteristics known ethnographically as part of the Developed Northwest Coast Pattern, are currently absent from the archaeological record along the Lower Columbia River (Matson and Coupland 1995:97).

The Seal Island Phase is characterized by broad-necked stemmed projectile points, bifaces and unifaces, chipped stone choppers, groundstone abraders, anvils, single-piece non-toggling and composite toggling bone harpoons, wedge-based bone points and harpoon valves, girdled netsinkers, and atlatl weights (Minor 1983:186). This phase is defined by materials recovered from the early component at Eddy Point, Skamokawa, and Burkhalter Sites, and is believed to be established by 3180 BP based upon uncalibrated radiocarbon (14C) dates obtained from Eddy Point (Minor 1983:188). The Burkhalter Site is located a few miles south/southeast of the current project loci. Features identified at the Burkhalter site consist of three rock clusters, likely the remains of hearths, with two of these clusters providing 14C dates of 2660±130 BP and 2080±110 BP (Minor 1983:170). The site is interpreted as a hunting camp with butchering, hide processing, stone and bone tool manufacture taking place onsite (ibid.). Acidic soils are believed responsible for the degradation and paucity of organic materials. However, based upon stylistic similarities in tool form, the Burkhalter assemblage, recovered from lower strata, has also been associated with the earlier Young's River Complex (Minor 1989:4).

Settlement and subsistence patterns have been interpreted as that of a generalist forager lifeway. Seasonally mobile peoples relied on a terrestrial and marine hunting diet, with few shellfish and salmonoid remains, supplemented by floral materials (Matson and Coupland 1995:118,122; Minor et al. 1980).

Ilwaco I (2000 to 900 BP) and Ilwaco II (900 BP / A.D. 1050 to 1775)
Climatic conditions beginning at about 1500 BP suggest a gradual increase in moisture with cooling temperatures and subsequent forest expansion, with the flora reaching its modern distribution. Settlement and subsistence patterns ascertained from archaeological sites resemble

those ethnographically known at the time of Euro-American contact, referred to herein as the Developed Northwest Coast Pattern (c.f. Ames and Maschner 1999;24-27; c.f. Suttles 1990). During this period, large winter and summer village sites were located along major rivers, such as the Columbia River, with hunting-fishing camps situated along secondary rivers, such as the Youngs and Lewis and Clark and Rivers, the latter of which abuts the Otter Point Estuarine Enhancement project area.

One of the best known sites is Eddy Point, located along a point separated by an island channel from the main flow of the Columbia River near Knappa, Oregon in an estuary-zone. A shell midden layer was dated to 1440±100 BP, and an overlying dark brown sandy silt to 890±120 BP and 930±80 BP. Chipped stone tools recovered from occupation layers include narrow-necked projectile points, bifaces, unifaces, bifacial, foliate, and triangular knives, scrapers, gravers, and choppers. Groundstone consisted of mauls and spherical stones, atlatl weights, and girdled netsinkers. An extensive antler and bone industry produced a variety of harpoons, including bilaterally and unilaterally barbed dart heads, shouldered and wedge-based bone points as well as composite toggling harpoon valves. Bone was also fashioned into awls, chisels, wedges, a drill, a pin, and a bead (Minor 1983:120-121). Elk and deer are the most common mammalian remains identified, yet harbor seal, bear, raccoon, mountain beaver, porcupine, otter, mustelids, and micromammals were recovered in conjunction with duck, goose, and swan. Marine fish included salmonids, sturgeon, sucker, peamouth, and minnows. Fragmented gaper and butter clam remains were also identified.

Large amounts of terrestrial animals and fish suggest that hunting and fishing were important pursuits, with butchery and hide processing occurring onsite. Wildfowl remains suggest a fall, winter and spring occupation, most likely in the form of a winter village (Minor 1983:129). The diverse nature of the cultural materials suggests that a range of activities took place at the site, such as woodworking, chipped stone and bone tool manufacture.

Ethnographic Phase (A.D. 1775 to 1851)

Native peoples were engaging in lifestyles referred to as the Developed Northwest Coast Pattern (c.f. Ames and Maschner 1999;24-27; c.f. Suttles 1990). Cultural materials are characterized by narrow-necked points, composite toggling harpoons, perforated and wrap-marked netsinkers, and dentalium shell beads, in addition to historical materials of both Oriental and Euro-American manufacture (Minor 1983).

Clatsop villages located near the project area were located on the Lewis and Clark River (*Ni' tl* and *Sqipanáwunx*), Youngs Bay (*Nu-sma-spu* or *Nuc-que-clah-we-muck*), and Youngs River (*Kil-how-a nak-kle*) (Lyman 1900; Silverstein 1990:534; Suphan 1974:43). On August 7, 1850, the Clatsop ceded lands from Smith Point (near Astoria) south to Saddle Mountain, west to the Lewis and Clark River (north of its mouth), and east along Youngs Bay to Smith Point (Ruby and Brown 1976:225-227). Under the Indian Treaty Act of 1850, the Tansey Point Treaties were negotiated between the Clatsop and Anson Dart, Superintendent of Indian Affairs for Oregon territory, between August 5 and 6, 1851. Under this treaty, the Clatsop ceded one-half million acres west of Lewis and Clark River from Point Adams south along the Clatsop Plains to Tillamook Head in exchange for a small reservation. Neither of these treaties was ratified, nor

have the Clatsop received lands for a reservation. As such, many families remained within their traditional homeland and are not members of a federally recognized tribe (Clatsop-Nehalem 2006).

Historic Period Context

The Lewis and Clark Expedition, 1805-1806

The Corps of Discovery arrived at the site of Fort Clatsop with 33 people and a dog on December 7, 1805. The expedition members had just spent the previous four weeks on the north bank of the Columbia River exposed to nearly continuous winter storms, prompting the Corps' decision to overwinter on the south side of river. Captain Lewis chose the location with a small expedition in early December, and the Corps completed building Fort Clatsop on December 31, 1805.

The expedition members spent much of their time at Fort Clatsop hunting for elk, making salt from seawater near the present town of Seaside, trading with the local Clatsop Indians, and preparing themselves for their return journey. Lewis and Clark reworked their journals and maps, and organized the scientific data gathered during the winter at Fort Clatsop. The expedition began its return journey on March 23, 1806, leaving Fort Clatsop and its interior fittings to the local Clatsops. Hussey (1958:2) notes that Clatsop tradition indicates that the local Clatsop Chief Comowool (Coboway) used the fort for several seasons as a temporary hunting quarters, until it naturally degraded into ruins some years later (Cromwell 2002).

Late-19th Century and Early-20th Century European Settlement

The location of the site of Fort Clatsop became fixed in local tradition at a very early date, but none of the early visitors mapped the site's location. The early history of land claims at the project site is unclear. It appears that Carlos Shane filed a land claim in 1848, under the territorial land claim laws. After Congress passed the Donation Land Claims Act in 1850, Carlos' brother Franklin Shane filed a claim. In 1852, American Richard Moore made arrangements with the Shanes to establish a lumber mill operation along the banks of the Lewis and Clark River (GLO 2010). Moore built the mill (Figure 11) and logged much of the landscape, sending the lumber to San Francisco from operations near the current Historic Canoe Landing interpretive site (Cannon 1995:16). After the taller timber was removed from his property, Franklin Shane established an orchard. It is likely that the original Shane house was destroyed by fire in the 1860s, and Franklin Shane died sometime between 1860 and 1867. His two daughters inherited his property, and in 1872, the husband of Mary Shane, William Hampton Smith, was given title to the half of the claim containing the Shane house (Cromwell 2002).

The Smiths built a new house to the south of the Shane house location, and lived with their children at the site until 1880, when they moved to Portland. The Smiths were part of a pottery company family, which operated major pottery works at Buena Vista, Oregon and established the Oregon Pottery Company in Portland in the 1880s (Schmeer 1987). The Smiths operated a brick manufacturing business near the site of Fort Clatsop for a while, and it is likely that clay was mined to the southwest of their house and barged to Portland for later operation of the

Oregon Pottery Company. When the Smiths moved to Portland in 1880, the Joseph B. Stevenson family rented their house and property, and it is reported that the family made charcoal on the property (Cromwell 2002).

The area of the Historic Canoe Landing (Figures 1 and 5) saw extensive use during the late-19th century. From 1860-1862, the United States Revenue Service docked a cutter for maintenance at the landing (Cannon 1995:17). In 1862, the Oregon Steam and Navigation Company established regular summer service between Portland, Oregon and the Historic Canoe Landing site (known as Fort Clatsop). This weekly service brought vacationers via a stage from the landing to the resort town of Seaside. This seasonal route was to continue until about 1900, when improved roads and railroad access to the coast made ship transportation redundant (Cannon 1995:17).

The Forest Landscape of the Clatsop Homeland

The journals of the Lewis and Clark Expedition contain several passages that briefly describe the forests surrounding the Netul River in 1805-1806. On November 6, Clark described the estuarine habitat when he recorded his course settings, " ... the bushes So thick that our hunters Could not get through, red wood, green bryors, a kind of Burch, alder, red holley a kind of maple &c. &c. The Species of Pine is Spruce Pine fir arber vitia &c. red Loril, the bottoms have rushes grass & nettles, the Slashes long grass bulrushes flags &c. Som willow on the waters edge".

Again on November 12th, Clark wrote of the hunters, "they found the woods So thick with Pine & timber and under groth that they could not get through ...". On December 1, 1805, Lewis remarked on the coastal forests, noting, "the wood was so thick it was almost impenetrable."

On December 7th, the party journeyed to the site Lewis had chosen for their winter encampment. Clark wrote that they, "...proceeded around this Bay which I have taken the liberty of calling Meriwethers Bay...we assended a river which falls in on the South Side of this Bay 3 miles to the first point of high land on the West Side, the place Capt. Lewis had viewed and formed in a thick groth of pine about 200 yards from the river, this situation is on a rise about 30 feet higher than the high tides leavel and thickly Covered with lofty pine. this is certainly the most eligable Situation for our purposes of any in its neighborhood."

On January 10, Lewis described the region: "The country in general as about Fort Clatsop is covered with a very heavy growth of several species of pine and furr, also the arbor vita or white cedar and a small proportion of the black Alder which last sometimes grows to the hight of sixty or seventy feet, and from two to four feet in diameter. some species of the pine rise to the immence hight of 210 feet and are from 7 to 12 feet in diameter, and are perfectly sound and solid. "

On February 5, 1806, Lewis notes that the western hemlock, "...is much the most common species; it may be said to constitute at least one half of the timber in this neighborhood." "It rises to a height of 160 to 180 feet very commonly, and is from 4 to 6 feet in diameter - very straight, round and regularly tapering."

The form of the hemlocks Lewis describes, 4 to 6 feet in diameter, "round and regularly

tapering" could only have arisen in situations where the hemlock had sufficient light to add girth. This growth form does not appear to be possible if hemlock is left densely stocked until it is 40 years of age or older.

Recent archeological surveys in the project area

It is possible that undocumented resources associated with pre-contact occupation or historic occupation Lewis and Clark River are located within the project area, but recent surveys suggest that this is unlikely. In 2010, NPS archeologist Beth Horton (Horton 2010) surveyed and conducted shovel probes along the proposed route for the park's South Clatsop Slough Trail. This trail travels through the project area. Though the trail route passed within 30 meters of the estuary and passed through a farm stead occupied during the historic period, only a cable associated with logging operations was found. In 2011, NPS archeologist Leslie O'Rourke conducted a survey and shovel probes along the proposed route for Forest Loop A and for modifications to the South Clatsop Slough Trail. She uncovered a nail, likely not of historic origin.

There are no known instances of the forest area being used for habitation during the pre-contact or historic periods. The project area might have been used for timber for the Moore mill in 1852 or for clay pits for the Oregon pottery company, although none of these uses has been documented or discovered. These uses are unlikely to leave substantial archeological evidence.

One of the reasons for a lack of archeological deposits is the significant re-shaping and erosion of the area's original soils. Forests within the project area have been harvested two or three times since 1850. Logging slash was gathered from the forest floor into piles and burned. In many areas, farm and forest activities conducted prior to today's best management practices resulted in landslides and modification of the surface soil layers. Equipment operation and erosion might have obscured much of the original forest floor in the project area.

The park may contain sections of a 19th century wagon road used to take passengers from a ferry dock to Seaside. The exact location of this road is not known. Some have conjectured that the wagon road followed the existing Fort-to-Sea Trail and Perkins Road. Others have suggested that the route was further south and followed an old county right-of-way that is now part of Lounsberry Road.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This section of the EA forms the scientific and analytic basis for the comparisons of alternatives as required by 40 CFR 1502.14. This discussion of impacts (effects) is organized in parallel with the section on Affected Environment and is organized by resource areas. The No-Action Alternative and each action alternative are discussed within each resource area. To the extent possible, the direct, indirect, short-term, long-term, beneficial, and adverse impacts of each alternative are described for each resource area.

The analysis includes a summary of laws and policies relevant to each impact topic, definitions of impact thresholds (negligible, minor, moderate, and major), methods used to analyze impacts, and the analysis methods used for determining cumulative effects. As required by the CEQ, a summary of the environmental consequences of each alternative is provided in Table 3 in Chapter 2: Alternatives.

Three categories of effects, or impacts, are considered and analyzed: (1) direct effects, which occur at the same time and in the same place as the action; (2) indirect effects, which occur later or at a location away from the action; and (3) cumulative effects, which are additive and include those that occur in the past, present, and foreseeable future. Direct, indirect, and cumulative effects are addressed for each affected resource under the proposed alternatives. The following resources described in Chapter 3, Affected Environment, were evaluated for potential effects.

1. Geology, Soils, and Topography
2. Water Quality
3. Vegetation (including Forest Health and Climate Change)
4. Wildlife
5. Threatened and Endangered Species6. Air Quality
7. Visitor Use and Experience and Soundscape
8. Visual Resources
9. Socioeconomics
10. Health and Safety
11. Cultural Resources

Analysis Approach

The potential direct, indirect, and cumulative impacts of the alternatives were analyzed for the alternatives. The resources expected to be affected by the proposed restoration alternatives are described in Chapter 3, “Affected Environment”.

The impact analysis involved the following steps:
• Identifying the resource that could be affected.

• Identifying the cumulative effect, duration of impact (long-term or short-term), and intensity of impact (negligible, minor, moderate, or major).
• Identifying whether effects would be beneficial or adverse.
• Identifying mitigation measures that may be employed to offset or minimize potential adverse impacts.

The impact analyses were based on professional judgment using information provided by project designs, NPS staff, relevant references and technical literature citations, and subject matter experts.

Impacts and Effects

Under CEQ regulations the terms “effects” and “impacts” are used synonymously (40 CFR 1508.8). Type of impact refers to the beneficial or adverse consequences of implementing a given alternative. Impacts, or effects, also consider spatial and temporal components. More exact interpretations of intensity, duration, and type of impact are given for each resource area examined. Professional judgment is used to reach reasonable conclusions as to the intensity and duration of potential impacts.

Intensity of Impacts

For all adverse impacts, the intensity of the impact on a given impact topic is described as negligible, minor, moderate, or major. For each impact topic, a distinct set of impact thresholds is used to provide definition of what constitutes an impact of a given intensity. The impact thresholds are aligned to relevant standards based on regulations, scientific literature and research, or best professional judgment. The intensity of an impact on a given topic is determined by comparing the effect to the impact threshold definitions for that topic. Impact thresholds are used for adverse impacts only.

Duration of Impacts

Effects can be characterized by the duration of the effect. Short-term effects include actions that temporarily affect, or have the potential to affect, a resource for 12 months or less, such as disturbance during restoration of areas that are later reclaimed. Long-term effects include actions that affect a resource for greater than 12 months, and may or may not be permanent.

Regulations and Policies

The Organic Act of 1916, NPS Management Policies (NPS 2006b), and NPS Reference Manual 77: National Resource Management Guidelines (NPS 1991) direct NPS managers to provide for the protection of Park resources. These regulations and policies require the NPS to protect and preserve geologic resources and processes.

Impairments

According to the 1916 Organic Act, which established the National Park Service, impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values. An impact to any park resource or value may, but does not necessarily, constitute an impairment. An impact would be more likely to constitute impairment to the extent that it

- affected a resource or value whose conservation was necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park, or

- was key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or

- was identified in the park's general management plan or other relevant NPS planning documents as being of significance.

Implementation of either action alternative considered in this environmental assessment would not result in impairment to park resources. An impairment determination is made for each potentially affected resource for the No Action alternative (Alternative 1), Alternative 2 (Rebuild Forest Soils) and Alternative 3 (Adaptive Management). Impairment evaluation is only applicable to natural and cultural resources within the park boundaries. Therefore, impairment determinations were not made for visitor use or socioeconomic evaluations.

Cumulative Impacts

The Council on Environmental Quality (CEQ) regulations, which implement NEPA, require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for both the no-action and proposed action alternatives.

Cumulative impacts were determined by combining the impacts of the proposed alternative with potential other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or foreseeable future projects within the project area and, if necessary, the surrounding region. Reasonably foreseeable cumulative actions include:

- The immediate area of the Fort Clatsop unit has been extensively logged in the past and logging operations continue in the region. Connectivity with other forests with late successional characteristics would continue to be a challenge as neighboring land uses continue or intensify.

- The Fire Management Plan for Lewis & Clark National Historical Park is currently being updated and includes alternatives with manual thinning operations along the boundary of the Fort Clatsop unit. The specific silvicultural prescriptions for forest restoration will

take into account the areas treated for fire hazard reduction. The material thinned under the Fire Management Plan will be scattered when feasible to help replenish forest soils.

- Proposed natural resource management actions at Lewis and Clark NHP include restoration of forests, wetlands and native species and eradication of invasive species.

- Future development at Astoria Airport is projected to include commercial and industrial activities. Commercial aviation service has recently been re-established.

- Tourism is becoming a larger segment of the regional economy of northwest Oregon. In addition to several sites associated with the Lewis and Clark expedition, numerous other events and recreational activities are drawing more visitors to the region each year. The increase in tourism results in a corresponding increase in the number of vehicles on regional roads.

- Conversion of lands around Lewis and Clark NHP from natural and agricultural use to housing and other development is expected to continue. This will continue to fragment wildlife habitat and corridors.

Consequences by Impact Topic

SOILS, TOPOGRAPHY AND GEOLOGICAL RESOURCES

Topography in the project area was altered in the past by road construction; soils in the project area have been previously disturbed by road construction and logging. Logging disturbs soils when bulldozers skid (drag) logs across the surface of the land, and when heavy machinery compacts soil layers. Logging and road construction prior to park establishment resulted in erosion of bare soils, alteration of soil horizons, and interruption of soil formation processes.

Methodology
NRCS data, GIS maps, soil layers, and the Lewis and Clark NHP GMP were all referred to in determining the geological environment of the project area.

Thresholds for Intensity, Duration, and Type of Effect:

- **Negligible**: Geologic resources would not be affected or effects would be below or at the lower levels of detection. Any effects to the geology or geomorphology of the site would be slight and no long-term effects would occur.
- **Minor:** The effects to geologic resources would be detectable. Changes in erosion could be measured. If mitigation were needed to offset adverse effects, it would be relatively simple to implement and would likely be successful.
- **Moderate:** The effect on landscape morphology would be readily apparent and likely long-term. The resulting change to the geology would cover a relatively large area. Mitigation measures would probably be necessary to offset adverse effects and would likely be successful.
- **Major:** The effect on landscape morphology would be readily apparent, long-term, and substantially change the character of the project area over a large area (> 5 ac). Mitigation measures to offset adverse effects would be needed, extensive, and their success could not be guaranteed.

Duration:

- **Short-Term:** Lasting only during the work period or no longer than the first growing season thereafter.
- **Long-Term**: A permanent post-thinning impact.

Alternative 1(No-Action) - Geology, Soils, and Topography

Impact Analysis: Under the No-Action Alternative there would be no impact to soils from thinning or harvesting activities. However, the existing old forest roads such as the Gasline spur would receive no attention and over time would remain with an increasing potential to fail and cause erosion. Over time roads would re-vegetate but it is unclear how effective this would be at preventing erosion in the long term.

Conclusion: This alternative would likely have minor-short term adverse impacts to soils along existing old forest roads at Lewis and Clark NHP due to erosion of road beds. Long-term impacts could vary depending on the ability of vegetation to re-colonize the road surfaces and stabilize the road prism. Impacts could be moderate, adverse

depending on the size and frequency of road failures.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

Alternative 2 - Geology, Soils, and Topography

Impact Analysis: Alternative 2 would begin active forest management in the Fort Clatsop Unit. Management under this alternative would be limited to thinning with all trees left on site. Impacts to soils, geology, and topography from forest restoration activities without biomass removal are a possibility. Impacts from these activities would potentially be some compaction from trees being felled. No heavy equipment would be used in areas away from roads and potential negative impacts should be minimal. Leaving all biomass on-site would cause long-term beneficial impacts to nutrient cycling and building soils.

Additional impacts under this alternative could result from using the existing old forest roads in the Park. Increased erosion could result from the use of the Perkins roads for restoration activities. The Perkins access roads would be maintained but other roads would be abandoned. The Gasline Road culvert conditions would be addressed and sections of the road would be converted into a walking trail. Over time roads would re-vegetate but it is unclear how effective this would be at preventing erosion in the long-term.

Construction of two loop trails totaling up to 115,400 square feet will have a localized impact on soils and topography. Trails will be designed to minimize erosion potential, using existing contours and topography. A general guideline of keeping all trail segments with a less than 10% slope will be followed.

Conclusion: Negative impacts from forest thinning without biomass removal should be negligible in the short and long-term. Short-term impacts of using the Perkins access roads should be minor as long as maintenance and mitigation requirements are followed. Long-term impacts should be minor due to the speed at which coastal areas re-vegetate. Planting and other mitigation measures would help keep impacts from restoration activities to a minimum. Minimizing trail slopes will mitigate against erosion. Increased soil development would be beneficial long term.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

Alternative 3 - Geology, Soils, and Topography

Impact Analysis: This alternative would expand forest restoration activities to include the possibility of limited biomass removal. Under this alternative the primary impact to soils would be from compaction in areas where equipment is being used to fell and yard trees for biomass removal. Compaction should be limited to skid trails and yarding corridors. Soils underlying areas with proposed biomass removal are characterized by low soil strength and are prone to rutting. Most of the stands have been thinned previously and

old skidder paths can be re-used to limit additional impacts.

Impacts to soils, geology, and topography from forest restoration activities away from existing forest roads are also a possibility. Impacts from these activities would potentially be some compaction from trees being felled. No equipment would be used in areas away from roads and potential impacts should be minimal.

Conclusion: As in alternative 2, negative impacts would be negligible in the short and long term. Possible biomass removal operations would likely only slightly increase impacts as long as yarding is kept to old skid trails. Long term impacts should be minor due to the speed at which coastal areas re-vegetate. Planting and other mitigation measures would help keep impacts from restoration activities to a minimum. Short-term impacts of using the roads in Alternative 3 should be minor as long as maintenance and mitigation requirements are followed. The Perkins roads are currently open and drivable. Increased soil development would be beneficial long term.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

WATER QUALITY

Methodology
On-site visits and discussions with biologists and foresters were utilized to estimate the effects of the proposed alternatives on surface water quality.

Thresholds for Intensity, Duration, and Type of Effect:
- **Negligible:** Very slight changes in surface water quality. Impacts barely detectable.
- **Minor:** Changes in surface water quality would be measurable, although the changes would likely be small and the effects would be localized. No mitigation measures would be necessary.
- **Moderate:** Changes in surface water quality would be measurable and potentially long-term but would be relatively local. Mitigation measures would be necessary and would be effective.
- **Major:** Changes in surface water quality would be measurable, long-term, and broad scale. Mitigation measures would be necessary and their success would not be guaranteed.

Duration:
- **Short-Term:** Recovery in less than a year.
- **Long-Term:** Permanent post-construction impact.

Alternative 1 (No-Action) - Water Quality

Analysis: The No-Action alternative would have little direct impact on water resources within the park. Potential indirect impacts to water quality could result from continued erosion along existing forest roads within Lewis and Clark NHP. Erosion from logging roads is one of the primary sources of sediment associated with forest management (Grace 2002). Erosion impacts on water quality could increase under the No-Action scenario if blocked culverts cause road failure along the Gasline Spur. Erosion would largely depend on how well vegetation is able to stabilize road surfaces but studies suggest that un-treated roads are still more prone to failure due to disruption of subsurface water flow down slopes (Bloom 1998, Luce 1997).

Conclusion: Under this alternative, adverse short-term impacts from road erosion would potentially be minor. Long-term impacts could be moderate adverse but would vary in intensity on the frequency, severity, and proximity of road failures to bodies of water.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

Alternative 2 - Water Quality

Analysis: Under this alternative, all stream corridors and wetlands would be buffered , so impacts from restoration thinning activities should be minor to negligible in the short term as they would take place away from water resources. Thinning should have a beneficial impact in the long-term as downed wood and larger trees develop and increase

the filtering capabilities of forest stands (Apostol 2006).

Construction of two loop trails totaling up to 115,400 square feet could impact water quality. During construction, short term impacts will be mitigated by placing baffles near stream crossing to ensure that no sediment enters the water. Construction of water bars and small diversion ditches will mitigate against longer term potential erosion into water ways. Trails will be constructed with slopes of 10 % or less, which will also minimize erosive potential.

Conclusion: Impacts from restoration activities should be minor to negligible as they would take place away from water resources. Direct impacts of restoration activities should be negligible in the short term, and potentially beneficial in the long-term due to increased ecosystem function and an improvement of overall watershed health.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

Alternative 3 - Water Quality

Analysis: Like the previous alternative, mitigation measures such as buffers around streams and wetlands should keep impacts to a minimum. Indirect impacts to water resources could result from erosion related to using heavy equipment on forest roads if biomass removal occurs.

Conclusion: Indirect adverse short-term impacts from using the roads should be minor as all would require minimal additional maintenance to limit erosion. Impacts from restoration activities should be minor to negligible as they would take place away from water resources. Direct impacts of restoration activities should be negligible in the short term, and potentially beneficial in the long-term due to increased ecosystem function and an improvement of overall watershed health.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

VEGETATION

Methodology
Timber cruise data, multiple site visits, aerial photos, and vegetation community maps, as well as professional knowledge of NPS staff and other resource professionals were used to determine potential effects of proposed alternatives.

Thresholds for Intensity, Duration and Type of Effect:

- **Negligible:** Direct or indirect impacts would have perceptible but small changes in the size, integrity, or continuity of vegetation at the site.
- **Minor:** Disturbance of vegetation would be measurable or perceptible but limited in size to less than one acre. The overall viability of plant communities would not be affected and would recover. The introduction of exotic plants would be limited to those species already established at the site.
- **Moderate:** Disturbance of 1 to 10 acres of vegetation would occur. Impacts would cause a change in the plant communities (e.g. abundance, distribution, quantity, or quality), but the impacts would remain localized. May result in the introduction of non-aggressive exotic plant species not previously established in the park.
- **Major:** Disturbance of more than 10 acres of vegetation or any disturbance to federally listed plant species would occur. Could also result in the introduction of aggressive exotic plant species not already established in the park.

Duration:

- **Short-term:** The physical impact from the proposed actions would require less than one growing season for the full recovery of plant communities.
- **Long-term:** The physical impact from the proposed actions would require more than one growing season for the full recovery of plant communities

Alternative 1 (No-Action) - Vegetation

Analysis: Under the No-Action Alternative, windthrow risk could potentially increase over time since trees in dense stands are unlikely to allocate resources to increase stem girth and so increase resistance to toppling (Oliver and Larson 1996). The predominance of even aged hemlock make these stands particularly susceptible to wind damage since hemlock is considerably less windfirm than to Sitka spruce, Douglas-fir, or western redcedar (Edmonds et al. 2000, Beese 2001, Holmberg et al. 2006). Most of these stands will all be reaching a period of peak wind susceptibility within a similar time frame. While the Sitka spruce forest zone is characterized by frequent windthrow events, the variability across a particular forest typically results in a pattern of smaller, frequent pockets of windthrow (Franklin and Dryness 1973). Large windthrow events do occur but these are typically less frequent (Edmonds et al. 2000). Given the predominance of western hemlock dominated stands at the Fort Clatsop unit, under the No-Action Alternative the present pattern of chronic patchy windthrow could develop into one characterized by larger catastrophic windthrow (Churchill 2003, Wilson 1998).

Overall, under the No-Action Alternative, stands at the Fort Clatsop unit would continue to have limited biodiversity, uniform tree sizes, and lack of snags and CWD (except in

those stands most severely hit by the December storm, in which the overabundance of CWD now may present a fire hazard in some areas). Stand development would take place but would be considerably slower than with even modest restoration activities, and current forest conditions with limited biodiversity and habitat value would continue to persist. The No-Action Alternative would not meet the park's overall goals to manage for the development of late successional characteristics and improve wildlife habitat characteristics.

Forest health would not change under this alternative. Resilience against changes which may come about due to climate change would remain low.

Conclusion: This alternative would result in moderate, adverse long term affects, as forests would remain in their current condition of poor habitat quality, lack of diversity, and increasing windthrow risk over time.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

Alternative 2 - Vegetation

Analysis: Actions under Alternative 2 would impact vegetation within the project area. Thinning would reduce overall stand densities, stimulate stand growth and development, release dominant trees, improve conditions for development of understory vegetation and canopy, improve stand resilience to stressors such as pathogens and climatic events, and increase the numbers of Sitka spruce relative to Douglas-fir and hemlock. Planting of other species of native tree would also change the overall composition of the plant communities.

Damage to existing vegetation could result from thinning activities. Impacts to shrubs and other understory vegetation would likely be moderately adverse in the short-term. Given the limited amount of existing understory vegetation and the productivity of the sites in the area, overall adverse long-term impacts to understory vegetation should be negligible. Thinning would enhance the development of understory vegetation because there would be more light reaching the forest floor via creation of canopy openings. This benefit would occur over several decades. Cut vegetation that is spread evenly over a site would act as mulch to retain soil moisture to encourage growth of understory vegetation.

Riparian vegetation would be protected by establishing streamside protection zones. This would be a long-term minor to moderate benefit to the riparian vegetation that has regrown following clearcutting and loss of riparian zones from past logging practices.

Damage to remaining trees during thinning would have a negative impact on damaged individuals but mitigation measures and project planning should limit impacts to minor, adverse. Other vegetation such as mosses would be more sensitive to ground disturbance but impacts should still be minor as skips and reserve areas would provide areas where these resources would be protected.

Invasive vegetation could increase as a result of opening up growing space during thinning. However results from other thinning experiments suggest that invasive species decrease over time (Carey et al 1999). Following BMPs of cleaning tools and equipment before entering new stands will mitigate against new infestations.

Insects and forest diseases could potentially increase due to the tree damage and trees left on the ground after thinning operations. However, impacts from these disturbance agents have been minor in nearby forests managed by the Oregon Department of Forestry (Dan Goody, ODF personal communication).

All action alternatives would enhance the resistance and resiliency of forests within the Fort Clatsop unit to the increased environmental stresses that will likely come with climate change. For example, lower tree densities and diverse species tend to reduce fire severity (Oregon Forest Resources Institute 2006). The unnatural density and homogeneity of intensively managed young stands leads to ecological instability and predisposes them to catastrophic disturbance (Apostle 2006). By restoring structural complexity to previously harvested timberlands, the park would be restoring the complex web of functions, processes, and relationships that are lacking in the low-diversity even-aged managed stands that currently exist. This would result in an ecosystem which would naturally be more elastic, responsive, and adaptable to whatever fluctuations in temperature and weather occur.

Construction of two loop trails totaling up to 115,400 square feet will have a localized impact on vegetation. The trail routes do not cut through any sensitive habitats, and due to the rapidity with which vegetation regenerates here, the impacts will be minor and short term.

Wind will continue to be the primary disturbance agent in these forests and adverse impacts to Lewis and Clark NHP forests could result. In the short-term thinning would increase wind damage susceptibility slightly as trees must adapt to more open growing conditions. However this can be mitigated by using lighter treatments spread over several years. Overall, impacts would be beneficial in the long-term as treated stands would be more windfirm than untreated stands as time progresses.

Conclusion: Overall, adverse impacts should be minor and limited to the short-term in the immediate area of active projects. Long-term impacts would be moderate, beneficial to park ecological resources as restoration treatments reintroduce essential habitat elements and encourage forest development.

Impairment: Clearcut logging impaired the old growth forest communities. The action alternatives would reduce the impairment within the project area by shortening the time for portions of the park forests to reattain old growth forest characteristics, structure, and function.

Alternative 3 - Vegetation

Analysis: Impacts under Alternative 3 could be greater than those under Alternative 2.

The main difference is that Alternative 3 allows limited biomass removal as a management option. An increase in the area treated with biomass removal would increase the area disturbed by machinery during removal activities resulting in slightly greater impacts compared to Alternative 2. However, projects should still be sufficiently separated both temporally and spatially to keep impacts to minor adverse. Long-term impacts would be beneficial as forest treatments would accelerate forest development and increase habitat quality.

Under this alternative there would be approximately 290 acres where thinning including biomass removal would be possible. This acreage was arrived at by looking at the proximity of densely stocked stands to usable roads, which the trees could be hauled out on. 423 acres would still receive thinning without removal and 90 acres would receive habitat improvement only (plantings, snag creation, etc). The stands selected for "habitat improvement only", while close to usable roads, were not identified for possible biomass removal because they are some of the oldest, least densely stocked stands in the park and it is not anticipated that biomass removal would ever be needed.

On the 290 acres where biomass removal would be possible, a variety of thinning treatments would be applied, due to the variety of stand ages and types. Prescriptions will be based on the results of the new round of timber cruising slated to take place. The Weyerhauser data from 2000 indicates a large range in the current density of these stands, from 133 stems/acre to over 800 stems/acre. While the specific prescriptions have not yet been determined, a thinning treatment which leaves 150 trees/acre is considered quite "heavy", and would represent the upper limit of any thinning which would occur. A much lighter thinning treatment would normally be employed.

If biomass removal is implemented, a diameter cap of 20" would be placed on all trees removed from the forest. This will ensure that larger diameter trees are either left standing, or turned into snags or large woody debris to benefit wildlife.

For a similar forest restoration plan being implemented by The Nature Conservancy in Washington, their models projected a conservative estimate of approximately 7 mbf (thousand board feet) /acre being generated from thinning in 25-35 year old stands, roughly comparable to the most of the stands in the Fort Clatsop unit.

Conclusion: Overall impacts would be minor adverse in the short-term in the immediate area of active projects. Long-term impacts would be beneficial as restoration treatments would increase windfirmness and increase habitat quality.

Impairment: Clearcut logging impaired the old growth forest communities. The action alternatives would reduce the impairment within the project area by shortening the time for portions of the park forests to reattain old growth forest characteristics, structure, and function. Potential removal of trees on 290 acres under the proposed action is acceptable because this would only be implemented if it is deemed essential to meet ecological objectives.

WILDLIFE

Methodology
On-site visits, species lists, on-going research, and knowledge and technical expertise by park staff were used to estimate the effects of the proposed actions in the various alternatives.

Thresholds for Intensity, Duration, and Type of Impact:

- **Negligible:** Wildlife would not be affected or the effects would be at or below the level of detection, would be short-term, and the changes would be so slight that they would not be of any measurable or perceptible consequence to the wildlife species' population.
- **Minor:** Disturbance of native terrestrial and/or aquatic wildlife habitat would be limited to highly localized areas.
- **Moderate:** Disturbance of regionally typical native terrestrial and/or aquatic wildlife habitat would occur. The area of disturbance would be between one to five acres of terrestrial habitat.
- **Major:** Disturbance of more than five acres of regionally typical terrestrial wildlife habitat.

Duration:

- **Short-Term:** Complete disturbance recovery in less than five years.
- **Long-Term**: Disturbance recovery requiring more than five years to return to pre-disturbance levels.

Alternative 1 (No Action) – Wildlife

Analysis: Under the no action alternative, there would be no actions such as snag creation or understory development to create wildlife habitat. The same species distribution, diversity, and population sizes would be expected to continue. Increased probability of catastrophic windthrow under the no-action alternative could lead reduced access for large ungulates such as elk, but could increase available habitat for small mammals and amphibians.

Conclusion: There would be negligible short and long term impacts.

Impairment: There would be no impairment to park resources from this alternative.

Alternative 2 – Wildlife

Analysis: All of the action alternatives would have an impact on wildlife in the project area. Short term, moderate disturbance to animals may occur during thinning operations. This will be mitigated against by leaving untreated “skip” areas as refugia, and spacing out thinning treatments in time and space so that only a small percentage of the project area will be disturbed at any given time. In the long term, the creation of snags, increase of coarse woody debris, reintroduction of diverse native plant species, and overall increase in structural and biological diversity will result in more available wildlife habitat.

Conclusion: Impacts to wildlife will be moderate short term; improved habitat will be beneficial long term.

Impairment: There will be no impairment to wildlife resources under this alternative.

Alternative 3 – Wildlife

Analysis: Impacts to wildlife under this alternative will be essentially the same as those under alternative 2. If monitoring or other information indicates that wildlife is being negatively impacted in any way from an over accumulation of biomass on the ground, this will be mitigated under this alternative through biomass removal in allowed areas.

Conclusion: Impacts to wildlife will be moderate short term; improved habitat will be beneficial long term.

Impairment: there will be no impairment of wildlife resources under this alternative.

THREATENED AND ENDANGERED SPECIES

Impact Indicators, Criteria, and Methodology

The *Endangered Species Act* defines the terminology used to assess impacts to listed species as follows:

No effect: The appropriate conclusion when the action agency determines that its proposed action would not affect a listed species or designated critical habitat.

Is not likely to adversely affect: The appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on the best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

Is likely to adversely affect: The appropriate finding if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial. In the effect the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action "is likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made.

Is likely to jeopardize proposed species/adversely modify proposed critical habitat – (Impairment): The appropriate conclusion when the action agency or the U.S. Fish and Wildlife Service identify situations in which the proposed action is likely to jeopardize the continued existence of a proposed species or adversely modify the proposed critical habitat

Alternative 1 (No Action) – Threatened and Endangered Species

Analysis: Under this alternative, conditions in the Fort Clatsop unit would remain unchanged.

Conclusion: No effect.

Impairment: There would be no impairment to park resources from this alternative.

Alternative 2 – Threatened and Endangered Species

Analysis: The only Threatened or Endangered species that could be impacted by the actions under this alternatives are fish that inhabit some of the creeks within the project area. Since all action alternatives include riparian buffer zones, there should be no impact to streams under any of the alternatives, and therefore no impact to listed fish species.

Conclusion: is not likely to adversely affect. There will be beneficial effects for

salmonids from improved watershed health.

Impairment: There will be no impairment to park resources under this alternative.

Alternative 3 – Threatened and Endangered Species

Analysis: impacts to T & E species under this alternative will be the same as those under alternative 2.

Conclusion: is not likely to adversely affect. There will be beneficial effects for salmonids from improved watershed health.

Impairment: There will be no impairment to park resources under this alternative.

AIR QUALITY

Related Laws, Regulations, and Policies

Lewis and Clark NHP is designated as a Class II Air Quality area under the *Clean Air Act (1997)*. The main purpose of this act is to protect and enhance the nation's air quality to promote the public health and welfare. The act establishes specific programs to provide protection for air resources and values, including the program to prevent significant deterioration of air quality in clean air regions of the country. Although Lewis and Clark NHP is designated as a Class II airshed area, the park strives to maintain the highest air quality standards, and project work within the historical park is completed in accordance with regional standards. However, the historical park does not possess sufficient autonomous authority to address issues of air quality improvements when air pollution originates outside the boundaries. NPS *Management Policies* direct parks to seek to perpetuate the best possible air quality to preserve natural and cultural resources, sustain visitor enjoyment, human health, and preserve scenic vistas (4.7). Parks are directed to comply with all federal, state, and local air quality regulations and permitting requirements.

Impact Indicators, Criteria, and Methodology

The impact categories are relevant to air quality issues related to forest management activities. Each category is discussed below relative to potential airborne pollution impacts from the alternatives on park resources and human health.

- **Negligible:** There is no perceptible impact on air quality.
- **Minor:** Exhaust from chainsaws or other mechanized equipment is perceptible during brief periods of time. Dust from the use of dirt roads is visible during brief periods. Mitigation is able to alleviate the impacts.
- **Moderate impacts:** Exhaust from chainsaws or other mechanized equipment is perceptible during extended periods. Dust from the use of dirt roads is visible for an extended area. Mitigation is able to alleviate the impacts.
- **Major impacts:** Exhaust from chainsaws or other mechanized equipment is easily detectable for extended periods of time in a large area. Dust from the use of dirt roads and equipment is visible for an extended period for an extended amount of time, and mitigation is unable to alleviate the conditions.
- **Impairment:** Air emissions contribute to continued violation of national standards. In addition, impacts have a major effect on park resources and values; contribute to the deterioration to the extent that the park's purpose cannot be fulfilled as established in its enabling legislation; affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning document.

Air quality impacts were qualitatively assessed after review of NPS best management practices to reduce air emissions in each alternative.

Alternative 1 (No-Action) - Air Quality

Analysis: The No-Action Alternative would have no foreseeable additional impacts on air quality.

Conclusion: Impacts would be negligible to non-existent. There should be no foreseeable cumulative impacts to air quality resulting from this alternative.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

Alternative 2 - Air Quality

Analysis: Active management under Alternative 2 would involve actions that could impact local air quality. Equipment use during thinning treatments would likely produce some additional exhaust resulting in localized reduction in air quality. These impacts would only be felt during active project periods and would dissipate quickly.

Conclusion: Restoration treatments involving thinning could result in minor adverse impacts that would generally be confined to the project area. Impacts from these activities would only be felt in the short-term and would not likely contribute to cumulative impacts on local air quality.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

Alternative 3 - Air Quality

Analysis: Like Alternative 2 short-term localized impacts to air quality could arise from equipment use during restoration treatments. Impacts would be minor and occur only during periods of active projects.

Conclusion: Restoration treatments involving thinning and biomass removal could result in minor adverse impacts that would generally be confined to the project area. Impacts from these activities would only be felt in the short-term and would not likely contribute to cumulative impacts on local air quality.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

VISITOR USE AND EXPERIENCE INCLUDING SOUNDSCAPE

Methodology

Personal observation of what is available to visitors under current management combined with information obtained from NPS personnel on visitation patterns, and applicable research were used to estimate the effects of the actions in the various alternatives.

Thresholds for Intensity, Duration, and Type of Effect:

- **Negligible:** Visitors would not likely be aware of the effects associated with changes proposed for visitor use and enjoyment of park resources.
- **Minor:** Visitors would likely be aware of the effects associated with changes proposed for visitor use and enjoyment of park resources; however the changes in visitor use and experience would be slight and likely short term. Other areas in the park would remain available for similar visitor experience
- **Moderate:** Visitors would be aware of the effects associated with changes proposed for visitor use and enjoyment of park resources. Changes in visitor use and experience would be readily apparent and likely long term. Some visitors who desire to continue their chosen activity would be required to pursue their choice in other available local or regional areas.
- **Major:** Visitors would be highly aware of the effects associated with changes proposed for visitor use and enjoyment of park resources. Changes in visitor use and experience would be readily apparent and long term. The change in visitor use and experience proposed in the alternative would preclude future generations of some visitors from enjoying park resources and values. Some visitors who desire to continue their chosen activity would be required to pursue other available local or regional areas.

Duration:

• **Short-Term:** During treatment
• **Long-Term**: Past treatment and 10 years into future.

Alternative 1 (No-Action) - Visitor Use and Experience

Analysis: Under the No-Action Alternative short-term impacts to visitor use and experience would be negligible. Adverse impacts could arise if dense stands become increasingly prone to windthrow and large blowdown patches continue to occur. Severity of blowdown impacts would depend on proximity to areas accessible to visitors but could be moderate to major if areas near trails are affected.

Conclusion: No-action would likely have negligible short term impacts to visitor use and experience. Long-term impacts would depend on location and severity of blowdown but could be moderate, adverse if trails or other visitor resources are affected.

Unacceptable Impacts: There would be no unacceptable impact on Lewis and Clark NHP's purpose, resources, or values from this alternative

Alternative 2 - Visitor Use and Experience

Analysis: Impacts to visitor use and experience under Alternative 2 could arise from thinning operations and increased potential for windthrow in the short-term. Noise from restoration activities could adversely impact visitor use and experience. Quieter alternatives, such as girdling trees with hand tools, could be used in areas near trails. Due to the small size of the Park, nearby activities such as logging, construction, and highway traffic already intrude on the visitor experience. Proposed actions would only be a temporary incremental addition to this background noise.

Another potential disruption to the visitor experience could result from temporary closures around project areas for safety concerns. Impacts from safety closures would be short-term.

Thinned forest stands could be more susceptible to windthrow in the short-term as trees adapt to growing with more wind exposure. Increased growth made possible by thinning should decrease the risk of catastrophic windthrow in the long-term as trees are better able to support themselves. Windthrow could cause temporary closures to trails if fallen trees pose a safety concern or block access.

The two new loop trails would enhance visitor experience by providing them more access to the Fort Clatsop unit.

Conclusion: Sound intrusions would be one primary adverse impact to visitor use and experience under Alternative 2. Impacts from sound would be adverse given the purpose of the park but could be limited to the short-term and minimized by adopting mitigation measures such as girdling by ax or handsaw instead of using chainsaws.

Impacts to visitor experience from safety closures would be isolated and short-term.

Visitor use could also be impacted by increased windthrow in the short-term. Short-term impacts could be moderate, adverse if they occur near trails or other accessible area.

Long term impacts should be beneficial as thinned stands would be more windfirm than untreated areas, and the forest will have an overall more natural, aesthetically pleasing appearance. The addition of two new loop trails will enhance visitor experience, enjoyment, and educational opportunities.

Unacceptable Impacts: There would be no unacceptable impact on Lewis and Clark NHP's purpose, resources, or values from this alternative

Alternative 3 - Visitor Use and Experience

Analysis: Like Alternative 2, the primary impacts to visitor use and experience could result from noise impacts, and windthrow risks. Under this alternative thinning with biomass removal would be possible, increasing the potential for intrusion of human caused sounds on the visitor experience. Quieter alternatives, such as girdling trees with hand tools, could be used in areas near trails.

Another potential disruption to the visitor experience could result from temporary closures around project areas for safety concerns. Impacts from safety closures would be short-term.

Thinned forest stands could be more susceptible to windthrow in the short-term as trees adapt to growing with more wind exposure. Increased growth made possible by thinning should decrease the risk of catastrophic windthrow in the long-term as trees are better able to support themselves. Windthrow could cause temporary closures to trails if fallen trees pose a safety concern or block access.

The new loop trails would enhance visitor experience by providing them more access to the Fort Clatsop unit. This will provide visitors with increased access to a variety of forested habitats.

Conclusion: Although Alternative 3 does allow possible biomass removal, impacts to visitor use and experience should be similar to Alternative 2. Minor short-term adverse impacts from noise would likely be one intrusion on visitor experience. Windthrow impacts could be minor to moderate in the short-term but should decrease in the long-term as treated forests become more windfirm. Long term impacts should be beneficial as thinned stands would be more windfirm than untreated areas, and the forest will have an overall more natural, aesthetically pleasing appearance. The loop trails will add to the long term benefit by increasing visitor access to the restored stands.

Unacceptable Impacts: There would be no unacceptable impact on Lewis and Clark NHP's purpose, resources, or values from this alternative

VISUAL RESOURCES

Methodology
Personal observation of what is available to visitors under current management combined with information obtained from NPS personnel on viewsheds, and applicable research were used to estimate the effects of the actions in the various alternatives.

Thresholds for Intensity, Duration, and Type of Effect:

- **Negligible:** Visitors would not likely be aware of the effects associated with changes in viewsheds or viewing opportunities.
- **Minor:** Visitors would likely be aware of the effects associated with changes proposed for
- Viewsheds and viewing opportunities; however the changes in visitor use and experience would be slight and likely short term. Other areas in the park would remain available for similar viewing opportunities and viewsheds.
- **Moderate:** Visitors would be aware of the effects associated with changes proposed for viewsheds and viewing opportunities. Changes in these would be readily apparent and likely long term.
- **Major:** Visitors would be highly aware of the effects associated with changes proposed for viewsheds and viewing opportunities. Changes in these would be readily apparent and long term. The change would preclude future generations of some visitors from enjoying wildlife viewing opportunities and or vistas. Some visitors who desire to see these would be required to pursue other available local or regional areas.

Duration:

- **Short-Term:** During treatment
- **Long-Term:** Past treatment and 10 years into future.

Alternative 1 (No-Action) - Visual Resources

Analysis: The No-Action Alternative should have negligible impacts to visual resources at Fort Clatsop. Forest would likely remain in their current state for an extended period with few perceivable changes.

Negative impacts to visual resources could indirectly arise in the event of large-scale blowdown or other large disturbance. No-action would likely increase the possibility of blowdown over time especially in young dense stands where trees are unable to develop the diameter growth needed to resist strong winds (Oliver and Larson 1996).

Conclusion: Short-term impacts to visual resources under the No-Action Alternative should be minor. However, no-action would leave many stands at higher risk of windthrow in the future resulting in moderate to major adverse impacts depending on the location and severity of wind damage.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

Alternative 2 - Visual Resources

Analysis: Direct impacts from forest restoration under Alternative 2 would primarily be from disturbance to vegetation caused by thinning. Impacts would include the sight of crushed vegetation, dead trees, downed logs, debris, and cut stumps. Mitigation efforts and planting could help to minimize visual disturbances. Still most visual impacts should be short-term as the increased light after thinning allows more re-growth of vegetation. Most visual impacts would be along areas of the Fort to Sea Trail and the two new proposed loop trails.

Additional impacts to visual resources could arise from windthrow in visible areas. Short-term windthrow risk would increase slightly in treated areas as trees adapt to additional wind exposure. However, long-term risk of windthrow impacts to visual resources should decrease as treated stands should be better able to resist wind damage (Oliver and Larson 1996). The perceived negative visual impact of wind-throw could be mitigated through education on the importance of wind as an ecological force, and windblown areas could be perceived positively.

Planting activities may also cause a visual disruption since tree shelters or other herbivory control methods could be required to successfully establish some species. Potential impacts could either be eliminated by limiting these activities to areas away from visitor access or by incorporating them into visitor education.

Conclusion: Direct visual impacts of actions under Alternative 2 would likely be minor to moderate adverse in project areas. However, visual impacts should be confined to the short-term. Long-term impacts should primarily be beneficial as vegetation grows back and forests mature.

Visual impacts due to wind could occur under any alternative. Treated stands may have a short-term increase in susceptibility to wind damage. Risk of windthrow should decrease over time compared to the No-Action Alternative.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

Alternative 3 - Visual Resources

Analysis: Visual impacts under Alternative 3 would be similar to Alternative 2 . Like Alternative 2, direct impacts to visual resources would primarily result from vegetation disturbance during restoration activities. Impacts would be confined to the short-term as vegetation is expected to rapidly grow back. If biomass is removed, the observation of heavy equipment and log-trucks would impact visual resources. This would be mitigated by spacing treatments apart in space and time, and taking the opportunity to educate visitors on why we are using various treatments.

Indirect impacts from wind disturbance would also be similar to Alternative 2 with an initial increase in wind risk due to treatment, but an overall decrease in risk in the long-term.

Conclusion: Actions under this alternative could have short-term adverse impacts on visual resources that would be primarily confined to active project areas. Visual impacts should dissipate rapidly and the long-term benefits should be positive. An initial period of increased windthrow risk may result in additional visual impacts if trees are blown over, however in the long-term visual impacts from windthrow should decrease. Long-term impacts should primarily be beneficial as vegetation grows back and forests mature.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative

SOCIOECONOMIC IMPACTS

Methodology
The Money Generation Model developed at Michigan State University, as well as past and projected future spending on forest management were used to determine socioeconomic impacts. A base economic impact of park operations of $2.2 million in wages and contracts and $10.1 million in visitor spending in the region was used to compare additional impacts.

Thresholds for Intensity, Duration, and Type of Effect:

- **Negligible:** Very slight economic impact. Impacts barely detectable.
- **Minor:** Economic impact would be measurable, although the changes would likely be small and the effects would be localized.
- **Moderate:** Economic impact would be measurable and potentially long-term, but would be relatively local.
- **Major:** Economic impacts would be measurable, long-term, and on a regional scale.

Duration:

- **Short-Term:** Impacts only during project implementation or of less than one year's duration.
- **Long-Term:** Impacts extend beyond project implementation and are longer than one year in duration.

Alternative 1 (No-Action) – Socioeconomic Impacts

Analysis: The No-Action Alternative would have no foreseeable addition to the economic impact provided by the national park unit.

Conclusion: Impacts would be negligible to non-existent. There should be no foreseeable cumulative impacts to economic impact resulting from this alternative.

Unacceptable Impacts: There would be no unacceptable economic impacts from this alternative.

Alternative 2 - Socioeconomic Impacts

Analysis: Under Alternative 2, the park could spend an additional $5,000 to $25,000 in project funds on forest treatments for 1 to 5 years. After 5 years, operations would be covered out of the park's base funding. These funds could be used to hire or contract silviculturists, landscape architects, sawyers, fallers, forest health monitors, or day laborers, depending upon project needs.

Conclusion: Alternative 2 would make a minor, long-term positive addition to the park's impact on the regional economy.

Unacceptable Impacts- There would be no unacceptable economic impacts from this alternative. There would be minor positive acceptable impacts from this alternative.

Alternative 3 - Socioeconomic Impacts

Analysis: As with the previous alternative, the park could spend an additional $5,000 to $25,000 in project funds on forest treatments for 1 to 5 years. These funds could be used to hire or contract silviculturists, landscape architects, sawyers, fallers, forest health monitors, or day laborers, depending upon project needs. After 5 years, operations would be covered out of the park's base funding and would not be additional funding allocated to the park. Alternative 3 may allow the removal of some biomass if scientific analysis determines that this removal would advance this project's restoration goals. The biomass might be removed through a cost-recovery contract, which would provide a minor, short-term benefit to the successful contractor.

Conclusion: Alternative 3 would make a minor, long-term positive addition to the park's impact on the regional economy.

Unacceptable Impacts- There would be no unacceptable economic impacts from this alternative. There would be minor positive acceptable impacts from this alternative.

HUMAN HEALTH AND SAFETY

Methodology
Human health and safety impacts were qualitatively assessed through determination of activities, equipment and conditions that could result in injury, literature review of type and extent of injury caused by equipment and conditions, and in light of mitigation measures and best management practices. When these criteria were not applicable, and in the absence of quantitative data, best professional judgment prevailed.

Thresholds for Intensity, Duration, and Type of Effect:

- **Negligible:** The impact to personnel and visitor safety is not measurable or perceptible.
- **Minor:** The impact to personnel and visitor safety is slight and temporary, but not sufficient to cause a permanent change in accident rates and can be immediately controlled by management actions in a timely manner.
- **Moderate:** The impact to personnel and visitor is slight and temporary, but could create a slight permanent increase in accident rates. The safety of park personnel and visitors can not be controlled immediately by park management, but control would occur within 24 hours.
- **Major:** The impact to personnel and visitor safety is sufficient to cause a permanent change in accident rates at existing low accident locations.

Duration:

- **Short-Term:** Impacts only during project implementation or of less than one year's duration.
- **Long-Term:** Impacts extend beyond project implementation and are longer than one year in duration.

Alternative 1 (No Action) – Human Health and Safety

Analysis: Under the no-action alternative, no additional work would occur in the woods. As the forests would remain in a wind-prone state, it is possible that future blowdown could impact the ability of visitors to access trails for exercising opportunities.

Conclusion: Impacts would be negligible to non-existent. There should be no foreseeable cumulative impacts to human health and safety resulting from this alternative.

Unacceptable Impacts: There would be no unacceptable impacts from this alternative.

Alternative 2 – Human Health and Safety

Analysis: Under this alternative, hand crews would use chainsaws, handsaws, loppers, chippers, and other potentially dangerous equipment. Strict adherence to equipment and procedural safety guidelines would minimize accidents. All crews would be thoroughly briefed on proper safety procedures, and proper PPE (personal protective equipment) would be used. These actions would mitigate the potential negative impacts on health and safety.

Negative impacts to visitors would be negligible, as work would usually occur outside of trail buffers, and if work was necessary near visitor use areas, appropriate short-term closures would be made if deemed necessary for visitor safety.

The addition of approximately 3 ½ miles of hiking trails will provide increased exercise opportunities for visitors.

Conclusion: Negative impacts would be negligible to minor due to adherence to strict safety guidelines. Long term impacts would be moderate, positive due to the creation of new hiking and walking trails.

Unacceptable Impacts: There would be no unacceptable impacts from this alternative.

Alternative 3 – Human Health and Safety

Analysis: Impacts would be the same as alternative two, with the possible addition of hazards resulting from yarding, cabling, and driving log trucks to remove biomass. These hazards would be mitigated by adhering to strict safety guidelines. Positive impacts to visitor health from the extension of the trail network would be the same as under alternative 2.

Conclusion: Negative impacts would be negligible to minor due to adherence to strict safety guidelines. Long term impacts would be moderate, positive due to the creation of new hiking and walking trails.

Unacceptable Impacts: There would be no unacceptable impacts from this alternative.

HISTORIC AND CULTURAL RESOURCES

Methodology

National Park Service guidance for the management of cultural resources is found in the Cultural Resource Management Guideline (1997) and 2006 Management Policies and references therein. With regard to fire management actions, archeological resources, structures, cultural landscapes and ethnographic resources are regulated principally by the National Historic Preservation Act (NHPA, 1966, as amended), and Section 106 in particular under the terms of the 2008 Programmatic Agreement among the National Park Service, Advisory Council on Historic Preservation (ACHP), and National Conference of State Historic Preservation Officers (http://www.achp.gov/2008%20NATIONWIDE%20PA%20-%20SIGNED.pdf). Other major legislation with pertinence includes the Archeological Resources Protection Act (ARPA, 1978, as amended) and Native American Graves Protection and Repatriation Act (NAGPRA, 1990). Proper management of museum objects is dictated through 36 CFR 79.

NEPA recognizes three types of impacts—direct, indirect, and cumulative. Direct impacts are those that are caused at the same time and place as the action, indirect impacts occur later in time and at a distance, while cumulative impacts are additive. In regard to cultural resources, direct, operational and indirect impact categories are utilized.

Under NEPA, impacts also vary in terms of intensity and duration, and can be adverse or beneficial, which stands in contrast to the NHPA. For the purpose of this analysis, negligible impacts are the equivalent of a *No Historic Properties Affected* determination; minor impacts to *No Adverse Affect*; and moderate and major impacts equate to *Adverse Affect* (as defined in 36 CFR 800.5). With some exceptions, the duration of impacts to cultural resources from forest management activities will be permanent or long-term.

Under the NHPA, historic properties, those listed or determined eligible for listing in the NRHP, are the cultural resources against which assessment of impacts are made. Lewis and Clark NHP will consider all cultural resources lacking formal evaluation for NRHP eligibility to be historic properties. It may also be the case, however, that certain cultural resources which do not qualify as historic properties are desirable to protect from potentially adverse impacts. This might include remnants of resources in park post-dated the Lewis and Clark expedition, but contribute important interpretive information on the lifeways of early visitors and residents. As such, the goal is to minimize the effects of forest management activities on those resources as well.

Thresholds for Intensity, Duration, and Type of Impact:

- **Negligible**: Impact is at the lowest levels of detection, barely perceptible, and not measurable.
- **Minor - Adverse**: Disturbance of archeological site(s) and/or alteration of a pattern(s) or feature(s) of the landscape results in little, if any, loss of integrity. The determination of effect for Section 106 would be *no adverse effect.*
- **Minor - Beneficial**: Maintenance and preservation of an archeological site(s). For Cultural Landscapes, landscape patterns and preservation of an archeological site(s). For Cultural Landscapes, landscape patterns and features preserved in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes. The determination of effect for Section 106 would be *no adverse effect.*

- **Moderate - Adverse**: Disturbance of archeological sites(s) and/or alteration of a pattern(s) or feature(s) of the landscape would result in an overall loss of integrity. The determination for Section 106 would be adverse effect. A memorandum of agreement is executed among NPS and applicable state or tribal historic preservation officer and, if necessary, the Advisory Council on Historic Preservation in accordance with 36CFR 800.6(b). Measures identified in the MOA to minimize or mitigate adverse impacts reduce the intensity of impact under NEPA from major to moderate.
- **Moderate - Beneficial**: Stabilization of a site and/or rehabilitation of a landscape or its patterns and features in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*. The determination of effect for Section 106 would be *no adverse effect*.
- **Major - Adverse**: Disturbance of archeological site(s) and/or alteration of a pattern(s) or feature(s) of the landscape would result in an overall loss of integrity. The determination of effect for Section 106 would be *adverse effect*. Measures to minimize or mitigate adverse impacts cannot be agreed upon and NPS and applicable state or tribal historic preservation officer and/or Advisory council are unable to negotiate and execute a memorandum of agreement in accordance with 36CFR800.6(b).
- **Major -Beneficial**: Active intervention to preserve a site and/or restore a landscape or its patterns and features in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*. The determination of effect for Section 106 would be *no adverse effect*.

Duration:

- **Short-Term:** Disturbance only during management activities.
- **Long-Term:** Disturbance lasting longer than management activities.

Alternative 1 (No-Action) - Cultural Resources

Analysis: Alternative 1 would not include active management of vegetation within the Fort Clatsop Unit and there would be no impacts to park cultural resources. The original landscape would not be restored to one representative of the forests that occupied the Clatsop homeland. Instead, the cultural landscape would be left in its current, impaired state.

Conclusion: This alternative would have negligible long-term negative impacts on historic and cultural resources due to its failure to recreate the historic forested setting of Fort Clatsop.

Impairment: There would be no impairment of historic or archeological resources. There would be no additional impairment of the forested cultural landscape.

Alternative 2 - Cultural Resources

Analysis: Under Alternative 2 active management would be used to restore forests in the Fort Clatsop Unit. Restoration activities in this alternative would limited to thinning without biomass removal throughout the unit. There would be no major ground disturbing activities such as road building, road removal, or heavy equipment operation

under this alternative. There would be ground disturbance due to contouring 3 miles of trail tread. Although most of the unit has been disturbed by commercial logging, there is still a potential for adverse impacts to cultural resources. NPS archeologist Leslie O'Rourke completed a survey and shovel probes of Forest Loop A and found no cultural material. NPS has made a determination of no adverse effect for the trail and consultation is in process with both affected Tribes and the Oregon SHPO.

This alternative would help to reverse the current impairment of the forested cultural landscape.

Conclusion: Forest treatments in alternative 2 and Trail Loop A would have no adverse effect on cultural resources. Forest treatments would have moderate beneficial effects on the forested cultural landscape. Surveys should be conducted and consultation completed before constructing Trail Loop B.

Impairment: There would be no impairment of Lewis and Clark NHP's resources or values from this alternative.

Alternative 3 - Cultural Resources

Analysis: Alternative 3 would involve thinning with the possibility of some biomass removal. Like the previous alternative, proposed actions would be occurring in areas that have already been extensively disturbed by previous land practices. There would be no major ground disturbing activities such as road building or road removal. Limited heavy equipment operation could be possible under this alternative. There would be ground disturbance due to contouring 3 miles of trail tread. Although most of the unit has been disturbed by commercial logging, there is still a potential for adverse impacts to cultural resources. NPS archeologist Leslie O'Rourke completed a survey and shovel probes of Forest Loop A and found no cultural material. NPS has made a determination of no adverse effect and consultation is in process with both affected Tribes and the Oregon SHPO.

This alternative would help to reverse the current impairment of the forested cultural landscape.

Conclusion: Forest treatments in alternative 3 that involve no ground disturbance and the construction of Trail Loop A would have no adverse effect on cultural resources. Forest treatments would have moderate beneficial effects on the forested cultural landscape. Surveys should be conducted and consultation completed before any treatments that involve ground disturbance and before constructing Trail Loop B.

Impairment: There would be no impairment of Lewis and Clark NHP's cultural resources or values from this alternative.

CONSULTATION AND COORDINATION

Scoping

Public Involvement

Preliminary public scoping for this EA was initiated in February of 2007. Press releases were sent to:

- Daily Astorian Newspaper
- Seaside Signal Newspaper
- Longview Daily News
- KUMN Radio
- New Northwest Broadcast Radio
- Coast River Business Journal
- Clatsop County Planning and Land Development
- Clatsop County Board of Commissioners
- City of Warrenton Community Development
- Lewis and Clark Fire District
- Weyerhaeuser
- Oregon Department of Forestry
- Oregon Department of Fish and Wildlife
- Oregon Department of Transportation
- Camp Rilea Oregon National Guard
- Fort Stevens State Park
- Trust for Public Land
- North Coast Land Conservancy
- Warrenton Trails Association
- Columbia River Estuary Study Task Force
- Lower Columbia River Estuary Partnership

The Daily Astorian further publicized the scoping effort in an article entitled “Returning the Forest to Its Natural State” by Tom Bennett on February 14, 2007.

A total of six written comments were received during this period and are on file in the Resources office at Lewis and Clark National Park. Five of the comments were supportive of the plan to re-establish a native coastal forest. One comment was not relevant and was an inquiry about the history of a parcel that is not within the park boundary or in the scope of the plan. One commenter's concerns about possible impact on streams are addressed in the plan through the use of riparian buffer zones in all action alternatives. Concern was also raised that the term “forest management plan” implies timber harvesting instead of the planned non-commercial thinning, habitat creation and planting; this was addressed by choosing the title “forest restoration plan” and discussing project objectives at the outset of the plan.

Regulatory Compliance

U.S. Fish and Wildlife Service

Section 7 of the ESA, Interagency Cooperation, is the process used to ensure that the actions taken by federal agencies do not jeopardize the existence of any listed species. This process is intended to involve the identification and resolution of species conflicts in the early stages of project planning. USFW consultation regarding federally listed species that occur within the Fort Clatsop Unit of the Lewis and Clark National Historical Park was initiated in February of 2007. Their initial response is found in Appendix B of this Environmental Assessment. Due to the amount of time that has lapsed, a fresh round of consultation was begun in May 2011.

State and Tribal Historic Preservation Officers

The NPS initiated the Section 106 consultation on March 15, 2011, when the park sent a letter and proposed design of an archeological survey of Trail A to the Oregon SHPO, Clatsop-Nehalem Confederated Tribes, Confederated Tribes of Siletz Indians, Confederated Tribes of the Grand Ronde and the Chinook Indian Nation. NPS will continue to consult with the Oregon SHPO, tribes, and interested parties, if appropriate, as part of its ongoing compliance with Section 106 consultation. NPS will undertake consultation through its established communication channels and practices.

Oregon Department of Environmental Quality

Before beginning ground disturbing work that is over an acre in size, such as Trail A, the park will obtain the necessary stormwater permits from the Oregon Department of Environmental Quality. Trail work will follow best management practices.

Review and Comment Period

There will be a 30-day comment period on the EA. The plan will be available at http://parkplanning.nps.gov/fova and http://www.nps.gov/lewi and at the following libraries:

Astoria Public Library
450 Tenth ST
Astoria, OR 97103-4699
503-325-7323

Warrenton Community Library
861 Pacific Drive
OR 97121
(503) 861-3919

Comments may be submitted online at: http://parkplanning.nps.gov/lewi, or in writing to the following address:

Lewis and Clark National Historical Park
92343 Fort Clatsop Road
Astoria, OR 97103

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Cover photo by Russ Greenburg

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APPENDICES

APPENDIX A
BIOLOGICAL ASSESSMENT

SPECIES ACCOUNTS AND HABITAT STATUS WITH EFFECTS

A.1 Background
This Biological Assessment (BA) was developed in accordance with Section 7 (c) (1) of the Endangered Species Act. This subsection requires Federal agencies to request information of the Secretary as to whether any species listed or proposed for listing might be present in the area of the proposed action. If the Secretary advises, based on the best scientific and commercial data available, that such species may be present, the requesting agency shall conduct a biological assessment for the purpose of identifying any endangered species or threatened species which is likely to be affected by the proposed action. For the subject project, documents relevant to the identified potentially affected species were reviewed for baseline information and life history requirements. Additional information was obtained by the Lewis and Clark NHP Resources Program Manager and other staff biologists through onsite observations and surveys. Impact analyses were based on several factors: the known or likely occurrence of a species or its habitat in the proposed project vicinity; direct physical loss of habitat; effective loss of habitat resulting from avoidance or abandonment due to construction activity or noise, and species sensitivity to human disturbance.

A.2 Defining Impact Areas
Alternative 3 in the Environmental Assessment is the preferred alternative and describes the proposed action. All action alternatives involve vegetation management within the Fort Clatsop unit of Lewis and Clark NHP – an area of land totaling approximately 1, 270.76 acres in size that includes the original Fort Clatsop and the boundary expansion purchased from Weyerhaeuser. The entire Fort Clatsop unit is made up of lands that were logged at least once and have a history of human disturbance. The boundaries of the Fort Clatsop unit will also serve as the boundaries for this biological assessment.

A.3 Findings
Specific species and habitat information presented below for the Fort Clatsop unit was developed by the Lewis and Clark NHP resources management staff, and documentation supporting much of the following information can be found on file in the Resource Management office. Direct effects as described in this report refer to mortality or disturbance that results in flushing, displacement, harassment for the animal, or removal of a plant species. Indirect effects refer to modification of habitat and/or effects to prey species.

A.4 Federally Listed Species (from USFWS Project Area Species List
Obtained and Dated February 7, 2007, with Reference #
18FF523F0C4510998825727B006BCF80).

Early coordination was conducted with the U.S. Fish and Wildlife Service (USFWS) in Portland, Oregon regarding federally threatened and endangered species that may be affected by the proposed project. In a letter dated February 7, 2007, the USFWS (as per Section 7(c) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) provided a list of species that may occur within the project area (Appendix B). List updated July 2, 2007.

• Columbian White-Tailed Deer—Federally listed as Endangered, historic reports have placed Columbian white-tailed deer as far west as Astoria in the Columbia River drainage. Anecdotal reports of whitetails in the vicinity of Astoria are received periodically by refuge biologists at the Columbian White-tailed Deer National Wildlife Refuge, but none have been confirmed. USFWS surveys have documented Columbian whitetail deer occurrence only as far west as Karlson Island in the Lewis and Clark Islands National Wildlife Refuge, approximately ten miles east of Astoria.

- Information Sources—Clark, Al. Refuge Manager, Columbian White-tailed Deer NWR (2002 pers com); and Verts, B. J. and Carraway, Leslie N. Land Mammals of Oregon. Berkeley: University of California Press, 1998.
- Direct Effects—None. Not present in or near project area.
- Indirect Effects—None.

• Marbled Murrelet—Federally listed as Threatened, marbled murrelets are year-round residents of nearshore waters along the west coast. Although they nest primarily in old-growth coniferous forests, they also have been found to nest in second-growth Sitka spruce/western hemlock forests in Tillamook and Clatsop Counties. Marbled murrelets have not been surveyed for or confirmed to occur within the Fort Clatsop Unit. While individual mature Sitka spruce trees exist within the park, there is not suitable contiguous habitat. Marbled murrelets have been noted within the vicinity of the park.

- Information Source—Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2003, 2006. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, Oregon. Federal Land Lease Approval Biological Assessment. February 2005. Washington State Parks and Recreation Commission. Bellevue, Wash: Parametrix Inc.
- Direct Effects—Species is not known or expected to occur in or near the project area, therefore no Direct Effects are expected to occur.
- Indirect Effects— None.

• Bald Eagle—Formerly listed as Threatened, bald eagles are year-round residents in the Columbia River estuary and are regularly observed along the Lewis and Clark River within and near Lewis and Clark NHP. An established nest, Lewis and Clark River site #824, located in UTM zone 10 at 5108250mN/ 433040mE, was one half mile east of the park. This tree blew down in the December 2007 storm, but a new nest has been constructed nearby. With the exception of 2005, this nest had successfully produced one to two fledglings each year since recordkeeping began in1998. The bald eagle was officially delisted on August 9, 2007. National management guidelines for continued nest protection delineate a 330 foot buffer around a nest tree with topographic or vegetative obstruction or a 600 foot buffer where there is a clear line of sight.

- Information Source—Maurice, Kevin. USFWS Oregon State Office (7/31/2007 pers com) and Isaacs, F.B. and R.G. Anthony. 2004. Bald Eagle nest locations and history of

use in Oregon and the Washington portion of the Columbia River Recovery Zone, 1971 through 2004. Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon, USA. .

- Direct Effects— No bald eagle nests occur within 660 feet of the project area, therefore no Direct Effects are expected to occur.
- Indirect Effects— None.

•Northern Spotted Owl—Federally listed as Threatened, spotted owls occur in all coniferous forest types at low to mid-elevations in western Oregon. Clatsop County spotted owl records since 1996 have documented presence of birds and active nest sites within the Nehalem River watershed only. No birds have been found within the Youngs Bay watershed during this time.

- Information Source—Scheuering, Eric. Zoologist/Data Manager, Oregon Natural Heritage Information Center – OSU, Portland, OR. (pers com 4/17/2007). Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2003, 2006. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, Oregon.
- Direct Effects— No individuals present at the location. None.
- Indirect Effects—None.

• Chum Salmon (Lower Columbia River)—Federally listed as Threatened, in 2007 juvenile chum were documented within Lewis and Clark NHP, utilizing the habitat in the South Clatsop Slough Restoration project.

- Information Source- Brenkman, S.J., S.C. Corbett, and P. Kennedy. 2007. Inventory of Fish Species in Lewis and Clark National Historic Park, Oregon. National Park Service, Olympic National Park, 600 East Park Avenue, Port Angeles, Washington 98362. Columbia River Estuary Study Taskforce (CREST) 2007.
- Direct Effects—No management activities will take place within riparian buffer zones. Therefore there will be no increased erosion or sedimentation into headwater streams, and no direct effects.
- Indirect Effects— None.

• Coho Salmon (Lower Columbia River) — Federally listed as Threatened, coho are present in the Lewis and Clark River and were documented in two of the park's streams in April 2005. Juvenile coho have been documented in the South Clatsop Slough restoration site in 2007.

- Information Sources—Brenkman, S. J., S. C. Corbett, and P. Kennedy (OLYM). 2007. Inventory of Fish Species in Lewis and Clark National Historic Park, Oregon. National Park Service, Olympic National Park. Columbia River Estuary Study Taskforce (CREST) 2007.
- Direct Effects—No management activities will take place within riparian buffer zones. Therefore there will be no increased erosion or sedimentation into headwater streams, and no direct effects.
- Indirect Effects— None.

•Steelhead (Upper Columbia River, Lower Columbia River, Middle Columbia River, Upper Willamette River, Snake River Basin)—Federally listed as Threatened, steelhead are present in the Youngs Bay watershed, and juveniles have been documented within the park at South Clatsop Slough.

- Information Source—Brenkman, S. J., S. C. Corbett, and P. Kennedy (OLYM). 2007. Inventory of Fish Species in Lewis and Clark National Historic Park, Oregon. National Park Service, Olympic National Park. Columbia River Estuary Study Taskforce (CREST) 2007.
- Direct Effects—No management activities will take place within riparian buffer zones. Therefore there will be no increased erosion or sedimentation into headwater streams, and no direct effects.
- Indirect Effects— None.

•Sockeye Salmon (Snake River)—Federally listed as Endangered, sockeye may be present seasonally in the Youngs Bay watershed, but have not been documented within the park.

- Information Source—Brenkman, S. J., S. C. Corbett, and P. Kennedy (OLYM). 2007. Inventory of Fish Species in Lewis and Clark National Historic Park, Oregon. National Park Service, Olympic National Park.
- Direct Effects—No management activities will take place within riparian buffer zones. Therefore there will be no increased erosion or sedimentation into headwater streams, and no direct effects.
- Indirect Effects— None.

•Chinook Salmon (Lower Columbia River, Upper Willamette River, Snake River)—Federally listed as Threatened ., Juvenile Chinook salmon have been documented within the park at the South Clatsop Slough restoration site and Trail (Perkins) Creek.

- Information Sources— Brenkman, S. J., S. C. Corbett, and P. Kennedy (OLYM). 2007. Inventory of Fish Species in Lewis and Clark National Historic Park, Oregon. National Park Service, Olympic National Park; Columbia River Estuary Study Taskforce (CREST) 2007.
- Direct Effects—No management activities will take place within riparian buffer zones. Therefore there will be no increased erosion or sedimentation into headwater streams, and no direct effects.
- Indirect Effects— None.

•Chinook salmon (Upper Columbia River)—Federally listed as Endangered. Chinook salmon have been documented in park streams.

- Information Source—Brenkman, S. J., S. C. Corbett, and P. Kennedy (OLYM). 2007. Inventory of Fish Species in Lewis and Clark National Historic Park, Oregon. National Park Service, Olympic National Park; Columbia River Estuary Study Taskforce (CREST) 2007.
- Direct Effects—No management activities will take place within riparian buffer zones. Therefore there will be no increased erosion or sedimentation into headwater streams, and no direct effects.
- Indirect Effects— None.

•Oregon Silverspot Butterfly—Federally listed as Threatened, the Oregon silverspot butterfly occupied early successional coastal grasslands on Clatsop Plains in Clatsop County. Its historic population center on the plains is approximately 8 kilometers (5 miles) long and 1.6 kilometers (1 mile) wide, extending from Camp Rilea on the north to the Gearhart Golf Course on the south.

The Oregon silverspot population on Clatsop Plains has declined in recent years' surveys, with only a single adult documented in 1998, near Camp Rilea, previously the species' population stronghold within the county. The project site contains no coastal grassland habitat.

- Information Sources—U.S. Fish and Wildlife Service. 2001. Oregon silverspot butterfly (*Speyeria zerene hippolyta*) revised recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon; and VanBuskirk, R. 1998. Survey for the presence of the Oregon Silverspot Butterfly, *Speyeria zerene hippolyta* (Lepidoptera, Nymphalidae) on the Clatsop Plains in 1998. University of California. The Nature Conservancy, Portland, Oregon.
- Direct Effects—No individuals or habitat present at the project location. None.
- Indirect Effects—None.

•Howellia—Federally listed as Threatened, this aquatic plant occurs in freshwater ponds and lakes. Historic collections of the species have been made from Sauvie Island, Multnomah County (1879, 1886), Marion County (1977), and Clackamas County (1892), all within Oregon's Willamette Valley. There are no known extant occurrences in Oregon, and the species has not been found on the coast.

- Information Sources— Brian, Nancy. Endangered Species Specialist – Botanist, National Park Service, Fort Collins, CO (pers com 5/14/2007). Vrilakas, Sue. Botanist/Data Manager, Oregon Natural Heritage Information Center – OSU, Portland, OR. (pers com 4/12/2007).
- Direct Effects—None.
- Indirect Effects—None.

A.5 No State-listed plant species within areas of the proposed action or alternatives.

A.5.1 Plant References:

• Sayce, Kathleen. Columbia Coast Vascular Plants: Pacific and Wahkiakum Counties, Washington and Clatsop County, Oregon. Nahcotta, Washington: Shoalwater Botanical, 2001.

• Thomas, Duncan W. The Vascular Flora of the Columbia River Estuary. The Wasmann Journal of Biology 42 (1-2), 1984, pp. 92-106.

• Oregon Natural Heritage Program, 2007. Rare, Threatened, and Endangered Species of Oregon; Oregon Natural Heritage Program, Portland, Oregon

A.5.2 PROPOSED SPECIES

None

A.5.3 CANDIDATE SPECIES

•Streaked Horned Lark—Streaked horned lark are reported to be a local and irregular breeding species on the north Oregon coast, especially on the South Jetty of the Columbia River and estuary dredge spoil islands including Rice Island, Miller Sands and Jim Crow Island. Preferred habitat includes estuarine tidal flats, beaches, dunes and sparsely vegetated dredge spoils. The species has not been documented to occur within the park.

- Information Sources—Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2003, 2006. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, Oregon. 768 pp. Patterson, J.M. 2006-2007 Lewis and Clark NHP Bird Survey. National Park Service, Lewis and Clark National Historical Park.
- Direct Effects—No individuals or habitat present at the project location. None.
- Indirect Effects—None.

A.5.4 SPECIES OF CONCERN

• Voles—The white-footed vole was historically documented within the Fort Clatsop Unit in 1940, but has not been found in more recent park small mammal surveys (1993, 2001). This species is most frequently found in riparian (especially alder) habitat within coniferous forests. Small clearings with forb growth may also provide important habitat. Red tree voles are found along the coast in Sitka spruce forests that contain some Douglas fir, since their diet consists almost exclusively of its needles, and to a lesser extent those of western hemlock, spruce and fir. They have not been found within the park.

- Information Sources—Csuti, Blair [et al.] *Atlas of Oregon Wildlife: distribution, habitat and natural history*. Corvallis: Oregon State University Press, 1997; Ek, David. A Selection of Rare Wildlife Species, or Species of Concern, within Clatsop County, Oregon. NPS: FOCL, 2/1997; and Museum of Vertebrate Zoology. Mammals from Accn. 6310 (Clatsop Co., Oregon) in MVZ Collections, 7/95.
- Direct Effects— No individuals present at the location. None.
- Indirect Effects— None.

• Bats— Fringed, Townsend's big-eared bat, long-eared, long-legged and Yuma myotis were mist-netted in coniferous forest habitat near the Fort Clatsop replica during 1995 surveys. Vouchers of these species were obtained during an earlier 1940 mammal survey of the site. A park mammal survey in 2001 netted a single long-eared myotis at Clay Pit Pond. Pacific big-eared bats have not been found within the Fort Clatsop Unit. A 1958 Clatsop County record reports a Cannon Beach collection location for the species. West of the Oregon Cascades, the bats are associated with moderate to older coniferous forests. They are reported to be very intolerant of human disturbance. Silver-haired bats have not been found within the park. These bats occur throughout Oregon except most areas of the Columbia Basin. Their primary habitat is older Douglas fir/western hemlock forests with riparian forage areas.

- Information Sources—Csuti, Blair [et al.] Atlas of Oregon Wildlife: distribution, habitat and natural history. Corvallis: Oregon State University Press, 1997; Ek, David. A Selection of Rare Wildlife Species, or Species of Concern, within Clatsop County, Oregon. NPS: FOCL, 2/1997; Mammals from Accn. 6310 (Clatsop County, Oregon) in MVZ Collections, 7/95; Petterson, Jim. Fort Clatsop Small Mammal Inventory, 2001. National Park Service, Mount Rainier National Park, 3/2002; and Verts, B. J. and Carraway, Leslie N. Land Mammals of Oregon. Berkeley: University of California Press, 1998.
- Direct Effects— Short term habitat disturbance may have a negative effect on some individuals. Untreated refugia areas will provide temporary undisturbed habitat.
- Indirect Effects— Over time, the structural and biological complexity which will be restored to the forests will have a positive effect on the overall survival of populations.

• Band-Tailed Pigeon—Band-tailed pigeons are present throughout the Columbia River estuary. Their preferred habitats are closed-canopy forest for nesting, open-canopy forests for foraging and mineral sites. They are highly mobile and may travel 32 miles from nest locations to food or mineral sites. Band-tailed pigeons have been documented during linear transect surveys at the project site and elsewhere in the park.

- Information Sources— Patterson, J.M. 2006-2007 Lewis and Clark NHP Bird Survey. National Park Service, Lewis and Clark National Historical Park; Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2003, 2006. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, Oregon; and Oregon Breeding Bird Atlas, 1995-1999.
- Direct Effects— Short term habitat disturbance may have a negative effect on some individuals. Untreated refugia areas will provide temporary undisturbed habitat.
- Indirect Effects— Over time, the structural and biological complexity which will be restored to the forests will have a positive effect on the overall survival of populations.

• Olive-Sided Flycatcher—Olive-sided flycatchers are summer residents in coniferous forests of the Columbia River estuary. They are most frequently found in open coniferous forests with tall snags for perching. The birds have been documented during linear transect surveys at the project site and elsewhere in the park.

- Information Sources—Patterson, J.M. 2006-2007 Lewis and Clark NHP Bird Survey. National Park Service, Lewis and Clark National Historical Park; Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2003, 2006. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, Oregon; and Oregon Breeding Bird Atlas, 1995-1999.
- Direct Effects— Short term habitat disturbance may have a negative effect on some individuals. Untreated refugia areas will provide temporary undisturbed habitat.
- Indirect Effects— Over time, the structural and biological complexity which will be restored to the forests will have a positive effect on the overall survival of populations.

• Purple Martin— Purple martins are summer residents in the Columbia River estuary, nesting and feeding primarily in riparian habitats. The birds were documented on the Lewis and Clark River within the park during a 2006 survey and more recently have been noted to be nesting in piling near the park's Netul Landing site.

- Information Sources— Patterson, J.M. 2006-2007 Lewis and Clark NHP Bird Survey. National Park Service, Lewis and Clark National Historical Park; Oregon Breeding Bird Atlas, 1995-1999; and Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2003, 2006. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, Oregon.
- Direct Effects— Short term habitat disturbance may have a negative effect on some individuals. Untreated refugia areas will provide temporary undisturbed habitat.
- Indirect Effects— Over time, the structural and biological complexity which will be restored to the forests will have a positive effect on the overall survival of populations.

• Northern Red-Legged Frog—Numerous observation and voucher records document the occurrence of northern red-legged frogs in park forest and riparian habitats. Suitable wetland

habitat is scattered across the project area and it is probable all sites have populations of red-legged frogs nearby.

- Information Source— Layes, Michael (Mount Rainier National Park). 2005 Lewis and Clark NHP Amphibian Survey. National Park Service, Lewis and Clark National Historical Park.
- Direct Effects— Short term habitat disturbance may have a negative effect on some individuals. Untreated refugia areas will provide temporary undisturbed habitat.
- Indirect Effects— Over time, the structural and biological complexity which will be restored to the forests will have a positive effect on the overall survival of populations.

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• Green Sturgeon—Green sturgeon occur in mixing and seawater salinity zones within the Columbia River estuary, but no records document them in the Lewis and Clark River. Green sturgeon have not been found in streams within the Fort Clatsop Unit.

- Information Source—Bottom, Daniel L., Jones, Kim K., Herring, Margaret J. 1984. Fishes of the Columbia River Estuary: Final Report on the Fish Work Unit of the Columbia River Estuary Data Development Program. Dept. of Fish and Wildlife Research and Development, Corvallis, Oregon; Samuel J. Brenkman, Stephen C. Corbett, and Philip R. Kennedy. 2007. Inventory of Fish Species in Lewis and Clark National Historic Park, Oregon. National Park Service, Olympic National Park, 600 East Park Avenue, Port Angeles, Washington 98362.
- Direct Effects—No management activities will take place within riparian buffer zones. Therefore there will be no increased erosion or sedimentation into headwater streams, and no direct effects.
- Indirect Effects— None.

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• River Lamprey—River lamprey have not been confirmed to exist in streams within the project area, although a 2002 fish survey of Hansen Creek netted a juvenile lamprey of unknown identity. Alder Creek within the Fort Clatsop Unit and South Clatsop Slough are potential habitat, as well as the Lewis and Clark River.

- Information Sources—Bottom, Daniel L., Jones, Kim K., Herring, Margaret J. 1984. Fishes of the Columbia River Estuary: Final Report on the Fish Work Unit of the Columbia River Estuary Data Development Program. Dept. of Fish and Wildlife Research and Development, Corvallis, Oregon; and FOCL Fish Survey, Hansen Creek, 2/2002.; Samuel J. Brenkman, Stephen C. Corbett, and Philip R. Kennedy. 2007. Inventory of Fish Species in Lewis and Clark National Historic Park, Oregon. National Park Service, Olympic National Park, 600 East Park Avenue, Port Angeles, Washington 98362.
- Direct Effects—No management activities will take place within riparian buffer zones. Therefore there will be no increased erosion or sedimentation into headwater streams, and no direct effects.
- Indirect Effects— None.

• Western Brook Lamprey—Western brook lamprey were observed in the 2005 Lewis and Clark NHP fish survey in Trail (Perkins) creek within the proposed project area. Other small streams within Lewis and Clark NHP may also have suitable habitat but Western brook lamprey have not

been observed in other streams.

- Information Sources—Bottom, Daniel L., Jones, Kim K., Herring, Margaret J. 1984. Fishes of the Columbia River Estuary: Final Report on the Fish Work Unit of the Columbia River Estuary Data Development Program. Dept. of Fish and Wildlife Research and Development, Corvallis, Oregon; and FOCL Fish Survey, Hansen Creek, 2/2002.; Samuel J. Brenkman, Stephen C. Corbett, and Philip R. Kennedy. 2007. Inventory of Fish Species in Lewis and Clark National Historic Park, Oregon. National Park Service, Olympic National Park, 600 East Park Avenue, Port Angeles, Washington 98362.
- Direct Effects—No management activities will take place within riparian buffer zones. Therefore there will be no increased erosion or sedimentation into headwater streams, and no direct effects.
- Indirect Effects— None.

• Pacific Lamprey—Pacific lamprey have been found in Youngs Bay, but have not been confirmed in streams within the Fort Clatsop Unit, although a 2002 fish survey of Hansen Creek netted a juvenile lamprey of unknown identity. Several small streams in the project area may provide suitable habitat for Pacific lamprey.

- Information Sources—Bottom, Daniel L., Jones, Kim K., Herring, Margaret J. 1984. Fishes of the Columbia River Estuary: Final Report on the Fish Work Unit of the Columbia River Estuary Data Development Program. Dept. of Fish and Wildlife Research and Development, Corvallis, Oregon. FOCL Fish Survey, Hansen Creek, 2/2002.; Samuel J. Brenkman, Stephen C. Corbett, and Philip R. Kennedy. 2007. Inventory of Fish Species in Lewis and Clark National Historic Park, Oregon. National Park Service, Olympic National Park, 600 East Park Avenue, Port Angeles, Washington 98362.
- Direct Effects—No management activities will take place within riparian buffer zones. Therefore there will be no increased erosion or sedimentation into headwater streams, and no direct effects.
- Indirect Effects— None.

•Coastal Cutthroat (Columbia River, Oregon Coast, Upper Willamette River)—Cutthroat trout have been documented in three park streams (Colewort, Alder, and Perkins Creeks).

- Information Sources—Brenkman, Samuel J., Stephen C. Corbett, and Philip Kennedy (OLYM). 2007. Inventory of Fish Species in Lewis and Clark National Historic Park, Oregon. National Park Service, Olympic National Park. CREST survey data, 2009.
- Direct Effects—No management activities will take place within riparian buffer zones. Therefore there will be no increased erosion or sedimentation into headwater streams, and no direct effects.
- Indirect Effects— None.

• Additional Species—The following animal and plant species have not been documented to occur within the project area: Steller sea lion, western snowy plover, brown pelican, short-tailed albatross, Lewis' woodpecker, mountain quail, tailed frog, Oregon coast steelhead, pink sand verbena, Saddle Mountain bitter cress, Chamber's paintbrush, Willamette Valley larkspur, frigid shootingstar, queen-of-the-forest, Saddle Mountain saxifrage, Henderson sidalcea, bristly-

stemmed sidalcea and the moss species Limbella fryei.

Determinations for each Federally Listed Species:

• Columbian White-Tailed Deer—No individuals or habitat present in or near the project area, therefore the determination is no effect.

• Marbled Murrelet—No individuals or habitat present in or near the project area, therefore the determination is no effect.

• Bald Eagle—The project site is outside of the mandatory disturbance distances indicated in the 1986 Pacific Bald Eagle Recovery Plan. Some flushing or minor disturbance could occur if individual eagles are roosting or feeding within the general vicinity of the project area. The documented active nest is also in the direct flight path of the Astoria airport which presents a constant noise and visual presence to the eagles occupying the nest. This coupled with farming activities and active roadways nearby indicate a high level of tolerance by these birds. The determination of the possible effects of this project are may affect, not likely to adversely affect.

• Chum Salmon and Chinook salmon—All required and available measures will be implemented to mitigate potential increased run-off from the project site that could increase sediment flow into the Lewis and Clark River. Existing storm flow containment features and engineered wetlands will be utilized to catch and store run-off from the site. Any potential effects should be minimal in scope and duration. Long-term stabilization and improvement of this area compared to its current existing degraded condition should improve riparian and aquatic conditions at and downstream of this site. The determination of the possible effects of this project on all salmonid species are may effect, not likely to adversely affect.

• Oregon Silverspot Butterfly—Neither individuals nor habitat are known or expected to occur in or near the project area, therefore determination of effects are no effect.

• Howellia—Neither individuals nor habitat are known or expected to occur in or near the project area, therefore determination of effects are no effect.

Lewis and Clark NHP Special Status Species List:

Fish Species

Name	Scientific Name	ESU	Federal Status	ODFW Status
Green sturgeon	*Acipenser medirostris*		SOC	none
Riffle sculpin	*Cottus gulosus*		none	none
Reticulate sculpin	*Cottus perplexus*		none	none
Western brook lamprey	*Lampetra richardsoni*		none	SV
Coastal cutthroat trout	*Oncorhynchus clarki*	SW Washington/Columbia River	SOC	SV
		Upper Willamette River	SOC	none
Chum salmon	*Oncorhynchus keta*	Columbia River	LT	SC
Coho salmon	*Oncorhynchus kisutch*	Lower Columbia River	LT	LE
Steelhead	*Oncorhynchus mykiss*	Snake River Basin	LT	SV
		Lower Columbia River	LT	SC
		Upper Columbia River	LT	
		Middle Columbia River, summer	LT	SC
		Middle Columbia River, winter	LT	none
		Upper Willamette River	LT	SC
Chinook salmon	*Oncorhynchus tshawytscha*	Snake River, fall	LT	LT
		Snake River, spring/summer	LT	LT
		Lower Columbia River, fall/spring	LT	SC
		Upper Columbia River, spring	LE	none
		Upper Willamette River	LT	SC
Eulachon	*Thaleichthys pacificus*		LT	none

Amphibian Species

Name	Scientific Name	Federal Status	ODFW Status
Cope's giant salamander	*Dicamptodon copei*	none	SV
Pacific giant salamander	*Dicamptodon tenebrosus*	none	none
Dunn's salamander	*Plethodon dunni*	SOC	none
Northern red-legged frog	*Rana aurora aurora*	SOC	none- coast populations
Columbia torrent salamander	*Rhyacotriton kezeri*	SOC	SV

Bird Species

Name	Scientific Name	Federal Status	ODFW Status
Western grebe	*Aechmophorus occidentalis*	none	none
Great egret	*Ardea alba*	none	none
Great blue heron	*Ardea herodias*	none	none
Marbled murrelet	*Brachyramphus marmoratus*	LT	LT
Green heron	*Butorides virescens*	none	none
Turkey vulture	*Cathartes aura*	none	none
Rhinoceros auklet	*Cerorhinca monocerata*	none	SV
Western snowy plover	*Charadrius alexandrinus nivosus*	LT	LT
Olive-sided flycatcher	*Contopus cooperi*	SOC	SV
Pileated woodpecker	*Dryocopus pileatus*	none	none
Little willow flycatcher	*Empidonax trailli brewsteri*	none	SV
Merlin	*Falco columbarius*	none	none
American peregrine falcon	*Falco peregrinus anatum*	delisted LE 1999	SV
Common loon	*Gavia immer*	none	none
Black oystercatcher	*Haematopus bachmani*	none	SV
Bald eagle	*Haliaeetus leucocephalus*	delisted LT 2007	LT
Harlequin duck	*Histrionicus histrionicus*	SOC	none
Osprey	*Pandion haliaetus*	none	none
Band-tailed pigeon	*Patagioenas fasciata*	SOC	none
Brown pelican	*Pelecanus occidentalis californicus*	delisted LE 2009	LE
Brandt's cormorant	*Phalacrocorax penicillatus*	none	none
Horned grebe	*Podiceps auritus*	none	none
Red-necked grebe	*Podiceps grisegena*	none	SC, breeding population
Purple martin	*Progne subis*	SOC	SC
Caspian tern	*Sterna caspia*	none	none
Common murre	*Uria aalge*	none	none

Mammal Species

Name	Scientific Name	Federal Status	ODFW Status
White-footed vole	*Arborimus albipes*	SOC	none
Townsend's big-eared bat	*Plecotus townsendii townsendii*	SOC	SC
Hoary bat	*Lasiurus cinereus*	none	SV

California myotis	*Myotis californicus*	none	SV
Long-eared myotis	*Myotis evotis*	SOC	none
Fringed myotis	*Myotis thysanodes*	SOC	SV
Long-legged myotis	*Myotis volans*	SOC	SV
Yuma myotis	*Myotis yumanensis*	SOC	none
Harbor seal	*Phoca vitulina*	none	none
Marsh shrew	*Sorex bendiri*	none	none

Vascular Plant Species

Name	Scientific Name	Federal Status	ODFW Status
Coyote brush	*Baccharis pilularis*	none	none
Ocean-bluff-bluegrass	*Poa unilateralis*	none	none

USESA Status Codes:

LE	Listed Endangered. In danger of extinction.
LT	Listed Threatened. Likely to become endangered.
PE	Proposed Endangered.
PT	Proposed Threatened.
C	Candidate species. Sufficient information exists to support listing as Endangered or Threatened.
SOC	Species of Concern. Conservation status is of concern, but additional information is needed.
PS	Partial Status. Taxa for which some, but not all, infraspecific taxa have status.

ODFW Status Codes:

LE	Endangered. In danger of becoming extinct or extirpated from Oregon.
LT	Threatened. Likely to become endangered in Oregon.
SC	Sensitive Critical; species for which listing as threatened or endangered would be appropriate if immediate conservation actions were not taken. Some peripheral species, at risk throughout their range and some disjunct populations are also considered Critical.
SV	Sensitive Vulnurable; species not in imminent danger of being listed as threatened or endangered, but with the potential to become so with changes in populations, habitat or threats
SP	Sensitive Peripheral or Naturally Rare; species on the edge of their range or with historically low population numbers in Oregon
SU	Status Undetermined; potentially susceptible species for which status is unclear.

WDFW Status Codes:

E	Endangered. In danger of becoming extinct or extirpated from Washington.
T	Threatened. Likely to become endangered in Washington.
S	Sensitive. Vulnerable or declining and could become Endangered or Threatened.
C	Candidate. Under review for listing.
M	Monitor. Taxa of potential concern.

Data Sources:

Bald Eagle; Removal of the Bald Eagle from the Federal List of Endangered and Threatened Wildlife. August 8, 2007 (50 CFR Part 17)

Brown Pelican; Removal of the Brown Pelican from the Federal List of Endangered and Threatened Wildlife. December 17, 2009 (74 FR 220, 50 CFR Part 17)

Eulachon USFWS proposed listing March 13, 2009 (50 CFR Part 223)

Oregon Natural Heritage Information Center. 2007. Rare, Threatened and Endangered Species of Oregon. Oregon State University, Portland, OR. http://oregonstate.edu/ornhic/documents/2007_t&e_book.pdf

ORNHIC Animal Updates, May 2009. animals_final_pub_Spr09.xls

ORNHIC Vascular Plant Updates, May 2009. Plants_Update_Sp09_final-Vascular.pdf

Peregrine Falcon; Removal of the Peregrine Falcon from the Federal List of Endangered and Threatened Wildlife. August 25, 1999 (64 FR 46542)

U.S. Fish and Wildlife Service, Oregon Fish and Wildlife Office. May 23, 2009. Federally Listed, Proposed, Candidate Species and Species of Concern under the jurisdiction of the Fish and Wildlife Service which may occur within Clatsop County, Oregon.

U.S. Fish and Wildlife Service, Western Washington Fish and Wildlife Office. Endangered, Threatened, Proposed, and Candidate Species, Critical Habitat, and Species of Concern in Western Washington. http://www.fws.gov/wafwo/pdf/species_list_Aug2007.pdf

Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. http://wdfw.wa.gov.hab/psh_list_2008.pdf

Washington Natural Heritage Program. 2009. List of Plants Tracked by the WNHP. http://www1.dnr.wa.gov/nhp/refdesk/lists/plantrnk.html

APPENDIX B
USFWS LETTERS

Printed on 100 percent chlorine free/60 percent post-consumer content paper.
United States Department of the Interior
FISH AND WILDLIFE SERVICE
Oregon Fish and Wildlife Office
2600 SE 98th Avenue, Suite 100
Portland, Oregon 97266
Phone: (503)231-6179 FAX: (503)231-6195

Reply To: 8330.SP02 (07) February 7, 2007

Scott Stonum
Lewis and Clark National Historic Park
92343 Fort Clatsop Rd.
Astoria, OR 97103

Subject: Fort Clatsop Management Plan/EA Project
USFWS Reference # 18FF523F0C4510998825727B006BCF80

Dear Mr. Scott Stonum:

This is in response to your request, dated February 7, 2007, requesting information on listed and proposed endangered and threatened species that may be present within the area of the Fort Clatsop Management Plan/EA Project in Clatsop County(s). The Fish and Wildlife Service (Service) received your correspondence on February 7, 2007.
Attached is a list (Enclosure A) of threatened and endangered species that may occur within the area of the Fort Clatsop Management Plan/EA Project. The list fulfills the requirement of the Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). National Park Service requirements under the Act are outlined in Enclosure B.
The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems on which they depend may be conserved. Under section 7(a)(1) and 7(a)(2) of the Act and pursuant to 50 CFR 402 *et seq.*, the National Park Service is required to utilize their authorities to carry out programs which further species conservation and to determine whether projects may affect threatened and endangered species, and/or critical habitat. A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) which are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (NEPA) (42 U.S.C. 4332 (2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to the Biological Assessment be prepared to determine whether they may affect listed and proposed species. Recommended contents of a Biological Assessment are described in Enclosure B, as well as 50 CFR 402.12.
If the National Park Service determines, based on the Biological Assessment or valuation, that threatened and endangered species and/or critical habitat may be affected by the project, the National Park Service is required to consult with the Service following the requirements of 50

CFR 402 which implement the Act.

Enclosure A includes a list of candidate species under review for listing. The list reflects changes to the candidate species list published May 11, 2005, in the Federal Register (Vol. 69, No. 86, 24876) and the addition of "species of concern." Candidate species have no protection under the Act but are included for consideration as it is possible candidates could be listed prior to project completion. Species of concern are those taxa whose conservation status is of concern to the Service (many previously known as Category 2 candidates), but for which further information is still needed.
If a proposed project may affect only candidate species or species of concern, the National Park Service is not required to perform a Biological Assessment or evaluation or consult with the Service. However, the Service recommends minimizing impacts to these species to the extent possible in order to prevent potential future conflicts. Therefore, if early evaluation of the project indicates that it is likely to adversely impact a candidate species or species of concern, the National Park Service may wish to request technical assistance from this office.

Your interest in endangered species is appreciated. The Service encourages the National Park Service to investigate opportunities for incorporating conservation of threatened and endangered species into project planning processes as a means of complying with the Act. If you have questions regarding your responsibilities under the Act, please contact Kevin Maurice at (503) 231-6179. All correspondence should include the above referenced file number. For questions regarding salmon and steelhead trout, please contact NOAA Fisheries Service, 525 NE Oregon Street, Suite 500, Portland, Oregon 97232, (503) 230-5400.

For future species list requests, please visit our website (http://www.fws.gov/oregonfwo/Species/RequestList.asp) for instructions on how to make requests.

Enclosures
Enclosure A: Clatsop COUNTY.PDF
Enclosure B: EnclosureB_Federal_Agencies_Responsibilities.PDF

ENCLOSURE A

FEDERALLY LISTED THREATENED, ENDANGERED, PROPOSED, CANDIDATE SPECIES AND SPECIES OF CONCERN WHICH MAY OCCUR WITHIN CLATSOP COUNTY, OREGON

LISTED SPECIES*i*

Mammals		
Steller (=northern) sea lion	*Eumetopias jubatus*	T*
Columbian white-tailed deer	*Odocoileus virginianus leucurus*	E
Birds		
Marbled murrelet*ii*	*Brachyramphus marmoratus*	CH T
Western snowy plover (coastal pop.)*iii*	*Charadrius alexandrinus nivosus*	T
Bald eagle*iv*	*Haliaeetus leucocephalus*	T
Brown pelican	*Pelecanus occidentalis*	E
Short-tailed albatross*v*	*Phoebastria (=Diomedea) albatrus*	E
Northern spotted owl*vi*	*Strix occidentalis caurina*	CH T
Fish		
Chum salmon (Columbia River)*vii*	*Oncorhynchus keta*	T*
Coho salmon (Lower Columbia River)*viii*	*Oncorhynchus kisutch*	T*
Steelhead (Lower Columbia River)*ix*	*Oncorhynchus mykiss* ssp.	T*
Steelhead (Snake River Basin)*x*	*Oncorhynchus mykiss* ssp.	T*
Steelhead (Middle Columbia River)*xi*	*Oncorhynchus mykiss* ssp.	T*
Steelhead (Upper Columbia River)*xii*	*Oncorhynchus mykiss* ssp.	E*
Steelhead (Upper Willamette River)*xiii*	*Oncorhynchus mykiss* ssp.	T*
Sockeye salmon (Snake River)*xiv*	*Oncorhynchus nerka*	CH E*
Chinook salmon (Lower Columbia River)*xv*	*Oncorhynchus tshawytscha*	T*
Chinook salmon (Upper Columbia River)*xvi*	*Oncorhynchus tshawytscha*	E*
Chinook salmon (Upper Willamette River)*xvii*	*Oncorhynchus tshawytscha*	T*
Chinook salmon (Snake River) *xviii*	*Oncorhynchus tshawytscha*	CH T*
Invertebrates		
Oregon silverspot butterfly	*Speyeria zerene hippolyta*	T
Plants		
Howellia	*Howellia aquatilis*	T

PROPOSED SPECIES

None

CANDIDATE SPECIES*xix*

Birds	
Streaked horned lark	*Eremophila alpestris strigata*

SPECIES OF CONCERN

Mammals	
White-footed vole	*Arborimus albipes*
Red tree vole	*Arborimus longicaudus*
Pacific western big-eared bat	*Corynorhinus townsendii townsendii*
Silver-haired bat	*Lasionycteris noctivagans*

Long-eared myotis (bat)	*Myotis evotis*
Fringed myotis (bat)	*Myotis thysanodes*
Long-legged myotis (bat)	*Myotis volans*
Yuma myotis (bat)	*Myotis yumanensis*
Birds	
Band-tailed pigeon	*Columba fasciata*
Olive-sided flycatcher	*Contopus cooperi*
Lewis' woodpecker	*Melanerpes lewis*
Mountain quail	*Oreortyx pictus*
Purple martin	*Progne subis*
Amphibians and Reptiles	
Tailed frog	*Ascaphus truei*
Northern red-legged frog	*Rana aurora aurora*
Fishes	
Green sturgeon	*Acipenser medirostris*
River lamprey	*Lampetra ayresi*
Pacific lamprey	*Lampetra tridentata*
Coastal cutthroat trout (Lower Columbia R.)	*Oncorhynchus clarki clarki*
Coastal cutthroat trout (Oregon Coast)	*Oncorhynchus clarki clarki*
Coastal cutthroat trout (Upper Willamette)	*Oncorhynchus clarki clarki*
Steelhead (Oregon Coast)	*Oncorhynchus mykiss* ssp. *
Plants	
Pink sand verbena	*Abronia umbellata* ssp. *breviflora*
Saddle Mountain bitter cress	*Cardamine pattersonii*
Chambers' paintbrush	*Castilleja chambersii*
Willamette Valley larkspur	*Delphinium oreganum*
Frigid shootingstar	*Dodecatheon austrofrigidum*
Queen-of-the-forest	*Filipendula occidentalis*
Moss	*Limbella fryei*
Saddle Mountain saxifrage	*Saxifraga hitchcockiana*
Henderson sidalcea	*Sidalcea hendersonii*
Bristly-stemmed sidalcea	*Sidalcea hirtipes*

(E) - Listed Endangered (T) - Listed Threatened (CH) - Critical Habitat has been designated for this species (PE) - Proposed Endangered (PT) - Proposed Threatened (PCH) - Critical Habitat has been proposed for this species

Species of Concern - Taxa whose conservation status is of concern to the Service (many previously known as Category 2 candidates), but for which further information is still needed.

**Consultation with NOAA's National Marine Fisheries Service may be required.*

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i *U.S. Department of Interior, Fish and Wildlife Service, October 31, 2000, Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 and 17.12*

ii *Federal Register Vol. 57, No. 45328, October 1, 1992, Final Rule - Marbled Murrelet*

iii *Federal Register Vol. 64, No. 234, December 7, 1999, Final Rule - Critical Habitat for the Western Snowy Plover*

iv *Federal Register Vol. 60, No. 133, July 12, 1995, - Final Rule - Bald Eagle*

v *Federal Register Vol. 65, No. 147, July 31, 2000, - Final Rule To List the Short-Tailed Albatross as Endangered in the United States*

vi *Federal Register Vol. 57, No. 10, January 15, 1992, Final Rule - Critical Habitat for the Northern Spotted Owl*

vii *Federal Register Vol. 64, No. 57, March 25, 1999, Final Rule - Columbia River Chum Salmon*

viii *Federal Register Vol. 60, No. 142, July 25, 1995, Proposed Rule - Threatened Status for Three Contiguous ESUs of Coho Salmon*

ix *Federal Register Vol. 63, No. 53, March 19, 1998, Final Rule-West Coast Steelhead*

x *Federal Register Vol. 62, No. 159, August 18, 1997, Final Rule - Snake River Steelhead*

xi *Federal Register Vol. 64, No. 57, March 25, 1999, Final Rule - Middle Columbia and Upper Willamette River Steelhead*
xii *Federal Register Vol. 62, No. 159, August 18, 1997, Final Rule – Upper Columbia River Steelhead*
xiii *Federal Register Vol. 64, No. 57, March 25, 1999, Final Rule - Middle Columbia and Upper Willamette River Steelhead*
xiv *Federal Register Vol. 56, No. 224, November 20, 1991, Final Rule - Snake River Sockeye Salmon*
xv *Federal Register Vol. 64, No. 56, March 24, 1999, Final Rule - West Coast Chinook Salmon*
xvi *Federal Register Vol. 64, No. 56, March 24, 1999, Final Rule - West Coast Chinook Salmon*
xvii *Federal Register Vol. 64, No. 56, March 24, 1999, Final Rule - West Coast Chinook Salmon*
xviii *Federal Register Vol. 57, No. 78, April 22, 1992, Final Rule – Snake River Chinook Salmon*
xix *Federal Register Vol. 69, No. 86, May 4, 2004, Notice of Review - Candidate or Proposed Animals and Plants*